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THE

CYCLOPÆDIA

OF

PRACTICAL MEDICINE.

VOL. IV.

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OF

PRACTICAL MEDICINE:

COMPRISING

TREATISES ON THE NATURE AND TREATMENT OF DISEASES, MATERIA MEDICA AND THERAPEUTICS, MEDICAL JURISPRUDENCE, ETC., ETC.

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"Hæc demum sunt quæ non subgessit phantasiæ imaginatricis temeritas sed phænomena practica edocuere."—SYDENHAM.

IN FOUR VOLUMES.

VOL. IV.

REFRIGERANTS—YAWS.

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THE

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OF

PRACTICAL MEDICINE.

REFRIGERANTS (from *refrigere*, to grow cold), may be defined, medicines which diminish the *morbid* heat of the body. Their influence is generally admitted, but the theory of their operation is not well understood; and, consequently, many and very opposite hypotheses have been advanced upon the subject. The first of these which deserve notice is that of Cullen, based upon a doctrine of Needham; it forms a remarkable instance of the obscurity into which hypothesis leads men otherwise distinguished for the perspicuity and soundness of their reasoning. This hypothesis supposes "that there is every where, in nature, an expansive and a resisting power; and that, particularly under a certain degree of heat, the expansive power appears in all the parts of organized bodies, in consequence of which they show a singular vegetating power; while, at the same time, there is, in other bodies, a power resisting and preventing the action of this vegetating power, and, at least, of diminishing its force." And it is assumed that this power is found in those substances which are usually employed as refrigerants. (Mat. Med. ii. 121.) It is unnecessary to comment upon these opinions; indeed, their obscurity is such as to render them scarcely intelligible.

A later theory is that of Dr. John Murray, whose habit of reasoning upon chemical principles led him to call in the aid of these to explain the operation of refrigerants. He founds his opinion on the presumption of the truth of the theory of Dr. Crawford, that, in the process of respiration, the arteries in the lungs absorb the caloric liberated there; and, owing to the great capacity of arterial blood for caloric, they instantly render it latent, in which state it remains until the subsequent conversion of the arterial into venous blood, when it is liberated equally through the system. Now, Dr. Murray considers that the consumption of oxygen in the lungs, supplying the caloric to the arterial blood, is greatly influenced by the nature of the food and other ingesta received into the stomach. He supposes that when these substances contain a small proportion of oxygen, the demand for that component of the air, and its consumption by the lungs, are augmented; and, consequently, the animal temperature is elevated; whereas an opposite effect takes place when the ingesta contain much oxygen, more especially if it exist in a loose state of combination. According to this theory, therefore, all substances containing much oxygen capable of being extricated by the powers of the stomach, should possess a refrigerant influence. Plausible as this theory appears to be, its accuracy is very questionable; but, in order to reason correctly upon its merit, it is necessary to take a cursory view of the theory of animal heat upon which it is founded; for if the difference of capacity of arterial and venous blood for caloric be insufficient to account for the temperature of the living body, Dr. Murray's theory of the changes produced by refrigerants must necessarily fall to the ground.

Dr. Crawford's object was to prove, as already stated, that arterial blood has a greater capacity for caloric than venous blood; and this is also the case in reference to common or atmospherical air and carbonic acid gas. The latter fact explains the augmentation of temperature arising from the change which the air undergoes in the lungs when carbonic acid is present in them; but as the caloric thus evolved is absorbed by the arterial blood, and rendered latent, the sensible temperature of the blood is not augmented; and it only becomes so as the arterial blood changes to venous in the course of its circulation. By this evolution of caloric the loss of temperature which the body sustains is compensated. Respiration, therefore, and the greater capacity of the arterial than the venous blood, are, according to this theory, the true sources of the peculiar temperature of the living body.

Many facts might be mentioned as favouring the truth of Dr. Crawford's hypothesis; for example, the greater the comparative size of the lungs, and the greater the quantity of blood which passes through them, the higher is the temperature of the animal. Thus, the capacity of the lungs is greatest in birds, which have the highest temperature among animals; and it is a well-known fact, that whatever lessens the free action of the lungs and diminishes the consumption of oxygen, reduces the temperature of the animal. Individuals who labour under a malformation of the heart sufficient to prevent the arterialization of the blood, are always of a temperature below the natural standard. In hybernating animals, also, the temperature falls as the respiration is suspended; and it rises with the return and the progress of respiration: and, farther, M. Gallois ascertained, by experiment, that the temperature of the body falls exactly in the ratio of any diminished quantityof oxygen consumed in respiration. These opinions are strengthened by some experiments of Dr. Wil-

son Philip; and, upon the whole, it is tolerably well ascertained that the temperature of the body sinks, if it be not maintained by the chemical changes which occur in respiration.

But, notwithstanding the support thus given to Dr. Crawford's opinion, many and as strong facts have been advanced in support of that view of the subject which regards nervous energy as the source of animal heat. The most important experiments on this side of the question are those of Mr. [Sir B.] Brodie. He found that, by maintaining the action of the heart by artificial respiration after the brain is removed, although the blood undergoes its ordinary changes, yet that the temperature of the animal thus treated is rapidly lowered. Sir B. Brodie's experiments were made on rabbits, in which the functions of the brain were suspended by dividing the spinal marrow: the blood, in both systems, underwent no change different from that which occurs in natural respiration. "It may perhaps be urged," says Sir B. Brodie, "that, in these experiments, the secretions had nearly, if not entirely, ceased: it is probable that the other changes which take place in the capillary vessels had ceased also, and that, although the action of the air on the blood might have been the same as under ordinary circumstances, yet there might not have been the same alteration in the specific heat of the fluid as it flowed from the arteries into the veins. But, on this supposition, if the theory of Dr. Crawford be admitted as correct, there must have been a gradual but enormous accumulation of latent heat in the blood, which we cannot suppose to have taken place without its nature having been entirely altered. If the blood undergo the usual change in the capillary system of the lungs, it is probable that it must undergo the usual change in the capillary system of the greater circulation also, since these changes are obviously dependent on and connected with each other." From the experiments of Sir B. Brodie it appears that, when the functions of the brain are suspended, the power of generating animal heat is also suspended; although the same quantity of oxygen be consumed as in natural respiration under ordinary circumstances. It is, nevertheless, proper to mention here the opinion of M. Le Gallois, that, owing to the nature of artificial respiration, upon which Sir B. Brodie's conclusions are founded, the temperature may fall, and the animal be killed by cold, although every part remain uninjured. The air in artificial respiration does not enter the pulmonary cells in the same manner as in natural respiration, but is forcibly propelled into them; a large formation of frothy mucus occurs, which both prevents the air coming in contact with the lining membrane of the air-cells, and by its evaporation tends to cool the body.

Many other facts concur, also, to prove that the temperature of the body is regulated by the nervous energy. It is true that these demonstrate its effect chiefly in maintaining the heat of parts; but if its influence on parts be admitted, it is not easy to conceive on what grounds its power over the entire system can be denied. Sir Everard Home divided the nerves going to the growing antler of a stag, and found that the temperature almost immediately fell; and although, after a few days, it rose again higher than before, yet this may have originated from the reunion of the divided nerves: at all events it does not invalidate the fact that the temperature fell on the division of the nerves, and, consequently, was regulated by their condition. In paralyzed limbs the temperature sinks, although in many cases the circulation in the limb is unaffected, and the paralysis is confined to the sensibility of the member. In a case recorded by Mr. Earle, in which the axillary plexus of nerves on one side was crushed, the paralyzed limb of that side was of a lower temperature than the opposite limb: indeed, in general we find that increased nervous action, whether depending on affections of the mind or on other causes, augments the heat of the body; whilst the effect of depressing passions, which diminish nervous energy, is followed by either general chilliness, or coldness of the extremities.

These facts undoubtedly go far to prove that animal heat is a vital principle closely connected with the integrity of the nervous system; but at the same time, as the stimulus of arterial blood is requisite for the excitement of the brain and nerves, and arterialization is the result of respiration, the influence of respiration in the production of animal heat must be so far admitted; for without the function of the lungs the brain would lose its energy, and the temperature of the system be necessarily greatly lowered. This opinion receives also considerable support from some experiments of Dulong to ascertain whether the quantity of caloric, developed by the consumption of oxygen in respiration, be equivalent to the quantity given out by the body. He found that in carnivorous animals the proportion is equal to forty-nine and fifty-five parts in one hundred of the heat generated by the whole body during the same interval of time; and, in phytivorous animals, to betwixt sixty-five and seventy-five parts; and that the whole quantity of caloric and water together is equivalent to sixty and eighty parts only; so that the animal heat is greater than can be accounted for by the fixation of oxygen during respiration. Upon the whole, the examination of both sides of the question leads us to conclude that both opinions are to a certain extent true; that animal heat is influenced chiefly by the state of the nervous system, but partly, also, by the chemical changes which take place in the lungs during respiration. [See, on all this subject, the physiological works of Müller, Carpenter or Dunglison.]

If this view of the sources of animal heat be correct, it presents a considerable obstacle to the admission of Dr. Murray's explanation of refrigerants, which can only be regarded in the light of an ingenious hypothesis. The subject, therefore, remains as he found it; and the question presents itself—can no rational explanation of the operation of refrigerants be suggested? The writer of this article, although he does not venture to offer a theory likely to be generally adopted, yet conceives that some approach to a rational explanation may be attained by ascertaining how far the action of refrigerants taken into the stomach resembles that produced on the skin by similar substances.

In abstracting caloric from the surface of the

body, or, in other words, cooling the skin, whatever agent be employed, whether diluted acids, salts in a state of solution, cold air, or cold water or ice, the activity of the capillaries of the part is immediately diminished; and as their action cannot be materially lessened without the whole vascular system being more or less influenced, the vigour of the heart and arteries is also materially depressed. The consequence of this diminished vascular action is immediately felt on the respiration; the blood does not undergo its necessary change; venous blood is conveyed to the brain, the function of which being impeded from defect of stimulus, a state somewhat resembling paralysis of the nervous system ensues, so that torpor of every organ, the function of which depends on the energy of the brain and nerves, must necessarily follow. The effect of the abstraction of caloric on the nerves is strikingly illustrated by the numbness and insensibility which follow the exposure of the hands, in many individuals, in cold weather; a result which is more likely to arise from the direct influence of cold on the nerves themselves, than from the diminished supply of blood to the parts. Indeed, as in this case the effect on the nerves is partial, we can scarcely imagine any other cause of the diminished action of the capillaries than the depression of the nervous energy. Now if we suppose,—and the supposition is far from being unreasonable,—that an effect resembling that produced on the surface takes place in the stomach when refrigerant agents are introduced into it, we may readily admit that the effect on the capillaries of that organ is extended by sympathy over the system. The possibility of such a result is equally probable in the one case as in the other. This opinion receives some support from the fact that nitrate of potassa operates as a powerful general refrigerant when it is swallowed at the instant of its solution; but it acts as an excitant when it is not taken into the stomach until after it have been some time dissolved. The sensation of cold which the nitre, during solution, causes in the stomach, is evidently owing to a partial abstraction of stimulus, and the effect of this being extended through the nerves to the heart and larger branches of the arterial system, a general reduction of action is produced, and this is followed by a sensation of cold over the whole body. Let us now inquire how far this theory is borne out by the known effects of refrigerants upon the functions of the stomach, the lungs, and other organs.

1. In the healthy condition of the *stomach*, refrigerants exert little perceptible influence upon it; but when it is either in an irritable state, or affected with inflammation, the continued use of refrigerants, particularly cold and iced water and lemonades, allays the sensation of heat, nausea, and general uneasiness. Even when no local inflammation exists, cold water and other cold, bland fluids, received into the stomach, moderate general excitement and control febrile action; an effect which can only be explained by the influence of the refrigerants on the nervous energy. The same results follow the administration of refrigerants in enteritis.

2. Refrigerants exert no evident influence on the *circulating* and *respiratory* organs, in the state of health; although in some individuals, owing to idiosyncrasy, acidulated fluids cannot be taken without so powerfully affecting the larynx as to cause a temporary loss of voice; but in a diseased state of these organs the influence of refrigerants is well marked.

In an excited state of the vascular system, when the pulse is both quicker and stronger than natural, acidulated drinks reduce both states, both moderating the action, and relaxing the tension of the pulse; nor is their effect on the capillaries less manifest; and it is to their influence on these that we must attribute the diminished temperature which follows their administration. It is surely unnecessary to say how intimately this is connected with their impression on the nerves of the stomach. In the febrile state, the effects of refrigerants on the circulation are necessarily communicated to the lungs; but besides this sympathetic influence, some of this class of medicines, in particular, acids, seem to operate directly on the pulmonary tissue. In acute inflammation of the air-tubes, or even of the pleura, acid fluids greatly augment the cough and oppress the breathing, when administered before the excitement be subdued; and after this is effected, we still perceive the evidence of their action on the mucous membrane by the aid which they afford to expectoration.

3. But the most decisive illustration of the extent to which the nervous system is influenced by refrigerants, is observed in the effects which acidulated fluids produce on those who are labouring under diseased conditions of the spinal cord. The author had an opportunity of witnessing this in a gentleman who was labouring under subacute inflammation of the spinal theca. Whenever he swallowed a spoonful of lemonade, or even an ordinary effervescing draught, a sensation of pricking was felt over the surface, the skin became so sensitive as scarcely to admit of being touched, and the whole system restless and uneasy. Hypochondriacal and hysterical persons, not unfrequently, suffer in a similar manner from the internal use of acids; and, as this effect is not confined to particular individuals, it cannot be ascribed to idiosyncrasy.

Upon the whole, it is evident that refrigerants operate to a certain extent as sedatives; diminishing the force and rapidity of the pulse, depressing morbid temperature, and calming, generally, the disturbance which always attends acute diseases.

The substances employed as refrigerants operate either on the organic functions or on the sensibility of the body in a state of disease.

1. The refrigerants operating on the organic functions are chiefly vegetable acids. The influence of *acetic acid*, in its diluted impure state or as vinegar, in cooling the body labouring under disease, was very early known. In its undiluted state it is a powerful stimulant; and when daily taken in large doses into the stomach in its diluted form, it produces great uneasiness, cramps, and colic, and gradually destroys so effectually the texture of the organ and its digestive function, as to cause emaciation of the body. When it is only occasionally taken, largely diluted with water and moderately sweetened, it displays decided soothing and refrigerant properties, and is em-

ployed with advantage in inflammatory and bilious fevers, for quenching thirst, calming the vascular excitement, re-establishing the perspiratory function of the skin, and restoring the action of the kidneys. In inflammatory affections of the lungs, however, it increases the cough, and augments the morbid sensibility of the mucous membrane in the same manner as all other acids; and, therefore, it is contra-indicated in such diseases, even as an expectorant, until the excitement be subdued.

The refrigerant influence of diluted vinegar on the surface is undoubted; it not only diminishes heat but allays pain. In hemorrhagic affections, the cold feeling which it produces on the skin is extended to the whole system; hence the benefit derived from it in internal hemorrhages, and in the inflammation of cavities; as, for instance, in uterine hemorrhages applied to the thighs and abdomen; and in acute meningitis applied as a lotion to the shaved scalp. In general fever, sponging the body with vinegar and water is applicable to every case in which the skin is preternaturally hot, when no idiosyncrasy stands in the way.

When diluted acetic acid is internally administered, if opium be prescribed at the same time, it should be recollected that it decomposes the meconate of morphia of the opium and forms an acetate, which is a more powerful narcotic than the meconate. The combination of this acid with ammonia, in the preparation known by the name *liquor ammoniæ acetatis*, possesses refrigerant powers nearly equal to those of the diluted acid, acting at the same time as a diaphoretic; and it is more generally employed than the acid in modern practice. The salts procured by the combination of acetic acid with the other alkalies operate chiefly on the kidneys.

The *citric acid* is more frequently employed than the acetic as a refrigerant; but chiefly in its combined state as prepared by the hand of nature, in the juice of the lemon, the orange, and other fruits. It is more grateful in its combined than in its uncombined state; a fact which is quickly perceived by patients in fever, when it is ordered to form the common effervescing draught for checking nausea and vomiting. When simply diluted with water, in the proportion of the juice of two moderately-sized lemons to a pint of water, and slightly sweetened, forming lemonade, citric acid constitutes a most serviceable and agreeable beverage in fevers; and in those of a typhoid character this is rendered more grateful and beneficial by using water impregnated with carbonic acid gas instead of common water. In the ordinary condition of the stomach, citric acid, either pure or combined, does not weaken the stomach; and in some irritable states of that organ, characterized by a sensation of heat, painful digestion, an unpleasant taste in the mouth, and a disgust of food, it removes these symptoms and proves decidedly beneficial: but on the other hand, when the stomach is highly irritable, and its nervous susceptibility great, lemon-juice, or the citric acid, even when largely diluted, causes heat, uneasiness, and pain, and not unfrequently obstinate vomiting. Nevertheless, as M. Broussais has remarked, (Phlegmas. Chron. t. iii. p. 254,) the citric acid is that which the stomach supports best when suffering under inflammation.

The citrates of potassa and of ammonia are also refrigerant: the citrate of soda, which is not an officinal preparation, operates as a purgative.

The above remarks are applicable to the juice of the orange, the apple, the currant, and the gooseberry, all of which owe much of their acidity to the citric acid.

The *tartaric acid*, except as it is contained in the tamarind, is much less frequently prescribed than the citric as a refrigerant, being more apt to disorder the digestive organs, to produce colic and to purge; and its morbid influence on those labouring under affections of the spine is more constant and evident than that occasionally resulting from the employment of citric acid: indeed, so obvious is this, that patients sometimes refuse to continue taking it on account of the nervous agitation which it causes. Its combination in the form of the *bitartrate* is more frequently employed; and in small doses at moderate intervals, it does not operate as a purgative, but as a simple acidulous refrigerant. It is best administered in the form of whey, or of cream-of-tartar beverage; it moderates febrile heat and softens the skin; but when its employment is followed by a red and dry tongue, it ought to be discontinued. Both the acid and the bitartrate are incompatible in mixtures with the nitrate of potassa, which it decomposes, and, uniting with its alkaline base, forms either a bitartrate or a tartrate.

The *oxalic acid* in the form of the binoxalate, as found in the oxalis *acetosella* and rumex *acetosa*, was formerly much prescribed as a refrigerant; but these plants, and, indeed, the oxalic acid in any form, are now rarely employed.

Nitrate of potassa, in small doses, is a well-known refrigerant: it produces a powerful sympathetic effect on the nervous system, depressing the strength and diminishing the frequency of the pulse, and lowering the animal heat: the skin becomes pale, and a sensation of languor is felt. To obtain the full refrigerant effect of nitre, the salt must not only be administered in small doses at short intervals, but it should not be dissolved until the instant in which it is to be administered. As a refrigerant, the dose should not exceed a scruple, or, at the utmost, half a drachm.

The *bicarbonate of soda*, although seldom prescribed as a general refrigerant in this country, yet is frequently administered in inflammatory febrile affections on the continent. It is, however, better calculated for operating as a local than as a general refrigerant.

2. The refrigerants operating on the sensibility of the body are few; but they are more directly refrigerant than those which have been already noticed. *Cool air*, the first of these, is so agreeable to the feelings in a heated state of the body, that observation alone might have led to its early employment as a remedial agent; and nothing marks more strikingly the perversity of mankind than the opposition of physicians, at one period, to the indulgence of the instinctive desire for this remedy in fever patients. Its utility in moderating high vascular action and operating as a sedative refrigerant is now generally acknowledged; and

consequently its admission to the apartments of the sick, in febrile diseases, is almost universal.

If cool air be beneficial in the above-mentioned conditions of the body, *cold water* and *ice* are still more so; and their application is extensive. For an account of the effects of cold water and ice in reducing the temperature of the body in its healthy condition, we must refer our readers to the articles Bathing and Cold. When cold water and ice are employed as curative agents, their influence may be obtained either by their internal administration or by their application to the surface; in both cases their effects are extended by sympathy over the system; but they are modified by the manner in which these agents are used. If the body be immersed in the *cold bath*, the most striking effect is the shock or nervous impression which produces the vascular reaction so beneficial when cold bathing is used as a tonic; an effect, however, which must be avoided as much as possible when the refrigerant influence only of the bath is required. To insure simple refrigeration, the water should be of a temperature not much below that of the skin; but as, even at such a degree of heat, the sudden immersion of the body is likely to cause more reaction than would be safe in cases requiring mere refrigeration, the cold bath is rarely or never employed in this country for producing that effect. The shock and reaction caused by dashing cold water over the body, constituting the *cold affusion* as it is termed, is as considerable as when the cold bath is used, but it is more transitory, and therefore it is a more useful refrigerant. *Sponging* the body with cold water, as far as a simple refrigerant effect is desired, is preferable to either the cold bath or the cold affusion: there is no shock; the fluid, being left to evaporate, merely cools the surface; and by persevering in the process, the cooling effect is fully obtained, and rendered permanent. One great advantage of sponging the surface with cold water is the facility of limiting the extent of the effect according to the feelings of the patient: in general it may be continued until the sensation of chilliness comes over the body, when the patient should be dried and placed in bed. The more simultaneously the influence of cold water is extended over the surface, the better; the process of sponging should, therefore, be performed by several attendants with large sponges on the different parts of the body at the same time. In ordinary cases the temperature of the water may be regulated by the feelings of the patient, as the beneficial effect depends on the evaporation, which may be aided by the addition of vinegar or alcohol. *Evaporating lotions* applied to a part, operate locally in the same manner as general sponging; the sedative and refrigerant influence is not confined to the part, but extends to other parts of the body, even to the interior, as, for instance, to the brain, the contents of the abdomen, and to joints. The sedative effect is still more powerful when a small stream of cold water is directed upon the part: the author of this article has seen this most strikingly exemplified in burns; the mere immersion of the part in cold water, or the application of cloths dipped in cold or even iced water, is much inferior in its effect to this method of employing cold water. It is scarcely necessary to comment on the influence of the local application of *ice*, which operates exactly in the same manner as evaporating lotions, but more effectively, owing to the steady continuation of the same low temperature to the parts.

The foregoing remarks lead to this conclusion—the utility of refrigerants as curative agents is more limited than that of most other classes of remedies. They are chiefly employed to depress inordinate vascular action, and thereby to lower temperature; consequently, it is in inflammation, active hemorrhages, and febrile affections that they are found beneficial; and in such cases they are, undoubtedly, most valuable remedies.

In local inflammations on the surface of the body, cold water and evaporating lotions prove highly serviceable; whilst in those more deeply seated, as, for instance, inflammation of the brain and its membranes, ice applied to the scalp is to be preferred: the steady abstraction of caloric which it effects, operates not only upon the vessels and nerves of the integuments, but, by diminishing action in the carotids and large vessels, it produces the most decisive benefit in reducing the vascular action within the cranium. These applications have been lately recommended in other internal inflammations, even those of the thorax and abdomen, and under proper circumstances have been found highly beneficial.

Hemorrhage arising from increased action, or accompanied by it, is frequently checked by the sedative influence of refrigerants. When the bleeding is internal, the degree of cold should be such as to operate sympathetically on the whole system; and to lessen not only the action of the vessels of the part, but to restrain, to a certain degree, that of the heart. Thus in hæmoptysis, not only should the patient be freely exposed to cold air, but ice and cold acidulous fluids should be freely administered; indeed, the temperature may be with safety, and even with advantage, diminished so much as to be uncomfortable to the feelings of the patient. In such a case, the low degree of temperature is accompanied with an evident diminution of the irritability of the contractile fibres of the whole vascular system, and, consequently, aids greatly in checking the flow of blood. The liquids administered as drink should be cooled down to 32°, either by ice or by a freezing mixture, and slowly swallowed. The influence of nitre has long been regarded as considerable in such cases; and much of the benefit received has been attributed to a chemical change effected on the blood; but if the opinions advanced in this article be correct, it is unnecessary to assert that this explanation of the operation of nitre must fall to the ground.

[The notion of nitrate of potassa being refrigerant has probably arisen from the coldness which it occasions whilst undergoing solution in water. Indeed, as elsewhere stated, (*General Therapeutics*, Philad. 1836, and *General Therapeutics and Materia Medica*, ii. 206, Philad. 1843,) all internal refrigerants probably act wholly by their being comparatively of low temperature, and thus reducing the heat of the stomach. A recent writer, Dr. Spillan, (*Manual of General Therapeutics*, p. 185, London, 1841,) after citing the published opinion of writers on this subject, states that

"the refrigerant effects of nitrate of potassa as a sedative, when given dissolved in even tepid drinks, such as whey, are known to every one." They certainly are not known to the writer; yet he has watched most carefully for them; nor have others been more fortunate. Dr. A. T. Thomson says, that "the dose of the salt should not be dissolved until the instant in which it is to be swallowed," (*Elements of Mat. Med. and Therap.*, 2d edit. Lond. 1835); and Dr. Pereira (*Elements of Mat. Med. and Therap.*, Amer. edit. i. 438,) accords with him; whilst Dr. Christison (*Dispensatory*, p. 741, Edinb. 1842,) expresses himself in a manner that still more strongly corroborates the views of the writer:—"Its refrigerant action, generally admitted by systematic writers on materia medica and by many practitioners, is of doubtful existence, having probably been inferred rather from the coldness it occasions while dissolving in water, than from actual evidence of its effects in disease. The sedative action ascribed by some to it has been probably inferred from its supposed refrigerant property, and not from observation."]

In hæmatemesis occurring in young and vigorous perons, the same assiduous employment of refrigerants is requisite as in hæmoptysis; and when the bleeding is so violent as to threaten quickly serious consequences, the other refrigerant plans may be aided by injecting iced water into the rectum, and by the local application of cold to the epigastrium. In no species of hemorrhage is the sympathetic influence of refrigerants more strikingly obvious than in epistaxis. Thus dashing cold water on the genitals has sometimes instantaneously suppressed bleeding at the nose; and on the same principle is explained, what it is scarcely necessary to notice, the popular remedy of applying a large cold key or a piece of metal between the shoulders under the clothes.

It is superfluous to say that, however useful refrigerants may prove in all cases of active hemorrhages, their employment in the passive is to be most carefully avoided.

But it is in fevers that refrigerants under every form are to be regarded as the most valuable set of therapeutical agents. In continued fever, the vegetable acids largely diluted are internally administered, especially those found in fruits; and not unfrequently nothing is more grateful to fever patients than cold water slightly acidulated with either the sulphuric or the nitric acid. It is, however, the general application of cold to the surface which proves the most useful refrigerant in continued fever. In those forms of the disease which assume a typhoid type, ventilation and the free admission of cool air into the apartments of the sick are absolutely necessary: irritation is allayed, debility obviated, and the whole complexion of the disease often changed in a few hours, by the removal of the patient into a cool and well-ventilated, from a close and filthy apartment. The most direct and effective refrigerant, however, in continued fevers is the cold affusion; but its employment requires certain cautions, without attention to which much mischief may be incurred. In the first place, the exact temperature of the body must be carefully ascertained. In this country, in the severest attacks of fever, it has rarely exceeded 108° Fah.; but in tropical climates it rises sometimes to 112°; the higher the temperature of the patient, the more benefit may be anticipated from the cold affusion. The temperature of the water should vary according to the season of the year and the feelings of the patient, the average range being from 40° to 70° Fah. The effect is to diminish the morbid heat of skin, to lower the force and retard the rapidity of the pulse, and to induce perspiration and sleep; and when such results follow, the cold affusion proves beneficial in any form of fever.

The thermometer is employed to determine the temperature of the patient; but if he feel cold when that instrument indicates an augmented morbid temperature; or if he feel hot when the thermometer demonstrates that the heat of the body is below that of the natural standard; then in neither case should this form of refrigerant be resorted to. It is also improper when the skin is bedewed with perspiration; or if the patient dread greatly its use; nor is it less so during menstruation, and in the latter months of pregnancy. In the advanced stages of fever, refrigerants of any kind are injurious.

With respect to the kinds of continued fever in which refrigerants are indicated, we may enumerate six.

1. In inflammatory fever, (*synocha*,) a rare disease when unaccompanied with topical inflammation, the advantages to be derived from refrigerants are well understood. The cold affusion is admirably adapted for rapidly abstracting the stimulus of heat, diminishing general excitement, and operating as a powerful sedative. In the more advanced stages of the disease, cool sponging is often substituted for the affusion; but when the patient can bear the fatigue of the affusion, it is always to be preferred. The greater frequency of this form of fever among the ancients than the moderns explains their constant employment of cold drinks and cold bathing in continued fever.

2. In fevers of a typhoid type, the disease has been cut short by the cold affusion; but in this case more perhaps is to be attributed to the shock and the reaction which follows, than to the refrigerant influence of the affusion.

3. In synochus or inflammatory fever, gradually assuming the typhoid character, refrigerants in general, but more especially the cold affusion, are chiefly applicable to the early stages of the disease; and, indeed, no form of remedy is more advantageous when there are no local determinations; but when these exist, particularly if the lungs be affected, much caution is required.

4. In remittent fevers, especially those of warm climates, and in their more intense and excited variety, the cold affusion may be employed with great benefit. In severe attacks, also, much advantage is derived from the application of ice or cold water to the scalp; in the remissions, however, the application of cold in any form must be suspended. In yellow fever, the safety of the patient frequently depends solely on the early application of the cold affusion.

5. If hectic be symptomatic of pulmonary affections, or determination to internal organs, the cold affusion is decidedly contra-indicated; but even in such cases much benefit is often obtained by sponging the trunk of the body with cold

water mixed with vinegar, whilst the lower extremities are kept warm in bed. We must, nevertheless, bear in mind that, under any form of hectic, although general refrigerants are useful auxiliaries, yet the cold affusion can scarcely be regarded as admissible.

6. In most eruptive fevers, except measles, the body should be freely exposed to cool air; and even the cold affusion may be safely and advantageously prescribed, should the state of the surface require it, nor should the presence of the eruption operate as a reason against its employment. The Hindoo physicians plunge their patients, during the eruption of small-pox, into cold water, and with the best results. It diminishes the fever, lessens the number of the pustules, and is said to prevent pitting. The writer of this article has long been in the habit of employing the cold affusion in scarlatina during the height of the eruption, and has seen the severity of the disease instantly checked by it.

In intermittent fevers, when the skin is dry and parched, and the general heat greatly augmented, cold in every form applied to the surface, and cold acidulated fluids taken into the stomach, are of the same value as in continued fever, and greatly favour the accession of the sweating stage. The affusion should be used in the hot stage of the paroxysm, and continued until the temperature of the body of the patient be reduced to the natural standard.

It is unnecessary to discuss the nature of the various diseases, besides idiopathic fevers, in which refrigerants are indicated: in all, much depends on the degree of the attendant fever, and the existence of local affections. In one local disease, phrenitis, however, their advantageous effects are very conspicuous: the most furious delirium is quickly subdued by allowing cold water to drop on the vertex, whilst the rest of the scalp is covered with cloths moistened with vinegar and water. The degree of collapse, indeed, which is thus produced, is often so great as to require most active measures to counteract it; when such occurs, the state of sinking is to be treated exactly in the same manner as when extreme debility suddenly appears from other causes: external warmth, particularly the application of bladders of hot water to the scrobiculus cordis, friction, electricity, and sometimes artificial respiration, are the means to be employed to restore animation; and when the power of deglutition returns, the administration of excitants, especially aromatics and ammonia, is to be resorted to.

From the foregoing remarks, it is evident that, although, as we have already said, refrigerants constitute a class of medicines of limited application, yet they are of much value in a few important diseases. Like every other class of therapeutical agents, their utility will be more or less obvious as the discrimination, the judgment, and the observation of the practitioner are properly exercised, in determining the exact condition of the body which demands their employment.

A. T. Thomson.

RHEUMATISM, from ῥεῦμα, *a defluxion*. This term, originally adopted when diseases accompanied with swelling were usually attributed to the flow of some special humour to the part affected, has been used for ages to designate an affection which has so much of distinct character as to justify its being considered a special disease. So loosely, however, has the term been applied, that a host of ailments, with no character in common save that of pain, have been classed under it, and much both of false experience and of bad practice has thence resulted. Diseases called rheumatic have been relieved by stimulant remedies, which from the character thus acquired have been empirically resorted to in states of constitution for which they were utterly unsuited. In acute rheumatism, a disease intensely inflammatory, we have known the use of the most powerful stimulants confidently urged by well-meaning but misguided friends, who in support of their prescription have pleaded the wonderful cures which they had seen their favourite specific perform in what they assumed to have been rheumatism; thus misled by a name to recommend in active inflammation what could have benefited only in a totally opposite state of the system. As many affections really rheumatic present an equivocal character which to superficial observation too often appears to justify the use of stimulants, it is very necessary to discriminate the real disease, so as to distinguish it from those diseases with which it is liable to be confounded; and however difficult it may be to class the latter, it is better to leave their place in nosology unassigned, than, by ranging them under the head of rheumatism, to beget confusion where clearness and precision are of the first importance.

In the investigation of rheumatism, the best mode, similar to what was followed in treating of gout, is to consider, first, the simple disease in its most perfect form; and then, with the lights thus supplied, to elucidate the more complex conditions which the larger portion of rheumatic affections present. So contradictory, and, we may add, so ineffectual are the means ordinarily used in treating the latter, that no greater benefit could be conferred both on patients and practitioners, than to divest the treatment of perplexing confusion and inconsistency by reducing it to fixed principles, and bringing it within the pale of rational and scientific practice.

In determining the diseased condition to which the name of rheumatism should be specially assigned, it is expedient to examine the representations given of it by the systematic nosologists. Sauvages describes rheumatism as "dolor diuturnus in parte carnosa artuum," and places it in the class *Dolores*, order *Vagi*, of his nosology. According to Linnæus, it is "musculorum dolor ad motum, a tunica cellulosa injecta;" class *Dolores*, order *Extrinseci*." Vogel places it in class *Dolores*, as merely "cutis et musculorum dolor." It would be difficult to recognise in these brief and meagre specifications the ordinary disease of rheumatism, such as we daily witness it.

Sagar is both more copious and more precise. He describes two diseases, a chronic one ranged in the class *Dolores*, order *Vagi*; and an acute under the specific name of myositis, in the class *Phlegmasiæ*, order *Phlegmasiæ musculosæ*, giving respectively the following definitions. "*Rheumatismus.* Dolor Diuturnus in parte carnosa

tendinosa artuum, vagabundus, sæpius sine coryza, rheumate, catarrho, erysipelete, et sine febre notabili; (acutus rheumatismus facit genus inter Phlegmasias, myositin a me dictum;) sanguis missus rheumatismo laborantium, est gelatinosa crusta tectus, et urina sæpe ad sulphureum colorem tendit." "*Myositis.* Febris acuta inflammatoria, dolores in diversis musculis artuum, eorundemque involucris, diu noctuque discruciantes, motum vetantes fere omnem, ad noctem exacerbantes; sanguis missus est tectus crusta inflammatoria subgelatinosa, vel pelli tenui tenaci: hic morbus vulgo audit rheumatismus acutus." It is worthy of remark that Sagar notices the blood drawn in chronic rheumatism as exhibiting a buffy crust. Cullen considers acute rheumatism alone as a special disease, regarding the chronic form as only a sequel of it. He places it in the class *Pyrexiæ*, order *Phlegmasiæ*, and gives the following definitions. "*Rheumatismus.* Morbus ab externa et plerumque et evidente causa; pyrexia; dolor circa articulos musculorum tractum sequens, genua et reliquos majores, potius quam pedum vel manuum articulos infestans, calore externo euctus." "Rheumatismi sequela est, *Arthrodynia.* Post rheumatismum, nisum violentem vel subluxationem, dolores artuum vel musculorum, sub motu præsertim aucti, plus minusve fugaces, calore lecti vel alio externo levati; artus debiles rigidi, facile et sæpe sponte frigescentes; pyrexia nulla; tumor plerumque nullus. Rheumatismus chronicus auctorum."

I. — Acute Rheumatism.

This disease is often designated by the trivial name of rheumatic fever, a term which implies a constitutional disturbance as well as a local. The ordinary phenomena which characterize it are so familiarly known, that a very brief account of its accession and progress will here suffice. That given by Sydenham, derived as it was from actual observation, and marked by his wonted truth and accuracy, presents in few words as clear a description of the early seizure as can well be rendered.

"This disease happens at any time, but especially in autumn, and chiefly affects such as are in the prime of life. It is generally occasioned by exposing the body to the cold air immediately after having heated it by violent exercise, or some other way. It begins with chilliness and shivering, which are soon succeeded by heat, restlessness, thirst, and the other concomitants of fever. In a day or two, and sometimes sooner, there arises an acute pain in some one or other of the limbs, especially in the wrists, shoulders, knees; which shifting between whiles, affects these parts alternately, leaving a redness and swelling in the part last affected. In the beginning of the illness the fever and the above-mentioned symptoms do sometimes come together, but the fever goes off gradually, while the pain continues, and sometimes increases."

The latter circumstance Sydenham, in conformity with the pathology then prevalent, attributes to the "derivation of the febrile matter to the limbs," which he conceives to be sufficiently shown "by the frequent return of fever from the repulsion of morbific matter by external remedies." The theory here propounded may be questionable as resting on hypothesis, but the facts with which it is connected are not the less valuable.

It appears, then, that acute rheumatism presents a state of active fever accompanied with local inflammation of one or more joints. And here one of the most important questions respecting rheumatism arises—whether the local inflammation be the cause of the fever, or only its attendant? On the solution of this, much both of the pathology and treatment of rheumatism must depend, and accordingly its elucidation will form a prominent part of the present article.

In the foregoing description of Sydenham, it appears that the state of febrile excitement precedes the local inflammation. In theoretic speculations this fact seems generally recognised, yet it does not appear to have been kept steadily in view either by speculative or practical writers. The term symptomatic fever, so often applied to the constitutional disturbance, implies that this was regarded rather as a contingent result of the local inflammation, than as a precursor or cause of it. To determine this point is of much importance, for by the decision must the whole course of treatment be influenced. If the local inflammation, whether seated in the *muscular*, though more frequently in the *fibrous* tissue of the affected parts, be the cause of fever, as implied by the term symptomatic, the reduction of local inflammation by the most direct means would be the best and most effectual relief; and this being duly attended to, the contingent fever might, according to the familiar axiom, *sublata causa tollitur effectus*, be little regarded. On the contrary, if the state of fever, or rather that condition of the habit which gives rise to fever, be the real source of rheumatic seizure, then should the constitutional state be chiefly attended to, and local treatment be only subsidiary to that by which the derangements of the constitution are rectified. We hope clearly to show that the constitutional state is that which chiefly claims our regard in the treatment of rheumatism.

When acute rheumatism occurs in its most active state, so intense is the inflammatory fever attendant, that whatever theory of the disease be entertained, the fever claims its full portion of attention, and is met by adequate activity of treatment. Bleeding, purging, and other means of reducing fever are promptly and freely employed, the more so as experience has shown this treatment to be indispensable for abating the local inflammation. This being the case, then, it may be asked, of what importance is it to decide whether the local or constitutional affection is to be regarded as the primary disturbance, inasmuch as the same treatment relieves both? It would be sufficient to answer that truth ought always to be ascertained, for it can never be unimportant. Were acute rheumatism in its more active state to be alone considered, the importance of the decision might be less, both the local and constitutional disturbance demanding the vigorous employment of corresponding means. But when the minor degrees of the same disease, constituting what is termed chronic rheumatism, come to be investigated, it will be seen that their essential character involves the point at issue; and that unless this be determined as truth and reason dictate, the

practice in a malady which is more prevalent, causes more suffering, and leads to more decrepitude than almost any other, must be vacillating, imperfect, and unsuccessful.

It will materially abridge the present article to refer to certain general principles of pathology already detailed in the articles Gout and Plethora. These principles apply directly to rheumatism, and through them alone can its pathology be adequately unfolded, or its treatment rationally explained.

Acute rheumatism principally attacks the young and vigorous. The period of life most subject is said to be from puberty to thirty-five years. Though no age is exempt, it yet more rarely occurs in the very young, or in advanced life. This circumstance alone would seem to indicate some connection between rheumatism and fulness of habit, or that approximation to plethora which was formerly noticed as exuberance of health; and if rheumatic seizures be duly scrutinized, they will be found to take place in those who from plethora, whether absolute or relative, are prone to fever or inflammation on any exciting cause being applied. The extraordinary health so often remarked by patients as having immediately preceded the rheumatic attack is sufficiently intelligible. But direct evidence of the state of constitution in which attacks of rheumatism occur is amply shown in those who, having had the disease, are liable to its recurrence, and on this account compelled to watch the premonitory indications of an attack. In these, constitutional disturbance of a febrile kind, marked by all the phenomena formerly detailed as denoting the transition of plethora into febrile excitement, will be invariably found to exist for a sensible time before the disease presents its full character by the establishment of a local inflammation. And to these premonitory indications should the earliest attention be given, for it is in this stage that relief can be most speedily and effectually afforded. By reducing plethora and subduing febrile action in this stage, the local inflammation may be wholly averted, and thus may be prevented not only the injury which the joints, when affected, are liable to sustain, but also the susceptibility to impression from slight causes which reiterated attacks of rheumatic inflammation never fail to leave.

The local inflammation of acute rheumatism undergoes a change during its progress which seems to have escaped observation. It exhibits at different stages two conditions, which may be conveniently distinguished as primary and secondary. The former is the immediate result of the rheumatic seizure, and must be attributed to the specific cause, whatever it may be, from which the disease derives its distinctive character. It differs from common inflammation in being more transient, for it is capable of rapid subsidence without any trace of its attack remaining. When this inflammation migrates from joint to joint, the occurrence of a fresh inflammation is oftentimes followed by a quick subsidence of that which immediately preceded. Still more signally does this rapid subsidence take place if active treatment for the relief of the constitutional inflammation be resorted to immediately on the attack occurring, and before the secondary inflammation has had time to supervene. In this respect the primary or specific inflammation of rheumatism has a close analogy with that of gout, from which it differs, however, in having a stronger tendency to pass into inflammation of a more ordinary and permanent kind. This specific inflammation is promptly relievable by constitutional treatment, no local applications being at all needed.

When from the severity of the attacks, or from neglect or delay in having recourse to suitable discipline, the specific inflammation lingers in a joint, a secondary inflammation results, more permanent in its nature, which does not immediately subside on the constitutional inflammation being subdued, and which generally leaves some traces of its existence, in effusion into the cellular membrane or bursæ mucosæ, or in more or less thickening and rigidity of the ligaments and other membranes surrounding the joints. The distinction here noticed is important, because it has a sensible influence on the local treatment of rheumatism, both acute and chronic.

Causes of acute Rheumatism.—The chief, if not the only exciting cause, is the application of cold to the body when unusually heated. Cold is more liable to produce this effect when combined with moisture, whence a cold and humid atmosphere, and wet or damp clothes, are the most frequent sources to which rheumatism can be traced. Partial cold, as when parts of the body are subjected to currents of cold air, is very apt to give rise to rheumatism. When the body is predisposed, a very transitory exposure of this kind will suffice to bring on an attack; if the current be sustained for any time, few will wholly escape some contingent suffering. Of the fact that rheumatism is so excited there can be no doubt. When it is reflected, however, that for every instance of rheumatism so induced, numbers continually endure a much or greater exposure to the alleged cause without any disease ensuing, too much importance should not be attached to it.

[Other causes have been enumerated, such as the repercussion of eruptions, the stoppage of an accustomed flux, &c. These may exert an influence, if a predisposition exist; but such influence is not easily appreciable. Recently, it has been affirmed by Messrs. Maddock and Sigmond, that where there is a disposition to acute rheumatism, the use of copaiba may develop it.]

Of far greater moment is it to regard the predisposition, without the concurrence of which either no rheumatism will take place, or it will be slight and partial, exhibiting none of the constitutional disturbance and febrile excitement which characterize acute rheumatism. A predisposition is said to be given by many circumstances, as age, temperament, climate, season of the year. Even hereditary liability has been classed among the predisposing causes, and possibly with reason, [and it is affirmed by Dr. R. B. Todd, (*Practical Remarks on Gout, Rheumatic Fever*, &c. Lond. 1843,) that the children of gouty parents are more liable to the disease than those who have not laboured under the gouty diathesis.] Each of these merits attention, but the circumstance common to all of them, and that which has most influence in pro-

ducing the disease, is a state of general constitution, which from the prevalence of plethora, either absolute or relative, is prone to be aroused by any excitement into febrile or inflammatory action. This subject having been fully discussed in its proper place, (see PLETHORA,) it will suffice on the present occasion to apply to the consideration of rheumatism the doctrines already explained. It furnishes a presumption, at least, of these doctrines having some foundation in truth, that corresponding principles have been advocated by one of the most enlightened pathologists of the present day. M. Andral, in various parts of his luminous Treatise on Pathological Anatomy, traces a variety of structural lesions, as well as the inflammatory actions which induce them, to a redundancy of nutritive matter in the blood, supporting his views with a copiousness of illustration, matured experience, clear discernment, and sound judgment, which claim the respect and confidence of every intelligent mind. These views, too, are so reiterated throughout the work as to show that they were not a mere transient conception, but a deliberate conviction deeply impressed.

A few extracts will evince that in these assertions we do not misrepresent this acute and philosophic writer. In discussing the effects of hyperæmia, or excess of blood, on particular tissues, he says: — "The hyperæmia, instead of being confined to a simple organ, may exist at the same time in every organ of the body. The general capillary system is thus overloaded with blood, and the whole system is said to be in a state of plethora or polyæmia. I shall not enter into a detail of the circumstances which characterize this state, the essential character of which seems to consist in the formation of a greater quantity of blood than is necessary for the purposes of nutrition and secretion. There are some individuals who, according to common observation, naturally make a greater quantity of blood than others. In general, those persons who live high, and make but little exertion, mental or corporeal, are most liable to this affection. It has been said, but without the slightest proof being adduced in support of the assertion, that an appearance of plethora has been produced in some individuals by an inordinate expansibility of the blood. When the blood-vessels contain a greater proportion of the nutritive fluid than is necessary to supply the demands of the different organs, the superabundant quantity becomes a permanent source of excitation to the solids, and at the same time the blood has a remarkable tendency to accumulate in different organs; so that, in such case, the whole system is in a general state of excitation, and some of the organs may become the seats of local congestions of various degrees of duration and intensity. Indeed, the phenomena which result from the plethoric diathesis, cannot properly be termed morbid unless when some local congestion is formed. Sometimes the brain is the seat of the congestion, and then follow the various symptoms of the cerebral disease, giddiness, headach, drowsiness, alteration of the sensorial and intellectual faculties, &c. which may be so violent as to induce death, and yet leave no trace of disease except a little more blood than usual in the cerebral vessels. Sometimes the congestion more particularly affects the pulmonary organs. The dyspnœa which accompanies this form of the disease arises from an unusual quantity of blood transmitted through the lungs, which necessarily requires a corresponding quantity of air to fit it for the purposes of the general circulation. It is this want of proportion between the blood which requires to be aerated, and the quantity of air inspired for that purpose, which produces the dyspnœa. In other cases the complication of palpitation with various degrees of dyspnœa proves that the heart has become the seat of congestion."

Corresponding effects are traced through other organs and tissues, and due notice is taken of the constitutional derangements resulting from polyæmia when no organ more especially suffers, as well as of the prostration of strength or false adynamia, as it is expressively called, which so generally attends this state. The section closes with remarks which are too apposite to our present purpose to be omitted, however reluctant we may be to indulge in lengthened quotations:—"The morbid state which I have now described, and to which may be referred some of the species of continued fever described by the older nosologists, may terminate in recovery or death. When the termination is favourable, the symptoms gradually improve as the superabundant quantity of blood, the original source of all the accidents, is diminished by abstinence and bloodletting. When death ensues, the post-mortem examination generally exhibits traces of well-marked inflammation of one or more organs. This inflammation seems to have taken place subsequently to the commencement of the febrile paroxysm; at least the symptoms would lead us to this conclusion. But on other occasions no trace of inflammation can be discovered, and the only morbid appearance consists in a simple accumulation of blood in the capillaries of the different organs, their textures remaining perfectly unaltered. These slight congestions affecting simultaneously several organs, may, by the various morbid sympathies which they excite, produce as violent and formidable symptoms as the most serious organic lesion of any individual organ. In such case, where are we to assign the origin of the disease?—Wherever the blood is distributed, there derangement of function is found. In the blood, then, indisputably resides the first cause of the disease; the lesion of the solids is only a secondary affection, but may, notwithstanding, become, during the progress of the disease, the prominent affection, and give rise to many and formidable accidents.

In noticing fevers, he particularises one class which he refers specially to excess of fibrine in the blood. "Lastly, the third class of fevers appears to be more particularly connected with alterations of the blood. On this head I can but refer to what I have already said, when treating of the diseases that may arise from that source. I shall content myself at present with repeating that the fever termed inflammatory seems to me often to arise from no other source than the blood being too rich in fibrine." Again, in considering the lesions of the blood, he refers the occurrence of inflammatory fever, not only to a general hyperæmia or excess in quantity of the circulating fluid, but more particularly to an altered condition

of its quality arising from redundancy of fibrine. "I have already established the fact that, under the influence of a state of general hyperæmia, every organ becomes excited; that death may result from such excitation; and that a superabundance of blood is found all over the body, but in no part is there any serious lesion, any alteration of texture. In such cases there exists that state of pyrexia, termed by nosologists inflammatory fever. But if, instead of being simply in excess, the blood contains more fibrine than ordinary, its exciting power will be still greater, and what it did in the former case merely by its increased quantity, it will now do by its alteration of quality." In fine, he applies the doctrines thus propounded to the particular disease which is the subject of the present essay. "Now if we mark the symptoms and progress of acute rheumatism, we find that very often a well-marked febrile action with a strong reaction, but without any symptom whatever of local affection, precedes the pain. In a word, there is first an inflammatory fever, and then rheumatism. Next observe the extreme mobility of the rheumatic pains. They run along in a manner wherever the blood is distributed; the application of leeches often removes the pain from one part, but it soon shifts to another, and not unfrequently it quits the articulating tissues and fixes on different internal organs, producing, by the derangement of their functions, symptoms more or less severe. It often happens that bleeding from a large orifice puts an end to the disease, as if by diminishing the mass of blood it proportionally diminished the stimulus that promoted all these shifting irritations."

The doctrines here advanced we believe to be founded in truth, and capable of furnishing much valuable guidance in the investigation and treatment of disease. In such copious extracts we may appear to have made too free with the pages of an author whose works are so generally known, but we could not resist the temptation of fortifying, by the authority of so distinguished a pathologist, principles which we have long maintained, and which we have endeavoured already to illustrate in the articles Gout and Plethora. They will suffice, we trust, to justify the assertion lately made, that whatever importance may attach to the exciting cause of acute rheumatism, the predisposition induced by a plethoric state of constitution is far more entitled to the practitioner's attention.

[As stated, however, in the article Plethora, M. Andral has pointed out the marked difference between the condition of the blood in it and in inflammation, and has shown that the increase of fibrin in it obeys the same laws as in the ordinary phlegmasiæ. He analyzed the blood of forty-three bleedings: in one of which the fibrin marked four, —the healthy proportion being three in 1000; in six, it marked five; in fifteen, six; in thirteen, seven; in three, eight; in three, nine; and in two, ten. When, however, the rheumatism was sub-acute, it oscillated between four and five; and when decidedly chronic, it did not exceed the healthy proportion. A recent writer, Dr. R. B. Todd, (*op. cit.*) regards both acute rheumatism and gout to be diseases of the blood, the phenomena of which are due to the presence of a morbid element in it, generated under the influence of particular causes, "by an abnormal chemical action of the blood itself."

It does not often happen that opportunities occur for examining the textures around the joints, whilst the rheumatic affection is active in them. As the disease rarely proves fatal, except by the supervention of inflammation in some of the fibrous or muscular tissues, seated internally, the mischief there is generally so predominant, that, for some time before death, the joints cease to be the source of suffering. Under these circumstances, it is not surprising that pathologists should differ as to the precise seat of acute rheumatism of the joints. It has been already remarked, that it invades every muscular and fibrous tissue, and that alternately the serous membranes may be implicated. Such may be the case in the articulations,—the synovial, which is a serous membrane, becoming affected last. On dissection, no decisive appearances may be met with. At times, the veins around the joints have been found gorged with blood; the ligaments, periosteum, and synovial membrane being injected, and thickened, with small collections of matter in the surrounding cellular tissue, and accumulations of pus or serum in the cavity of the synovial membrane. (Ferrus, art. *Rhumatisme*, in *Dict. de Méd.* 2de. édit. xxvii. 567, Paris, 1843.)

It is clear, that the hyperæmia of acute rheumatism—active as it is—can scarcely occasion any great organic changes, inasmuch as, in the course of a few hours, it shifts its seat, and leaves behind no evidences of its previous existence. This mobility has, indeed, given rise to the opinion, amongst many, that the disease is essentially seated in the nervous system; that the sanguiferous system is affected secondarily, and that it is very probable the nervous filaments of the diseased parts are more considerably involved than any other tissue. Dr. Mackintosh, (*Principles of Pathology*, &c. 2d Amer. edit. ii. 461, Philad. 1837,) who supports this view, remarks, however, that he has seen cases, which presented symptoms similar to those of rheumatism, in which, after death, the lymphatics of the limb were found inflamed, and filled with a puriform fluid. Some, again, have considered acute rheumatism to be nothing more than acute inflammation of the lining membrane of the arteries. The whole disease is certainly peculiar, and appears to be more neuropathic than ordinary inflammation. Its extremely changeable character sanctions this idea, and the remedies are not always those which we should think of prescribing in ordinary active phlegmasia.]

Diagnosis of acute Rheumatism. — This may be briefly disposed of. The only disease with which it is liable to be confounded is gout, in treating of which the distinctive character of each malady has been sufficiently noticed. Formerly discrimination in this respect was deemed of high importance, the prevailing theories of gout demanding a course of treatment very different from that to which rheumatism was subjected. In the present day a juster pathology of gout assimilates the treatment of both diseases sufficiently to render extreme accuracy of discrimination of very slight moment.

Prognosis of acute Rheumatism. — The

prognosis is so dependent on the promptitude with which suitable treatment is resorted to, that any remarks on the natural course or duration of the disease are of little worth. Generally speaking, there is little immediate danger to life, there being no inflammatory disease of equal intensity which so little deranges the vital functions. This, most probably, is owing to the disease expending its violence on the joints and other external parts, and being little prone to attack the viscera. The peculiar character of the inflammatory action too, and the little liability which it has to pass into suppuration, or undergo the other changes consequent to phlegmonous inflammation, may account for the safety with which even the metastasis of rheumatism to internal parts is borne. It is certain that such metastasis is not attended with so much danger as the severity of the symptoms would seem to denote. In early life we were often appalled by the metastasis of rheumatism from the joints to the heart, an organ more peculiarly liable to this transition than any other. More extended experience abated such fears, by showing that the immediate danger was by no means commensurate with the suffering experienced.

[Still, the pericarditis and endocarditis of acute rheumatism must be regarded as most dangerous complications—if they may be so termed—of the disease; for even if the patient recovers, which is often the case, from the immediate attack, cardiac lesions are apt to remain, which may lay the foundation for disease afterwards. M. Bouillaud (*Traité Clinique du Rhumatisme articulaire*, Paris, 1840,) has affirmed, that about one half of those who suffer under acute articular rheumatism are affected with pericarditis; and we know that endocarditis is a common accompaniment. One of the most important points, therefore, in the management of acute rheumatism is to watch the supervention of the morbid action in the fibro-serous tissues of the heart. It is not necessary to repeat here the symptoms of pericarditis and endocarditis (See PERICARDITIS); but the occurrence of dyspnœa, with more or less anxiety, jerking, or feeble and rapid pulse, and tumultuous action of the heart, ought to direct the attention of the practitioner to that viscus, and if he discover, by the physical signs and functional phenomena, the existence of inflammatory action there, it must be treated as if the disease were unconnected with rheumatism; for nothing is better established, according to M. Andral, (*Cours de Pathologie Interne*,) than that, although primary rheumatism, seated in the fibrous and muscular tissues around the joints, is remarkable for its great and rapid change of seat; secondary rheumatism—if it may be so termed—loses this mobility when it fixes upon a serous membrane.

Dr. Graves (*Clinical Lectures*, Amer. edit. Philad. 1842,) states, that rheumatic fever may exist without the affection of the joints; and that pericarditis may occur as a primary symptom before the appearance of the articular swelling. This is probable. The writer has certainly seen many cases in which the signs of pericarditis were amongst the earliest phenomena.]

If an attack of rheumatism be treated at the onset with due activity and discrimination, it may be relieved in a very few days without the affected joints sustaining any injury. But both with respect to time and local ravages, much will depend on suitable discipline being resorted to and adequately pursued, ere the specific inflammation of the joints becomes complicated with that which we have termed secondary. The specific inflammation we have repeatedly seen subside in twenty-four hours, leaving behind but little trace of its accession. When secondary inflammation, however, has been suffered to supervene, the case is materially altered, and greater obstinacy of local affection may be expected. It might be laid down almost as an axiom, that the severity and duration of the disease are proportionate to the degree of plethora present, the activity of inflammation, and the length of time during which the morbid actions are suffered to prevail unrestrained. If the plethora be great, inflammation high, and much delay take place in resorting to efficient means for correcting the constitutional derangements, then would it be difficult to assign limits either to the constitutional disturbance or local ravages, both of which may continue, though with abated force, for months or years, to undermine health and cripple the limbs; in other words, acute rheumatism may then pass into chronic of the most inveterate and intractable kind. Thus, though acute rheumatism rarely destroys life by its immediate seizure, however violent, this furnishes no excuse for supineness or inactivity in the treatment; for if not radically relieved in its early stage, the disease, even when of no extraordinary violence, may become so confirmed as to yield afterwards with difficulty to the most active and judicious use of remedies, while progressive disorganization of joints may entail protracted suffering and lasting decrepitude.

It is true that a slight rheumatic seizure may, like a gouty paroxysm, pass away without medical interference, the efforts of the constitution sufficing for relief. But this is not its general character; and to rely on such a contingency would be in the highest degree rash and inexcusable. Whenever an attack of acute rhematism occurs, the constitution must need some relief, which enlightened practice will never withhold. To neglect of this principle may be ascribed a very large proportion of the decrepitude which the victims of rheumatism so continually present. There is no truth of which we are more thoroughly persuaded, than that if rheumatism were at its onset treated as its real nature demands, and if due care were afterwards taken to guard against its recurrence by prophylactic measures judiciously directed and adequately pursued, there need not from this malady be one case of disorganized and crippled joints for every hundred that are so afflicted. The effects of the earlier treatment will, therefore, in general, decide the prognosis. There is inflammatory fever to subdue, local inflammation to remove. If early bloodletting in subduing the fever make prompt impression on the local affection, so that both pain and swelling quickly subside, thus marking the local inflammation as still retaining its specific character unmixed with secondary effects, speedy and effectual relief may be con-

fidently predicted, medical treatment judiciously conducted being fully capable of ensuring it. When febrile action is inveterate, and it is oftentimes very obstinate, though chiefly so when the earlier periods of disease have been neglected or inadequately treated, a tedious progress may be expected, for so long as fever remains unsubdued are the local inflammations incapable of removal, either keeping their ground unmitigated, or if abated by topical remedies, continually recurring. Again, when abatement of fever is not followed by quick subsidence of local swellings, in consequence of the latter having passed into the secondary stage, and especially when effusion and organic changes have already taken place in the affected joints, then is the restoration of the joints much more tedious, though great local derangements will admit both of speedy and decisive relief, provided the local mischief be not rendered inveterate, or continually renewed by unsubdued fever.

Much, too, depends on the state of constitution in which acute rheumatism occurs. In a healthy subject, capable of bearing the depletory and other treatment required for relief, great reliance may be placed on the efficacy and certainty of the curative process. When the constitution is depraved by long-continued relative plethora, with its attendant febrile excitement, and especially if the feebleness, natural or acquired, be such as to render caution necessary in carrying bloodletting and other remedial processes to the requisite extent, more protracted disease and more tedious recovery must be the natural and inevitable consequence.

It is said that rheumatic inflammation does not tend to suppuration or gangrene, and the remark is generally true. Yet we have seen abscess of the cellular membrane supervene on rheumatic inflammation, and we have also witnessed sloughing ensue when leeches have been applied to a highly inflamed joint without adequate constitutional treatment being conjoined. The most frequent consequences are, gelatinous effusion into the bursæ, thickening and rigidity of the ligaments and other membranes surrounding the joints, contractions of the limbs, and wasting of the muscles, all of which will come under consideration in the latter part of this essay, where it treats of chronic rheumatism.

Treatment of acute Rheumatism.—The indications are here to subdue fever and remove inflammation. It has been already shown that the former claims the first consideration. The promptitude with which the local inflammation in its earliest stage yields to the treatment by which a plethoric state of constitution is corrected, and febrile action allayed,—and the obstinacy of the local ailments, whenever the constitutional state is overlooked or inadequately treated, furnish the best proofs of the correctness of this pathology. In its simplest form and early stage, acute rheumatism is speedily and effectually relieved by antiphlogistic treatment, properly directed and adequately pursued. Bleeding, purging, salines with antimony, diluents, and abstinence, suffice both for subduing the general fever and removing the local inflammation. It continually happens, however, that these means, however actively or perseveringly employed, will not succeed in re-establishing health; a lurking fever remaining unsubdued, the blood retaining its buffy crust even when the crassamentum is reduced far below its natural and healthful proportions, and the local inflammation maintaining its hold of the affected joints. Further means are then required, which will be noticed in their proper place. The treatment of the simple and more manageable form must be first discussed.

One of the earliest practical writers on this complaint was Sydenham; and so direct and judicious was his practice, that we cannot do better than to make it the text on which to comment in treating this part of the subject. Sydenham's theories of disease often involved the pathological fantasies prevalent in his day; but it is his signal merit that he never suffered them to mislead him from the path which his clear discernment and practical experience enjoined him to follow. He attributed the local affection to "the derivation of the febrile matter to the limbs," which, as he observes, "the frequent return of the fever from the repulsion of the morbific matter by external remedies sufficiently shows." But we cannot perceive that he was influenced by this hypothetical principle, further than to adduce it in explanation of facts which his experience had taught him. He had witnessed the inefficacy of local treatment, and also the increase of constitutional disturbance which resulted when this alone was trusted to, and he wisely abstained from repellent applications. Having described the disease with some of its modifications, he gives the following concise instructions for its cure. "Since both kinds of this disease seem to arise from inflammation, as appears from the concomitants just mentioned, and especially by the colour of the blood taken away, which exactly resembles that of persons in pleurisy, which is universally allowed to be an inflammatory disease, so I judge that the cure ought to be attempted only by bleeding, the heat of the blood being in the mean time abated by cooling and thickening remedies along with a proper regimen. Accordingly, as soon as I am called I order ten ounces of blood to be immediately taken away from the arm of the side affected, and prescribe a cooling and incrassating julep. To ease the pain I order a cataplasm prepared of the crumb of white bread and milk tinged with saffron, or a cabbage-leaf to be applied to the part affected, and frequently renewed. With respect to diet I enjoin a total abstinence from flesh, and even from the thinnest flesh broths, substituting in the place barley-broth, water-gruel, panada, and the like. I allow only small-beer for drink, or, what is more proper, a ptisan prepared of pearl-barley, liquorice, sorrel-roots, &c. boiled in a sufficient quantity of water, and I allow the patient to sit up some hours every day, because the heat which arises from lying always in bed promotes and increases the disease. The next day I repeat the bleeding to the same quantity, and in a day or two after, as the strength will allow, I bleed again. Then interposing three or four days, as the strength, age, constitution of the patient, and other circumstances indicate, I bleed a fourth time, which is generally the last, unless too hot a regimen has preceded, or heating remedies have been exhibited without necessity. But the use

of opiates requires more copious bleeding; and, therefore, though the pain be ever so violent during the whole course of the disease, yet when I intend to effect the cure solely by bleeding, I judge it highly necessary to refrain from opiates, because the disease is fixed thereby, and does not yield so readily to bleeding; so when such medicines are given too frequently, bleeding must in consequence be oftener repeated than is otherwise necessary. Besides, in the height of the disease, they do not answer the expectations we have conceived of them. Whilst the above-mentioned remedies and regimen are carefully continued, I inject glysters made of milk and sugar, between times on the intermediate days of bleeding, earnestly recommending the exact observance of these directions for at least eight days after the last bleeding; and then I prescribe a gentle purging potion to be taken in the morning, and in the evening a large dose of the syrup of white poppies in cowslip flower-water, whereby a check is put to the tumultuary motion of the blood which might otherwise occasion a relapse. This being done, I allow the patient to return by degrees to his customary way of living in relation to diet, exercise, and air; but, at the same time, caution him to refrain for a considerable time from wine and all spirituous liquors, salt or high-seasoned flesh, and, in general, from all food of difficult digestion. After having repeated bleeding as above specified, the pain greatly abates, though it does not go quite off; but as soon as the strength returns, which bleeding had greatly impaired, the symptoms will vanish, and the patient perfectly recover."

In the simplicity, fitness, and activity of the foregoing course of treatment, there is much to admire. It comprises the more essential articles of antiphlogistic discipline, bleeding and abstinence; it discourages the premature use of narcotics, which, when employed too early, or in substitution of depletory measures, only mask the symptoms even when they allay pain, while they too often exasperate the disease, rendering it both more violent and more obstinate. It also inculcates a salutary reserve in the return to animal food and fermented liquors. That under this simple treatment many would pass safely through the disease, there can be no doubt, although recovery would certainly be slower than it might be rendered. But cases continually occur in which this treatment would be utterly inadequate, the febrile action maintaining its ground, and the local inflammation migrating from joint to joint, notwithstanding the diligent employment of all the means which Sydenham's practice in the disease comprises. In this practice one great deficiency is observable, the use of purgatives in aid of bloodletting not being at all enjoined. For regulation of the bowels, clysters of milk and sugar are trusted to, and not until eight days after the last bleeding is a gentle purging potion prescribed. In this and other respects, later experience has added much to our means of combating acute rheumatism.

When this disease occurs in its most active state, the means suited for reducing plethora, abating fever, and checking the progress of inflammation, must be promptly and adequately employed; full bloodletting and active purging, with the united powers of colchicum and antimony, being required to lower the circulation and arrest the evils which inflammatory action when unrestrained is sure to occasion. The first procedure in respect both of time and importance is bloodletting. In many instances the use of this directed by Sydenham would suffice, but in many it would fail. As a rule of practice, therefore, Sydenham's directions in this respect are defective, as not embracing conditions of disease which are of frequent occurrence, and for which the depletion directed by him would prove utterly inadequate. Indeed, no express rule in this respect could be laid down, both the amount and frequency of venesection being in every instance dependent on the degree of plethora existing, the activity of fever and inflammation present, and the natural powers of the constitution to be acted on. The pathology of inflammation, and the use of bloodletting most effectual for subduing it, have been so amply discussed in the articles Gout and Plethora, that to recapitulate what has been already advanced on these points must be needless. We shall proceed, therefore, on the presumption of the principles inculcated in those articles being clearly comprehended, and in conformity with these principles state practically how the lancet can be most successfully used. In ordinary cases the loss of twelve, sixteen, or twenty ounces of blood may suffice to check disease and prepare the way for the subsidiary treatment. But if absolute plethora be considerable, inflammatory action high, and the constitution robust, blood must be drawn to much greater extent if adequate impression is to be made on disease. In such case the rule should be not to abstract any assigned quantity, but to carry the bloodletting to the extent of making a sensible impression on the force of circulation. Thirty or forty ounces of blood may require to flow ere this is effected, and so essential is the impression alluded to, that even large bleedings, if not carried to this extent, will fail to produce their full effect in restraining inflammatory action. It continually happens in cases of active inflammation, that notwithstanding the loss of thirty or forty ounces of blood, the pulse does not yield, but maintains its hardness, while the abstraction of a few ounces more, by inducing a disposition to syncope, completely checks the inflammatory action and abates the violence of the disease. By making the constitutional powers the measure of the depletion, less bleeding on the whole is needed; thus by this mode blood is virtually saved and unnecessary exhaustion prevented, a single venesection carried to the necessary extent being far more effectual than reiterated bleedings to a far greater aggregate amount, if these be respectively of insufficient extent. Bleeding to actual syncope is not desirable, but if inflammation be high, some impression on the pulse should be manifested. If this begin to falter, while nausea is felt, the lips grow pale, and perspiration begin to bedew the forehead, such bloodletting may be relied on for accomplishing all that this remedy is capable of effecting. This use of the lancet, however, can only be required where severity of symptoms with vigorous habit demands such active treatment. In a large pro-

portion of cases much more moderate depletion will suffice. From twelve to twenty-four ounces of blood may be regarded as the ordinary limits, and many repetitions are never advisable; for when bloodletting to such extent, assisted by purging and other febrifuge treatment, does not make sensible impression on disease, other more adequate means of arresting its progress must be resorted to. Blood may be drained away until the body is blanched and the crassamentum reduced to a tithe of its just proportions, yet febrile action will continue, inflammation be unsubdued, and the blood drawn be still buffed and cupped.

It is right to mention here, that although a full and hard pulse is generally attendant on acute rheumatism, yet the absence of hardness is no evidence of active inflammation not being present, or of bloodletting not being needed. If the general symptoms concur to indicate inflammatory action, then, though the pulse be soft and compressible, bloodletting is nevertheless essential, the blood drawn in such case being almost uniformly buffed and cupped, the pulse rising after venesections, and disease more rapidly subsiding.

[Of late years, the profession have been startled by the extent to which bloodletting has been recommended by M. Bouillaud (*Op. cit.*); bleeding *coup sur coup*, with the view of "strangling" the disease, to use his own expression. The writer has had recourse to it in what appeared favourable cases; but the results have not been equally happy; and it has seemed to him, that the too vigorous use of the lancet has occasionally rather favoured the shifting of seat, which has been so much dreaded. It can, of course, only be admissible in vigorous individuals, and even in them, a more sparing use of the lancet, with the agents to be mentioned presently, appears to be less liable to objection. There are cases in private practice, and most of those that are seen in our eleemosynary institutions, in which any abstraction of blood from the general system could not fail to prove injurious.

As an adjunct to general bloodletting, the tartrate of antimony and potassa has been highly extolled of late years, and there are cases in which its sedative influence has been highly advantageous. The writer has frequently prescribed it under the restrictions and inculcations mentioned under another head (See Pneumonia), and occasionally with the best effects. It has seemed to him, however, that the antimony has acted most beneficially when it produced nausea, and the nausea was kept up two or three days in succession.]

The next measure is to purge freely the stomach and bowels; and here again we must refer to what was formerly advanced on this subject in illustration of the necessity of suitable and adequate purging being employed in aid of bloodletting. As soon as may be after bloodletting, a full dose of calomel combined with antimony (either James's powder or tartarized antimony) should be given, and in a few hours after a cathartic draught. The bowels being well evacuated, diaphoretic salines with antimony and colchicum contribute much to allay fever, quieting the pulse, and promoting the several excretions.

One of the best forms of saline for this purpose is a combination of acetate of ammonia, camphor mixture, antimonial wine, and wine of the colchicum seeds, as in the following formula:

R. Liquor. ammon. acet.
Mist. camphoræ, āā f.℥ss.
Vin. sem. colch.
Vin. ant. tart. āā *m.* xx.
Syrup. aurant. f.℥i. *m.* fiat haustus quartis vel sextis horis sumendus.

The properties of colchicum and the best modes of administering it have already been so fully discussed in the article Gout, that to avoid needless repetition, we shall refer to what is there stated. It is only necessary to remark that the effect of colchicum on the bowels requires to be watched, for when it irritates them so as to excite active purging, its use must be discontinued. In our early trials of colchicum in gout and rheumatism, we were accustomed to give it in full doses, but, for reasons already explained, we have for many years discontinued them, the salutary effect of the remedy being fully attainable from the more moderate exhibition of it which has just been prescribed. When the use of it irritates the bowels, producing frequent watery stools, discontinuing the colchicum suffices in general for the relief of this disturbance; but should it continue troublesome, moderate doses of Dover's powder are sure to allay it. It has been surmised that the use of colchicum has through irritation of bowels led to ulceration of their mucous membrane, but this effect we altogether distrust. It must be a very rash use of the remedy which could produce any such effect, and where it has appeared to result, our persuasion is, that the membrane was in an advanced stage of subacute inflammation ere the colchicum was exhibited. We have given colchicum freely and extensively for many years, with caution certainly, though not greater than is required in the administration of every active drug, yet a single instance has never occurred to us in which we could trace any injury to its use, while its medicinal properties have rendered valuable aid, not only in gout and rheumatism, but in many other inflammatory diseases.

[Aconitia, delphinia, and veratria, have been used both internally and externally; and cimicifuga carried to the extent of producing catharsis, and even slight narcosis, has likewise been of service. Of the different revellents, cupping on the back, strongly recommended by Dr. J. K. Mitchell, has appeared to be most frequently attended with happy results. An idea has been entertained that this has been owing to the depletion and revulsion effected near the origin of the nerves that are concerned in the articular inflammation. Whatsoever view may be entertained as to this matter, it is unquestionable that the highly sensitive integument of the back is an excellent locality for revulsion in many diseases; and it is not necessary that the mischief should be directly or indirectly connected with the spinal marrow, or its sheath, to explain this. The writer has seen the intense suffering in the joints as effectively relieved by cupping over the loins as by any other agency.]

As the extent and repetition of bloodletting must depend on the activity of disease and vigour of constitution, so must the use of purgatives be regulated by the condition of the bowels, and the necessity for purging which the stools may evince.

So long as these are dark, slimy, fetid, and otherwise unhealthy, must purgatives be used; and the most effectual are those by which the morbid secretions of the alimentary canal are evacuated. Pills of colocynth, calomel, and tartarized antimony should be given at intervals, and, if necessary, cathartic draughts should be interposed. When fever declines, and the stools present a more healthy appearance, milder aperients will suffice. Under such treatment low diet and a cooling regimen are indispensable. Barley-water or toast-water is quite sufficient during the inflammatory stage. Animal food and fermented liquors of every kind are prejudicial, and should be carefully withheld.

The several means now pointed out will in many instances suffice to allay fevers, remove inflammation, and restore health. But cases occur in which neither fever nor inflammation can be thus subdued. If active treatment be not resorted to on the first accession of disease, or if it be not urged to the requisite extent, inflammatory action acquires an inveteracy which simple antiphlogistic treatment is quite unable to correct. In such circumstances bloodletting may be pursued until the patient become nearly exanguious, yet the blood will still be buffed and cupped, febrile action will remain unsubdued, and local inflammation continue to disorganize and cripple the joints.

Even in milder cases of this kind, although permanent injury may be averted, and perfect recovery ultimately ensue, yet the successive migrations of local inflammations prove harassing to both patient and practitioner. We have seen such inflammation traverse almost every joint of the body, attacking several a second and a third time before the disease yielded. When the progress is favourable, each successive inflammation becomes slighter, until towards the close a mere blush of redness marks the morbid effort.

But this course of proceeding is at best tedious and unsatisfactory, even where an issue so favourable as has just been mentioned is attained. Such result, however, is not to be relied on; for in the form of disease now considered, it will more frequently happen that unsubdued fever will exhaust the general powers, and inflammation inflict its ravages on the joints, producing effusion, thickening of ligaments, with enlargement, rigidity, or contraction. When, therefore, one or two full bloodlettings, assisted by purging, abstinence, and other means, fail to make adequate impression on the disease, it becomes necessary to call in other aids in order to prevent the exhaustion and other ills which repeated bloodletting would occasion. And fortunately one exists which is worthy of our fullest confidence. This is mercury, which, when judiciously administered and made subsidiary to bleeding and purging, is capable of subduing rheumatic inflammation with as much certainty as attaches to the operation of any remedy in any disease. The practice of arresting the progress of rheumatism by mercury has been before the public sufficiently to have made it more generally known and more justly appreciated than it appears to have been. It originated with Dr. Robert Hamilton of Lynn Regis, who published, in the Medical Commentaries of the year 1783, an interesting account of the success with which he had administered calomel and opium in the treatment of several inflammatory diseases. So far back as the year 1764 he had been induced to employ calomel for the cure of hepatitis. Its efficacy in the disease and in several other inflammatory affections led him to extend his views of its applicability, and to conceive that it was a suitable remedy for inflammation in whatever viscus or tissue this might be situated. He accordingly employed its aid with the best effects in inflammations of every part, and particularly in acute rheumatism. His practice in the latter was to take blood in proportion to the violence of the inflammatory symptoms and to the age and constitution of the patient; after which he exhibited calomel and opium at suitable intervals until the disease yielded, or until the influence of the remedy on the constitution was evinced by increased secretions from the salivary glands, bowels, or skin. If in twenty-four hours after the use of mercury was commenced, relief did not ensue, or if inflammatory symptoms continued unabated, he bled again, and gave the calomel more frequently. Salines, antimony, camphor, and other auxiliaries were combined with bleeding and mercury, and through their united agency he found disease subside with a promptitude which no other mode of treatment could command. When this treatment was employed early in the disease, recovery was soon accomplished; if postponed to a later period, its effects were more tedious and uncertain. His experience also taught him that the curative process was most favourable when the salivary glands became affected by the medicine. This brief account of Dr. Hamilton's rational and effective practice in rheumatism embraces so many essential points of the treatment of this disease, that we shall have little to add save the detailed instructions which the young practitioner may need for conducting that treatment with discrimination and effect. In confirmation of the truth and accuracy of Dr. Hamilton's views, we may here remark, that having for five-and-twenty years pursued the practice and applied the principles which he inculcates, our faith in them has never wavered, and that with ample opportunities for subjecting them to the test of experience, we can truly say that we know of no fact in medicine better established than the power which mercury possesses of subduing inflammations, when used as subsidiary to bleeding and purging.

Every case of acute rheumatism does not require mercury for its cure. Bleeding, purging, abstinence, and salines, with antimony and colchicum, will frequently suffice. But if, after twenty-four hours, the early discipline has not produced sensible effect on the disease; if after this period fever continues unabated, inflammation unallayed, and further bloodletting be required; as obstinacy of disease is here sufficiently announced, it is expedient to lose no more time, but to resort to the only means by which an adequate check can be given to the malady.

Profuse use of mercury is not needed; both the amount of dose and frequency of exhibition must be determined by the circumstances of the particular case. Although it is desirable to obtain evidence of the constitution being affected by the remedy, so far as tenderness of gums indicates, it is not expedient to produce this effect very speedily,

and there are many reasons for enjoining caution in the administration of this medicine. It is not necessary to urge on its full operation, for the curative effect commences ere the specific action on the salivary glands appears. Unless the plethoric state of constitution, too, be adequately relieved by depletion, there is considerable risk of pressing the use of mercury. On this subject we must once more refer to what has been already advanced respecting it in the article PLETHORA. The susceptibility of impression from mercury, too, varies greatly in different persons, so much so, that while some cannot be salivated by any quantity, a few grains of calomel will in others induce severe ptyalism, with inordinate swelling of the jaws and extensive sloughing. On every account, then, it is advisable to incline to the minimum quantity capable of acting on the disease. The expediency of combining opium with calomel, when exhibited for this purpose, admits not of question. When thus conjoined, it allays pain, abates irritability, prevents the calomel passing off too quickly by the bowels, and promotes its more certain absorption. In general, two grains of calomel and a quarter of a grain of opium is a sufficient dose, and the frequency of its exhibition will be best guided by the severity and threatened obstinacy of the attack to be combated. In severe cases it is beneficial to commence with five grains of calomel, one of opium, and one of tartarised antimony at bedtime, and to pursue the course the next day with the smaller dose. In mild cases it may suffice to give this night and morning; to administer it thrice a day is no inactive practice, and by this use the gums will in general soon become affected. Given every six hours, so that, in the four-and-twenty, four doses are taken, is perhaps the frequency that will most commonly be needed. We have never had occasion to enlarge the dose, nor to exhibit it oftener than every four hours; but to this extent we have been occasionally compelled to employ it. The cases, however, requiring the active use of it are rare. The circumstances to guide its use are the curative effects on the constitutional and local symptoms, and its specific effects on the salivary glands, bowels, and skin: if any of these be signally induced, the use of it should abate, and the intervals of its exhibition be lengthened. Unless active salivation take place suddenly, and unexpectedly, it is never expedient to withdraw it wholly so long as fever lurks or inflammation keeps its ground. The best practice is to lengthen the interval, and to do this progressively by reducing the employment from four times a day to three, then to twice, and finally to continue a single dose daily for a short time. By this cautious proceeding, if bloodletting be adequately practised, the bowels freely purged, and no error in diet committed, the beneficial effects of mercury may be ensured without any risk of injury and scarcely of inconvenience. Should salivation chance to advance beyond what would be wished, the evil is but a slight counterbalance to the benefit which mercury confers in the case of this most painful and disorganizing malady. When the mouth becomes painfully affected, we may here remark that saline purges abate the distress, and that gargles of chloride of soda or of nitrate of silver have considerable power in allaying the morbid sensibility of the gums and tongue which is sometimes experienced. There are constitutions on which mercury acts so unfavourably, producing great derangement of the nervous system, that its use cannot be borne. When such sinister effects occur, its use must of course be abandoned; but such instances are not common, and when they do occur, we strongly suspect that neglect of early depletion is more in fault than any idiosyncrasy inimical to the remedy.

While mercury is exhibited in the way directed, the salines formerly prescribed should be continued, and occasional purges should be interposed. The use of the latter should be regulated by the degree of fever and the state of the stools. If fever continues high, with a dry tongue and costive bowels, or if the stools be very dark and slimy, purgatives must be the more freely used. When the bowels are unusually torpid, it is often expedient to substitute for the diaphoretic saline a solution of sulphate of magnesia in rose infusion, giving this at such intervals as shall keep the bowels free. It is generally conceived that purgatives impede the constitutional operation of mercury, and in consequence, when this operation is the object in view, purgatives are usually withheld. Without discussing this point, we shall merely observe that if the degree of fever or the foulness of bowels demands purging, it should be carried to the full extent required, without regard to its supposed interference with the effects of mercury. Under such circumstances greater injury would result from the neglect of purging, than even the unimpeded action of mercury would compensate.

There are cases in which it is not expedient to combine opium with the calomel, but they are rare. If headach prevail,—if the tongue, instead of becoming moist and clean, grow parched and dark, and the skin be hot and dry,—opium should be withheld, and the calomel given either alone or conjoined with James's powder.

[Opium has not unfrequently been given in acute rheumatism, with the view of inducing narcosis, and of establishing a new impression and action on the nervous system. Care must, of course, be taken not to push the remedy too far, and yet to keep the patient clearly under its influence. With this view, any of the preparations of opium may be prescribed; but the soft pill is as efficacious as any other; or the acetate or the sulphate of morphia or the pulvis ipecacuanhæ compositus; but the last can be seldom given in quantity sufficient for the opium to produce its narcotic action, without the ipecacuanha disordering the stomach.]

The progress of recovery and the experience of a few cases thus treated will readily guide the practitioner in that adaptation of remedies to the exigencies of each case which no specific rules could prescribe. He who possesses himself of the principles on which the treatment here directed is founded, will commit no error in the extent or duration to which he may carry it.

There is a period, however, in the progress of rheumatism, even when actively and judiciously treated, which calls for something more than has yet been enjoined. In a large proportion of cases, the treatment now prescribed will fully suffice. It will subdue fever, remove local inflammation, pre-

vent disorganization of joints, and restore the patient in moderate time to health and the free exercise of limbs. But it occasionally happens that notwithstanding the full employment of all the means directed, a certain degree of fever lingers, the skin continues dry with some morbid heat, the tongue too white, and pains of acute character are still felt in the joints. When this state first met our view, so completely did the assemblage of symptoms simulate active inflammation, that we hesitated whether there was not an actual relapse of disease, and a necessity for reverting to active remedies. But the indecision was of short duration; for assured by the treatment already pursued, and the effects produced by it, that inflammation had been successfully combated, we could not regard the supervening state as corresponding in its nature to that which we had already corrected, and instead of recurring to bleeding and mercury, we made trial of bark as a preferable agent, and with such benefit, that we have seen it remove, in twenty-four hours, the whole train of symptoms which we have just mentioned. Half a drachm of bark with ten grains of nitre is the combination on which we most rely, giving this twice or thrice a day; and so effectually does it answer the purpose that we are slow to change it. What we have now stated may serve to explain the confidence with which some writers have advocated the use of bark as almost a specific in rheumatism. There is undoubtedly a stage of the disease in which it may be beneficially given, but in the acute stage, to which we have hitherto chiefly referred, we at least would not compromise the patient's safety by trusting to bark, while bleeding, purging, and mercury were applicable; and even in what is called chronic rheumatism we would as little rely on it so long as plethora was unrelieved, the pulse high, the bowels loaded, and active fever predominant. When the general state of constitution is restored to the proper balance of its several functions, should some febrile indications linger, and pains continue to infest the joints or muscles, bark furnishes then a valuable and unexceptionable means of correcting the slight remnant of disease, but not before.

[The writer has had frequent opportunities for witnessing the exclusive use of both modes of treatment, antiphlogistic and tonic, and it is but proper to say, that he does not recollect to have seen the symptoms in any case aggravated, under the prudent employment of either. In the mass of cases that occur, except in very active, vigorous habits,—and it is generally applicable even to them,—a combination of the two modes of treatment has appeared as advantageous as any other,—treating the disease during the early period, by the ordinary antiphlogistics, and afterwards endeavouring to remedy the neuropathic condition by the cautious employment of tonics, as the sulphate of quinia. Dr. D. Davis, late Professor in the London University, has expressed a confident belief, that cinchona "is the most powerful remedy that can be employed even in an incipient case of acute rheumatism, and affirms, that he does not remember a case in which the disease was not happily subdued. "I have often recommended it," he adds, "in cases of pure arthritic rheumatism during its acutest stage, and the disease has always yielded to the remedy; and I have also recommended it in violent pains of the joints, accompanied by alarming complications; but never in any one case injuriously to the interest of my patient. I have, therefore, no difficulty in recommending its adoption to my medical brethren, and especially to those who are most frequently favoured with opportunities of seeing acute rheumatism in its earlier stages." Dr. Davis prescribes the cinchona in the dose of from a scruple to half a drachm, repeated three or four times daily. He always, however, premises the free abstraction of blood. (See, also, Popham, *Dublin Journal of Medical Science*, Sept. 1844, p. 50.) M. Briquet, and others, have advised large doses of the sulphate of quinia—from ʒi to ʒiss in the course of the 24 hours; and, they affirm, with unusual success. M. Briquet considers, from his observation, that the sulphate is a powerful sedative, diminishing nervous excitability, retarding the pulse, and lowering the temperature. It has been objected by M. Devergie to this plan, that it is apt to cause serious disturbance in the functions of the brain and organs of sense; but care in regulating the dose may prevent this.]

The cure of rheumatism by profuse perspiration has fallen so much into disuse that it can hardly be necessary to notice it. Yet it was held in high estimation not many years back, and very generally deemed the most effectual mode of treatment. The late Dr. Gregory, in his lectures, used to represent sweating as the evacuation most to be relied on for the cure of rheumatism, and to bear his testimony to its efficacy. He gave a caution, however, against resorting to it until the pyrexia had been abated by bloodletting, and stated that his test was, never to employ it until the pulse was reduced to 100. The chief agent was Dover's powder, given in doses of ten grains every two or three hours, assisted by warm covering and copious diluents, the latter to be used only when the perspiration commenced. To be effectual, this required to be kept up for forty-eight hours. This practice has, we believe, been very generally, and, as we think, judiciously, laid aside, the treatment recommended in the foregoing pages being far more certain and effectual, producing less exhaustion, and leaving less susceptibility to recurrence of disease.

[Recently, iodide of potassium has been recommended both internally and externally, and the treatment by large doses of nitrate of potassa, so highly advised in the last century by Dr. Brocklesby, has been revived, and, it is said, with much success,—from a quarter of an ounce to an ounce being given dissolved in a large quantity of gruel in the twenty-four hours.]

We have hitherto treated chiefly of constitutional disorder, and have considered the local inflammation only so far as it was connected with or dependent on the constitutional state. It is necessary, however, to scrutinize the local affections still further. So directly is the local disturbance dependent on the constitutional in the incipient stage, that if the latter be promptly and vigorously treated, the former will very speedily subside without any local treatment being needed. We have seen the local inflammation thus subside in rheumatism equally as in a first attack of

mild gout, leaving as little trace of its visitation. It must be admitted, however, that such speedy decline is not the general character of this local affection. Notwithstanding the abatement of fever, some pain, heat, and swelling will continue to affect the joint for a longer or shorter time; and in order to understand the treatment which this requires, it is necessary to bear in mind what was formerly stated respecting the change of character in the local inflammation. If on fever becoming subdued by the means directed, the local inflammation declines, no topical treatment whatever is needed, nor is it expedient that any should be resorted to. Decline of inflammation thus obtained affords conclusive evidence of disease being arrested at its source, and relapse need not here be apprehended; while, if the local inflammation be checked by topical remedies, its abatement affords no such assurance, and if the constitutional derangement be not thoroughly rectified, repeated renewal of the local inflammation with successive migrations from joint to joint will most probably ensue. But independently of this consideration there are other objections to the early use of topical remedies which ought not to be overlooked. Repellent applications may remove inflammation from any particular part; but only to transfer it to some other, if not to the heart, stomach, or other internal organ. Local bloodletting would beget less danger of this kind, but neither is it free from objection. The inflamed part is ill suited to sustain the operations by which blood can be abstracted. We have seen leeches when applied to a rheumatic joint prematurely and without sufficient regard to the constitutional state, exasperate every symptom, and cause increase of inflammation both in the skin and cellular membrane, ending in extensive sloughing, with troublesome ulceration, and followed by thickening of the ligaments with rigidity and contractions of unusually obstinate kind. So long as it is possible, therefore, to procure decline of local inflammation by the constitutional treatment, we consider it the better practice to abstain from topical remedies.

When inflammation continues in the joint, however, after fever has been sufficiently subdued, thus manifesting its having passed into what we have distinguished as the secondary state, it then becomes necessary to regard it as a local disease, and by appropriate topical treatment to avert those ravages which its continuance would occasion. The means are cupping, leeches, warm fomentations, poultices, cold lotions, modified according to the degree of inflammation, the sensations of the patient, and the effects produced. By such means, the local inflammation in this its secondary state may be so corrected as to prevent organic lesion, and preserve unimpaired the mobility of the joint.

[The application of methodical compression around the affected joints by means of a flannel bandage is often productive of great relief. It was advised many years ago, and has been revived. (See the writer's *New Remedies*, 4th edit. p. 183, Philad. 1843.) It is especially serviceable where there is great effusion. It has been recommended, that the compression should be made by means of compresses covered with mercurial cerate; and that a position and attitude should be given to the limb that would be most favourable to resolution. An elevated position would certainly tend to prevent the engorgement of the parts. The writer has seen good effects from compression where it could be borne, and a simple flannel bandage is all-sufficient.]

We would here impress, as we formerly did when treating of gout, the importance of an early renewal of motion in the affected joints, as indispensable for re-establishing their health and preserving their flexibility and power. From neglect of this, much protracted confinement and ultimate decrepitude continually result. On the subsidence of inflammation, the parts so lately disturbed are indisposed to motion, and some pain attends the early attempts at its removal. Yet leaving them at rest is not the means by which the power of motion is best restored. Exercise of the parts is necessary not only to restore those which have been morbidly affected to their healthy functions, but to preserve in due energy and activity the muscular apparatus by which they are moved. By exercise healthy circulation is maintained, effusion prevented, absorption promoted and flexibility preserved. By it, too, the muscles subservient to the motions of the joint are kept in a healthy and efficient condition. When, from too great apprehension of exciting pain or renewing inflammation, quiescence is too long continued, the ligaments and other parts surrounding the joints become rigid; if these be kept bent, contractions take place, and the mobility of the part becomes permanently impaired; while the several muscles, from want of exercise essential to the maintenance of their nutritive and healthy actions, progressively waste and lose power. This latter contingency is, we are persuaded, much more frequently owing to the continued inactivity to which the muscles are consigned than to any morbid action induced in them by the disease; and as we before observed, so satisfied are we of the mischiefs resulting from long-continued rest after rheumatic inflammation, that we would in our own person much rather hazard any renewal of inflammatory attack, than suffer those derangements to proceed which spring from a state of inaction too long continued.

[Capsular Rheumatism. — When rheumatism is seated in the lining membrane of the joints, and bursæ of the tendons, it is termed *capsular*. The parts most liable to its attacks are the feet and hands. It is recognised by the enlargement of the joints, which is circumscribed, owing to the distension of the synovial capsule with fluid; and is thus distinguishable from the smaller and more diffused swelling of ordinary rheumatic fever. In its history, too, it differs generally, as Dr. Macleod (*On Rheumatism, &c.*, London, 1842) has observed — affecting several joints, but commonly becoming more especially fixed in a limited number, and ultimately localized, and, in some cases, inducing permanent changes of structure, or disorganization. When death occurs in the acute stage, the joints are found to contain an increased quantity of synovia: when the disease has been more prolonged, distensions and nodosities are seen, similar to what occur in gout. Deposits are often formed in such cases on the cartilages of the joint,—which

Dr. Macleod found to be of urate of soda, as in gout. In cases of old synovial rheumatism, however, Dr. Chambers found them to consist of carbonate of lime. At times, suppuration has been observed in the joint; but these cases are rare.

Partial rheumatism of the joints, when of great intensity, is almost always of the capsular kind.

This form of rheumatism is said to occur generally in persons of feeble or debilitated constitution; or in the robust, after great and protracted mental or corporeal exertion. It is said, also, to supervene on gonorrhœa and other venereal affections, but in the latter case almost exclusively, according to Dr. Macleod, "where long-continued courses of mercury have been adopted." It is very rare for metastasis to take place to internal organs, and when it does, it usually passes to the pleura or membranes of the brain, and proves fatal in a very high ratio. Of 81 cases of capsular rheumatism, recorded by Dr. Macleod, 47 occurred in men, and 34 in women. These were much more equally diffused over the different periods of adult age than acute rheumatism, and much more prone to affect persons under forty than genuine gout; at the same time, it appeared to be more the disease of middle life than either rheumatic fever or muscular rheumatism; — from forty to forty-five years of age giving twenty-two out of eighty-one cases, or rather more than one-fourth, which is a much larger proportion than holds good with respect to either of the two others."

The average duration of capsular rheumatism was found to be more than twice that of acute rheumatism.

The general treatment, both internal and external, is that recommended under Rheumatism and Gout.]

What remains to be said respecting acute rheumatism, and the sequelæ occasionally left by it, will be more properly noticed in the division of the subject which treats of the chronic form of the disease, to the consideration of which we shall now proceed.

II. Chronic Rheumatism.

It would simplify the consideration of this form of the disease, if it were limited to that morbid condition to which analogy with the acute affection discussed in the foregoing pages would justify the name of rheumatism being applied. So many and various, however, are the derangements loosely classed under this generic term, that to give any history of the disease which should comprise the whole, would present a mass of confusion, if indeed it were not utterly impracticable. It has been too much the practice to pronounce as rheumatic every chronic pain of which the nature is obscure, or to which no other specific character is assigned. Practical writers have not overlooked this tendency; it is noticed by Heberden in the following very expressive passage: "Multi dolores quibus nomina nondum propria imposita sunt, quanquam inter se distent, ex causis longe diversis orti, tamen ad rheumatismum pariter referuntur." In order to ensure as much clearness as possible in the following observation, it will be expedient to commence with that modification of disease which, presenting all the essential characters of rheumatism, differs from the acute affection already treated of only in being less violent in its symptoms, and of longer duration.

The distinctive characters of this malady are a febrile state of the general system, with more or less of pain and swelling in certain tissues and joints. And in this, precisely as in acute rheumatism, the continuance of febrile action undermines the general health, while the local inflammation, however indolent, disorganizes the joints, occasioning eventual decrepitude. The pain and swelling of joints with progressive thickening of the ligaments, and effusion in the several bursæ, sufficiently evince the morbid actions from which such effects result. But, coincident with these will generally be found in the instances now referred to, evidences of constitutional derangement sufficiently marked to denote that a plethoric and febrile state of the circulation is also present. A quickened pulse, some increased heat of skin, and a furred tongue, are in greater or less degree the invariable attendants of chronic rheumatism of the joints so long as the disease in them continues to advance. It, no doubt, occasionally happens that in the course of time all febrile symptoms disappear, and the morbid action in the joints ceases to make further ravage. In such cases there is no longer rheumatism, but only the disorganization produced by it; and the distinction is important, for where such ravages alone remain, so far as they are concerned, constitutional remedies can be of no avail, and any treatment, to be effectual, must have special reference to the local lesions by which the free motion of the limbs is impeded. In the larger proportion of cases, however, the disease is strictly rheumatic, that is, it consists of a constitutional derangement having a febrile character, and of a local inflammation seated in the joints. This condition may be, and frequently is, the sequela of acute rheumatism; but it may be fully formed without any particular acute attack having preceded. Cullen regarded it in the former light, as appears from his definition of arthrodynia being introduced as "rheumatismi sequela." In the definition itself he somewhat incongruously represents this as ensuing to violent sprains and luxations, though why the pains resulting from such accidents should be deemed rheumatic it is difficult to imagine. In this definition, too, which ought to embrace every form in which chronic rheumatism presents itself, he states somewhat too positively the absence of fever and of swelling, — "pyrexia nulla, tumor plerumque nullus;" characters which do not apply generally to the disease, and which seem to have been introduced as an antithesis to the definition of acute rheumatism. This imperfection obliged him, when treating of chronic rheumatism, to enter into explanations rather at variance with his own definition, and in the following passage he describes more correctly and intelligibly the transition of the acute into the chronic stage. "The limits between the acute and chronic rheumatism are not always exactly marked. When the pains are still ready to shift their place, — when they are especially severe in the night time, —when at the same time they are attended with some degree of pyrexia, and with some swelling, and especially with some redness of the joints, the disease is to be considered as still partaking the nature of acute rheumatism. But when there is no degree of pyrexia remaining, — when the

pained joints are without redness, when they are cold and stiff,—when they cannot easily be made to sweat, or when, while a free and warm sweat is brought out on the rest of the body, it is only clammy and cold on the joints,—and when especially the pains of these joints are increased by cold and relieved by heat applied to them, the case is to be considered as that of purely chronic rheumatism." If the character of chronic rheumatism is to be derived from the most numerous and predominant instances, then we would say that the former of these descriptions is far more applicable to the disease, as generally met with, than the latter; for though all the phenomena recited as indicating the continuance of febrile and inflammatory action may not attend, it rarely happens that some or other of them are not present. As the former condition is capable of indefinite duration, for it may endure for years, and is hence strictly entitled to be called chronic,—it could not, where any distinction were made, be classed with the acute disease lately treated of; while, if it constitute any part of the chronic malady, a definition professing to characterize this ought assuredly to embrace it. Perhaps the more perfect representation of the disease, if it be necessary or beneficial to make any such distinction, would be to include both descriptions under arthrodynia, subdividing this into sthenic and asthenic. In this view the sthenic arthrodynia is by far the most frequent form in which the disease presents itself; and, what is no less important, it is that which, if unrelieved or improperly treated, is productive of the greatest mischief and of most distressing results; for under it the disease both local and constitutional, however indolent it may appear, is yet sufficiently active to continue and extend its peculiar ravages, deranging the general health, enfeebling and crippling the body through progressive disorganization of joints, and consequent wasting of muscles. In the asthenic form, the mischief is already done, and, however the body may suffer under the ravages sustained, there is no longer the active constitutional derangement inflicting further injury, which forms so essential a part of rheumatism. In the latter form there is little to do but support the general health, and remedy, as far as may be, the local lesions. But sthenic arthrodynia both admits of and demands more corrective treatment, the judicious, discriminating, and persevering use of suitable remedies being capable of accomplishing much, both in renovating health, and restoring power of motion to the still inflamed though rigid and contracted joints. With the consideration of this form we shall now proceed.

[The chronic form of rheumatism is often described as being frequently the sequel to the acute. This does not accord, however, with the experience of the writer. So far as his observation has gone, the subjects of acute rheumatism rarely suffer from the chronic form; and, on the other hand, persons who are constantly more or less crippled by chronic rheumatism may pass through life without suffering from the acute.]

It is a prevailing impression that a chronic disease cannot be inflammatory. How this originated it is needless to conjecture; but, however the misconception arose, it is a familiar truth that the term chronic conveys to most minds not the simple idea of duration, which alone it expresses, but something the opposite of inflammatory; some state to which the treatment proper for inflammation cannot be applicable. The pure chronic rheumatism of Cullen as described in the foregoing extract, is unquestionably of this latter character; but as the disease comprises, in addition to this, the subacute or sthenic condition also noticed by him, it is necessary to understand the term chronic, when its application is thus extended, in that restricted sense alone which rightly belongs to it.

Practitioners who are accustomed to regard chronic rheumatism as asthenic, and to treat it accordingly, are little aware of how long a decidedly inflammatory character may attach to it. Years may elapse, yet a distinctly febrile state, indicated by its appropriate phenomena, prevail, accompanied with evidences of disorganizing inflammatory action on the joints. And so long as this state endures, is there progressive deterioration of general health, and increasing structural derangement of joints. It gratifies the writer of this article to see this fact unequivocally stated by Dr. Elliotson, in his excellent clinical lectures delivered at St. Thomas's Hospital. He acknowledges the inflammatory character, and also the great length of time for which this may be retained, specifying this form of rheumatism as active in contradistinction to the term acute, which in its strict sense could not apply to it. The same character was long ago indirectly recognised by Sagar, when, in his definition of chronic rheumatism, he stated the blood drawn to exhibit a buffy crust. In this form, however subdued the symptoms may be, the characteristics of rheumatism, as they have been exhibited in the acute disease, are distinctly traceable. There is a febrile state of the general constitution, and more or less of inflammatory action in the joints; and the principles of treatment are precisely similar, though they require to be modified in their application so as to adapt this to the derangements, both constitutional and local, which need relief. It will assist in comprehending the real nature of this form of the disease to bear in mind what was formerly stated in treating of relative plethora. Certain delusive appearances were then noticed, as misleading practitioners from a right conception of the state of circulation or condition of health existing; and to similar delusions has it been owing that the febrile character of active or sthenic arthrodynia has been so frequently overlooked. An apparently feeble and compressible pulse induces the persuasion of debility; the enfeebled powers of the body sanction the conclusion; and relief is sought from a class of remedies which, in such case, cannot give other than transient relief, if, indeed, they do not aggravate every symptom. Were we sure that the doctrines of plethora formerly illustrated were rightly understood, we could at once close the discussion of the constitutional state prevailing in sthenic arthrodynia, by representing it briefly as that of relative plethora. It differs from the condition formerly described as relative plethora, only in having the local inflammations with their consequences superadded. In order to determine accurately this state of constitution, it is necessary

to judge, not from any one indication, but from that assemblage of evidences which, when collectively present, cannot mislead. The pulse, if alone trusted to, may deceive, at least where the practitioner is not on his guard against the delusive lowness of pulse which belongs to incipient plethora, or is unacquainted with the peculiar changes which the pulse undergoes when the congestive state is passing into that of febrile action. Though apparently low in force, it yet evinces some resistance to pressure, and is more or less quickened; the skin, too, is hotter than natural, and the tongue is white and furred. The gastro-intestinal membrane will also be found charged with redundant mucus, such as it generally secretes under febrile action. When all these phenomena are present, and especially when they are accompanied by evidences of local inflammation in the joints, no doubt need be entertained either of the nature of the disease, or of the principles of treatment. In this form of disease, then, it is obvious that the indications of cure are in no respect different from those which have been already shown as applying to acute rheumatism, namely, to subdue fever, and remove local inflammation. And the rationale of the practice suited for fulfilling these indications will be clearly perceived by those who have taken the trouble to comprehend the doctrines respecting the pathology of the circulation advanced in the article PLETHORA.

The constitutional state of sthenic arthrodynia bears the same relation to relative plethora that the acute form does to absolute; and in the principles of treatment laid down for the correction of relative plethora, with its concomitant disturbances, will be found the best guidance for conducting with precision and effect that of active chronic rheumatism. On the same principle as in acute rheumatism, it is the constitutional state which demands the first attention; for, unless this be radically corrected, all efforts to cure permanently the local ailments must fail, or be only of transient effect. In treating the constitutional disturbance, it is necessary to bear in mind that it is connected with relative rather than absolute plethora; that, consequently, the derangements existing are more complex, and that the practice must hence embrace considerations which it was not necessary to insist on particularly in discussing the acute disease. In acute rheumatism, active bloodletting was directed; the object being not only to reduce plethora, but to make speedy impression on febrile action, in order to arrest promptly the injuries which unrestrained continuance of this would occasion. In the more chronic form it is necessary to diminish plethora, but not equally so to make so speedy impression on febrile action. This latter requires to be regulated, but not extinguished; for some increased energies of circulation are absolutely necessary for correcting the concomitant derangements of function produced by defective capillary circulation. To restore the impeded circulation of the capillaries, and renew the secretory and excretory processes of which they are the agents, seems to be the final cause for which febrile action is instituted; it is assuredly the end which it often attains, and hence, when natural fever fails to accomplish it, we are accustomed to institute an artificial fever through the operation of mercury to effect the purpose. This, however, is not to be forced; it requires time for safe and salutary progress: minute vessels long obstructed cannot be all at once rendered pervious and efficient for the discharge of functions long disused; and hence, in treating the febrile state of chronic rheumatism, the practice, though corresponding in principle with that of acute, must be much less energetic. Bleedings must be of smaller amount and at longer intervals; a free state of excretion must be moderately but steadily maintained; and mercury must be employed for that renewal of function in the capillary vessels and their secerning extremities, which the powers of the constitution, unaided by mercury, are inadequate to accomplish.

It will be recollected that in relative plethora the redundancy of blood results more from its imperfect appropriation than from absolute excess; and that correction of this state requires, not only that the larger vessels be relieved from the load which oppresses them, but that the aggregate capacity of vessels be enlarged by renewal of the suspended activity of the capillaries, and also by promoting the natural expenditure of blood through the several secretions and excretions. These are the curative effects of febrile action; they constitute also the beneficial operation of mercury on the system, and on regulating them conformably with the views here displayed will the success of medical practice in a great measure depend, not only in this but in many other diseases. In the diseased state now under consideration, the first object should be to relieve the oppressed circulation, and thus arouse the energies of the system by taking away some blood; and in conducting this part of the treatment, judgment and discrimination are so requisite, that, even at the hazard of being deemed unnecessarily minute, we must dwell on the several circumstances from which any guidance can be derived.

If, with the general evidences of plethoric oppression and febrile action, the powers of the constitution be very low, and the pulse very feeble, it may be advisable to suspend for a while direct depletion, and to trust to purgatives. It may, in such case, be even expedient to employ gentle stimulants in order to arouse the dormant energies, and enable them to bear direct bloodletting; this being the end to which the use of stimulants should in this stage be directed. The necessity for this degree of caution, however, is not of most frequent occurrence. Much more generally may the curative treatment commence with small bleedings; and in these it should never be forgotten that the object is not to make impression on the moving powers, but to withdraw a portion of the circulating mass, and this with a view of arousing the natural powers to the discharge of functions required for the re-establishment of health. Small bleedings here suffice; and the extent of six or eight ounces will best answer the end designed. According as power increases, larger bleedings will be borne; but beyond twelve ounces it is rarely necessary to carry them. In general, even the first portions of blood drawn will be buffed, if not cupped; and under such circumstances the pulse, if previously low, will be found to rise

under bleeding. As was before remarked, a soft pulse is no contra-indication of bloodletting; for we continually find buffy blood and increase of power after venesection, where the previous softness and feebleness of pulse would, to unreflecting observers, appear to prohibit all direct depletion. This deceptive character of pulse is too often allowed to influence the practice even in acute rheumatism; yet it has been so often the subject of remark, that practitioners ought to be fully aware of it. Dr. Gregory, who in the treatment of acute rheumatism did not employ bloodletting indiscriminately, nor deem it essentially necessary, but who trusted rather to sweating as the preferable evacuation, used to acknowledge that he had been obliged to have recourse to bleeding after several weeks' duration of disease, where he had at first been apprehensive of employing it from the smallness and apparent debility of the pulse; and that after bleeding, the pulse rose and disease subsided. This is not peculiar to rheumatism, but a general fact connected with derangement of circulation, and worthy of attention in many diseases. The explanation of it has been fully and clearly given in the article PLETHORA; and if the principles there inculcated be duly regarded and discriminately applied, there will be little hazard either of bloodletting being withheld where it is needed, or of its being carried to any injurious extent.

Next to bloodletting, the most important evacuation is purging, which requires to be regulated both according to the degree of febrile action present, and to the state of the bowels as manifested by the stools. In proportion as fever is active will the free use of purgatives be required, and saline cathartics be needed in aid of those which more peculiarly deterge the mucous membrane of its morbid secretions; but so long as these continue dark, slimy, and unnatural, must suitable purgatives be assiduously employed. Pills of calomel, colocynth, and antimony, with occasional doses of sulphate of magnesia and senna, are the most effectual means of adequate purgation. According as active fever prevails, as evinced by a quick pulse, hot skin, and white or furred tongue, salines with antimony and colchicum, assisted by antiphlogistic regimen, should also be conjoined.

If under this treatment febrile action does not speedily abate, and local inflammation subside, mercury will be required, and for purposes similar to those for which its use was directed in acute rheumatism. According as fever is active will calomel and opium be necessary, for the proper administration of which no further instruction can be here needed, it being only necessary to observe, that as the morbid actions requiring correction yield more slowly than in acute rheumatism, a more slow and cautious administration of the remedy is here expedient. The direct agency of the medicine is to excite freer circulation in the capillary vessels, by which the larger vessels become relieved, both through the increased capacity thus given to the vessels through which the mass of blood circulates, and the increased expenditure of blood in the several secretions and excretions thus promoted. Whoever bears these facts and principles in mind, will experience no difficulty in regulating the administration of mercury in this or any other disease.

In many cases, however, febrile action, though sufficiently manifested by its appropriate phenomena, is less developed than in those just referred to. The pulse is feeble and irregular, the several secretory and excretory functions are inactive, and the whole frame displays a deficiency of power. Here stimulants are needed, and the most effectual for arousing the dormant energies is mercury. The milder preparations in small doses, repeated at intervals, are what should here be employed. The compound calomel pill, blue pill, hydrargyrum cum cretâ, are the remedies chiefly in use where a slowly alterative effect is desired. In old and obstinate cases minute doses of the oxymuriate have effect when other preparations fail. When the latter is resorted to, decoction of sarsaparilla is beneficially combined. Whenever mercury is employed for such purposes, it is highly necessary to watch closely the state both of the circulation and of the bowels. If under its use the arterial system becomes excited, and the pulse rises, becoming full, hard, or resisting, blood should be taken; and as mercury, when so administered, promotes the intestinal excretions, these should be assiduously evacuated by suitable purges, which in such case serve the double purposes of removing from the intestines a source of irritation, and of maintaining the excretories in an active exercise of those functions which so materially assist the curative process.

Under the foregoing treatment part of the local inflammation will subside without any topical remedies being applied. But as these inflammations have long reached the secondary stage, and as local derangements, such as were formerly noticed, have become more or less established, the local treatment suited to the special circumstances of each case is here indispensable. According as the local inflammation presents an active character, cupping or leeches will be required; and by these, with fomentations, or with cooling and sedative lotions, much impression may be made. Blisters, too, in time, are of much effect, especially where the bursæ are loaded with glairy effusion, the ligaments thickened and rigid, and the whole joint enlarged. To these changes all the joints are liable; they peculiarly occur in the wrists, where they materially impede the motions of the hands, rendering the patients very helpless. These swellings, when accompanied with heat and redness, require leeching and cold lotions; otherwise, repeated blisters are the means by which the enlargement can be best reduced, the effusions absorbed, the ligaments attenuated, and the flexibility of the articulations restored. In the intervals of blistering, stimulant embrocations are very serviceable; and frictions, especially the kind of manipulation termed shampooing, are of much avail.

In the inveterate cases which continually occur in practice, it is not any one remedy that can be relied on. The combined agency of all is required, and they should be assiduously employed in such succession and alternation as enlightened judgment may direct. By a judicious and steady use of them many a case, apparently hopeless,

may be restored to the enjoyment of good general health, and to considerable freedom of the affected limbs. Throughout the whole course of treatment warm bathing is signally beneficial, as is largely attested by the records and daily experience of the noble institution to which the writer of this essay is indebted for much practical knowledge—the Bath Hospital. It cooperates with the constitutional treatment to improve general health, promoting a free circulation in all the capillary vessels, and calling into renewed activity the highly important excretory functions of the skin, while its special effect on the pained and crippled joints is eminently salutary. For the latter purpose, pumping on the limbs, as it is termed, that is, directing against those affected a stream of tepid water, impelled with such force as to exert a mechanical influence on the part, is oftentimes a very powerful auxiliary. Even when general warm bathing is not admissible, this partial application of warm water may be used with much advantage for the relief of local ailments.

Subsidiary to these several means, one of the most effectual aids for restoring motion to rigid or contracted joints is the persevering endeavour to render them flexible by assiduous exercise; and the more this can be promoted through the appropriate muscles of the affected joints, the greater will be the benefit resulting; for the muscles previously wasted will thus recover bulk and strength, and through renewal of exertion will prove a most valuable instrument both in preserving and extending any power of motion that may be gained. Frictions and shampooing are a sort of passive exercise, and through this, as well as by promoting absorption and inducing a freer circulation in the extreme vessels, their effect on enlarged or rigid joints is considerable.

But even where, from great rigidity and extreme muscular feebleness, the joints are incapable of being exercised by their own proper muscles, the advantage derivable from passive exercise is not to be despised. Frictions and shampooing may lessen rigidity, so as to give more effect to the feeble muscles in their languid efforts. When the wrist and finger joints are affected, the parties may materially benefit themselves by moderate but continually renewed attempts to move the joints of each hand by means of the other. The joints may resist for a long time, but this should not discourage, and the slightest renewal of mobility should be hailed as the sure harbinger of further improvement. It is needless to urge this further. The principles are obvious, the effects proved by ample experience; and at all events perseverance in such endeavours, however little it may in extreme cases accomplish, holds out to the rheumatic cripple the only hope of recovering mobility in joints rendered inflexible by the effects of rheumatic inflammation. Attempts to restore mobility in such cases by internal medicines alone, is worse than fruitless. They may correct constitutional derangements where these coexist, and, by restoring general health, prevent further mischief; but they can have no effect in renewing either mobility or power to limbs so affected.

It has been shown that the secondary inflammation of acute rheumatism may survive the cause in which it originated. In like manner the local inflammation of chronic rheumatism may continue, although the febrile state which nurtured and aggravated it may have wholly subsided; and, further, the ravages of rheumatism in the joints may remain when all fever, as well as local inflammation, whether primary or secondary, has ceased to exist. Chronic rheumatism, therefore, may be said to present three conditions which deserve to be practically distinguished; — active fever with local inflammation;—inflammation unaccompanied with fever;—and structural derangements of joints unattended by either fever or local inflammation. Each of these conditions requires to be treated on principles applicable to its peculiar state; and any treatment adopted merely on account of its being specifically suited for rheumatism, must, if indiscriminately applied, be productive of much mischief.

There is another diseased condition often consequent to rheumatism, namely, a loss of nervous energy, which constitutes a modification of paralysis; but this demands a separate consideration, which belongs rather to paralysis than to the present subject.

The first condition of chronic rheumatism, or that which comprises both active fever and local inflammation, has been sufficiently discussed. The next in order is where the local inflammation, with the attendant pains and other derangements, endures after fever has subsided. This form also is of frequent occurrence, and it differs from the former in not requiring general bloodletting for its cure. Local depletion and occasional blisters constitute the principal topical treatment; and mercury with sarsaparilla and other such auxiliaries, is the chief agent for inciting the constitutional energies to cooperate in the cure. It is this form of the disease that has misled even intelligent practitioners into pronouncing that general bloodletting is not necessary in chronic rheumatism. Dr. Elliotson in his admirable clinical lectures has expressed himself of this opinion, and declared that he has relinquished general bleeding in active rheumatism, unless when some internal inflammation coexists. That in many such cases the treatment recommended by him, namely, local bleeding, colchicum, and mercury, will succeed without general bleeding, we were well aware; but we are no less assured that in very many it would prove very tedious, if not wholly fail. We consider, therefore, that Dr. Elliotson has stated this opinion somewhat too broadly; and that on reconsideration he will himself admit that the criterion for employing the lancet should be, not the presence of an internal inflammation, but such degree of plethora and febrile excitement as in itself demands direct depletion, independently of all coexisting local derangements. Topical bleeding, low diet, colchicum, and mercury, form a combination of influences which has great power in subduing febrile and inflammatory action; but if plethora exist to a certain extent, even their united agency will be insufficient, unless direct depletion be conjoined. And in such case it requires to be borne in mind, that, as has been already explained, the operation of mercury is not devoid of danger. When there is local inflammation without plethora or fever, the treatment recommended by Dr. Elliotson cannot be improved.

Even where plethora and fever exist only in slight degree, it may also succeed, although the progress will be slower than when venesection is conjoined. But when plethora and fever exist to any extent, then, even though there be no internal inflammation, general bleeding ought unquestionably to form part of the treatment.

Chronic rheumatism has been sometimes distinguished into hot and cold,—the hot being the active rheumatism of Elliotson, the cold the arthrodynia of Cullen. In the last, various stimulants are of much avail, and for the relief of such disease they should undoubtedly be resorted to. It is to be hoped, however, that their misapplication to acute or to any active rheumatism as the appropriate remedies, has passed away, or is confined only to ignorant empirics. It illustrates the difficulty of adapting treatment explicitly to the name of a disease, or even to special degrees of it, that there are modifications of active rheumatism in which even stimulants, cautiously administered, are not only safe but beneficial; and this circumstance confirms the necessity of all medical treatment being regulated, not by express rules, but by those principles from which all rules ought to emanate, and to which they ought to be subservient.

It would be vain to enumerate the various stimulants which have obtained character for the cure of cold rheumatism. The principal are essential oils drawn from resinous substances, such as turpentine; various balsams and gum-resins; the latter either in substance or in simple or ammoniated tinctures; sudorific decoctions; electricity. Any of these may benefit according as the general constitution is prepared for their operation, or as the special ailments may require. If there be no plethoric or febrile state present, their use will at least be harmless, if not beneficial; but should the case be such as to need depletory treatment and the operation of mercury, then must the use of such stimulants as are now named be watched with great caution.

Warm bathing and active exercise are among the unexceptionable and most powerful means of relieving chronic rheumatism. The local treatment formerly directed for the sequelæ of acute rheumatism also requires to be assiduously employed.

There are some affections generally regarded as rheumatic, which, however connected with rheumatism, seem to depend chiefly on a morbid condition of particular nerves. Of this kind are *sciatica* and *lumbago*, both of which differ so much in their symptoms from acute rheumatism, as scarcely to admit of their being classed under it. A mere error of arrangement, however, is of little consequence, as the same principles of treatment apply to all. If the state of constitution be such as to require for its correction bleeding, purging, colchicum, and mercury, these remedies must be employed, else the local affection will not readily yield. That sciatica arises from some lesion of the sciatic nerve or its investments, most practitioners are agreed. That this lesion results from a primary congestion or inflammatory action, seems evidenced both by the whole train of symptoms, and by the treatment most successful in giving relief.

When there is only the local affection to treat, repeated cupping or leeching, and blistering, with the warm bath, and a cautious return to exercise, will do much to effect restoration. Stimulant and sedative embrocations too, are occasionally of service.

In lumbago, though the spinal nerves affected are less distinctly indicated, yet the character of the pain marks it as more neuralgic than rheumatic. Free cupping and the general treatment of acute rheumatism will best succeed in relieving this disease.

But there is a form of neuralgia occasionally attendant on rheumatism which causes much suffering, and which does not seem to be generally understood. It occurs in paroxysms of great intensity, attended with a severity of pain which few can patiently endure. This may arise ere the febrile state has thoroughly subsided; and this circumstance is apt to mislead, for a continuance or removal of inflammation is thus apprehended, and depletory treatment is pursued, under which the disease is aggravated instead of relieved. The character of this affection is best denoted by the suddenness of the painful accessions. The nature of the pain, too, so different from that which attends inflammation, seems to distinguish it. For this affection the most certain and effectual remedy is iron; but it must be largely used, and assisted, if necessary, by full doses of opium. The carbonate is the best preparation, and this should be given in doses of two drachms three or four times a day. By administering it with equal parts of treacle, as directed by Dr. Elliotson, its constipating effects are obviated. Should opium be required, it should be given in full doses, and the best preparation for the purpose is Battley's sedative solution, of which from thirty to ninety minims may be given at bed-time without any sinister effect resulting. Under this treatment it may be necessary to purge occasionally with the common senna draught, which is sensibly improved by the addition of half a drachm of spirit of ammonia.

In the progress of rheumatism the chest is apt to become affected with pain and great dyspnœa, the distress being referred to the lower part of the chest, and described as if the point of the sternum were drawn back to the spine. This arises from the extension or translation of rheumatism to the diaphragm. The means of relief are bleeding, purging, and colchicum, with calomel and opium. So soon as the gums are touched, the distress finally ceases.

One of the most important affections connected with rheumatism is that in which the heart or its investments becomes the seat of rheumatic inflammation. This inflammation may be of the most acute kind, constituting complete carditis or pericarditis; or it may be only such increased action of blood-vessels as ultimately leads to hypertrophy. For the acute attack the most active treatment is required; full bloodletting, purging, antimony and colchicum, but above all the early and decisive operation of calomel and opium. If the latter be not speedily and effectually obtained in subserviency to bloodletting, this will be required to such extent as to render recovery extremely doubtful, sink greatly the powers of life, and occasion a very tedious convalescence. Some interesting cases of

rheumatic pericarditis have been recently published by Dr. Davis, the senior physician of the Bath hospital. He seems, however, to have trusted to general antiphlogistic regimen, without calling in the aid of mercury. The principles advocated in this article display the merits of mercury as an adjuvant; and the experience of the writer fully confirms their truth and practical utility. But independently of this acute seizure there is continually found in connection with rheumatism inordinate action of the heart, with evidences of actual enlargement or hypertrophy of that organ. The treatment of this affection, we can from much experience say, is best conducted on the principles inculcated in this article. Moderate bleedings are indispensable, the blood being almost invariably buffed and cupped. In judging of the state of circulation, the pulse at the wrist would mislead, for it may be soft and compressible even when the action of the heart is tumultuous. The carotid should here be examined as furnishing a more certain criterion. Free bowels and antiphlogistic discipline are indicated by the same necessity which calls for abstraction of blood. Mercury with opium is also required to produce its specific effects, by which alone the morbid action can be effectually or permanently subdued. The use of this requires to be cautiously conducted, for its slowest operation is that which is here most beneficial. The morbid condition is generally of slow formation; the changes wrought are not of a nature to be suddenly rectified; and attempts to accelerate the case beyond what nature permits, would beget mischief and lead only to disappointment. Cupping and leeching over the heart are valuable auxiliaries, and blisters are occasionally needed.

In fine, when inflammation both general and local is allayed, and the action of the heart still continues inordinate, or is too easily excited, the application of belladonna to the side, in the form of plaster, affords a valuable means of quieting the heart's motions, and of procuring rest from a disturbance which is always distressing.

[In this as well as in every form of rheumatism, the iodide of potassium, given in large doses, has been greatly extolled. (*New Remedies*, 4th edit. p. 396, Philad. 1843.)]

By the cautious adaptation of such means, and steady perseverance in their use, the disturbance of heart here treated of may in time be effectually relieved. Time, however, is required, for the disease yields slowly; and though impression be made on it by the early procedures, months may elapse ere perfect tranquillity of circulation can be restored. The patience, however, which can await this result, and pursue steadily the means of accomplishing it, will be amply rewarded.

There is one more form of rheumatism which requires to be noticed, namely, that which is called *rheumatic gout*; and so far as a name is concerned, this appellation, though only a popular term, is not misapplied. So much has this disease in common both with gout and with rheumatism, that it is scarcely possible to regard it otherwise than as a hybrid malady, in which the elements of both these diseases coexist. Its accession corresponds most with rheumatism; its ravages have a greater resemblance to those of gout. The enlargement of joints to which it is so prone presents much more of the character of gout than of rheumatism. Dr. Haygarth has described this disease, and proposed to denominate it *nodosity of the joints*. Of its history and treatment there is little to be said beyond what has been already advanced under the heads of gout and of rheumatism. It is more frequent in women than in men. Its commencement is often marked by active fever, and in proportion as this is disregarded or inadequately treated, are its ravages more severe and inveterate. But in many it advances by a slow and insidious progress, disorganizing the joints without materially deranging the general health. The local swellings long retain the character of active inflammation, being hot, red, and painful. They in general surround the whole joint, and, so far as mere touch can determine, they seem to arise from a general enlargement of all the structures constituting the joint. It seems strange that the structures actually enlarged have not been long since ascertained by actual dissection; yet we are not aware of any account of them, founded on anatomical examination, having been published. In 1805 Dr. Haygarth had not met with any such account, as appears from the following paragraph of his treatise: "In this disease the ends of the bones, the periosteum, capsules, or ligaments which form the joint, gradually increase. These nodes are not separate tumours, but feel as if they were an enlargement of the bones themselves. *This point might be anatomically ascertained without any difficulty or doubt.*" The disease, according to Dr. Haygarth, does not appear to shorten life; the first patient whom he saw so affected reached the age of ninety-three.

As to treatment, this must be regulated according to the state of constitution and local symptoms, and on the principles inculcated in this article. By local treatment much relief may be rendered. Frequent leeching has much effect in abating heat, swelling, and pain. In the purely chronic stage, successive blisters contribute much to reduce swelling and restore flexibility. As the hands particularly suffer from this malady, it becomes necessary to blister each finger separately, and even each joint; a process, which, however irksome, is yet ultimately recompensed by the increased power of using the hands which may be thus obtained.

[Under the name *Rheumatic Dermalgia*, Mr. Beau (*Note sur la Dermalgie*, in *Archiv. général. de Méd.* x. ii. 120, Paris, 1840) has described an affection characterized by the following symptoms. The head and lower extremities are the parts most usually attacked, but the pain does not remain in one place, often changing its seat gradually, and wandering from place to place. Two kinds of pain are experienced, the one enduring, the other intermittent and severe, resembling the prick of a pin or an electric shock, and recurring about every half minute. The enduring pain is often little more than an exaltation of the natural sensibility of the skin. Friction of the part with the finger, or with the patient's dress, always augments the pain; and if there be hair on the affected part, very severe suffering may be produced by passing the hand over the hair.

Rheumatism of the skin commonly alternates

with that form of the disease, which affects the muscular and fibrous tissues. Its usual duration is a day or two, after which it gradually subsides. It is said to be a more frequent occurrence among men than women, to be induced by damp, cold, and the ordinary causes of rheumatism, and, in general, not to require much treatment.]

E. Barlow.
[Robley Dunglison.]

RICKETS.—Rhachitis, Rachitis. The term *rhachitis* was derived by Glisson from the Greek ῥάχις (spine), because this disease affects, in an especial manner, the spinal column; but he acknowledges that he was induced to adopt this term from its near resemblance to *rickets*, a word by which the malady was commonly known in England even before his time.* The work of Whistler, and the remarkably clear and full account of rickets afterwards given by Glisson and his associates Bate and Regemorter, have procured a currency for their opinion that the disease made its first appearance in the western parts of England towards the middle of the seventeenth century, and have obtained for rickets among continental writers the designation of the *English malady*, (Morbus Anglicus, Maladie Anglaise, Englische Krankheit.) That rickets was never distinctly described by any medical author before the times of Whistler and Glisson, we readily admit; but that it was of such recent origin as the period stated above, we conceive to be quite inconsistent with the several terms in the Greek and Latin languages denoting deformity and decrepitude of the human body, and with the instances recorded in ancient history of persons so afflicted who were distinguished in various departments of letters and even in arms.

The essential characteristic of rickets is a softening of the bones; but the exact change which takes place in their structure, and the general symptoms by which this alteration is attended, are considerably different at different periods of life. Taking the term rhachitis in this extended sense, to which perhaps *osteomalakia* would be more properly applied, the disease may be divided into two species;—1st, softening of the bones of children, or common rickets; 2d, that of adults, mollities ossium, or osteo-sarcosis. Softening of the bones, like scrofula, is not unfrequently met with among the inferior animals. Thus Lordat dissected a rickety monkey; Bicherod found softening of the ribs of an ox (Act. Maris Balthici, 1707); Dupuy describes the skeleton of a rickety horse (Dupuy, De l'Affection Tuberculeuse); Mason Good (Study of Medicine, vol. v. p. 327) asserts that rickets occurs in the lion; and Comber has written a dissertation on the disease as it appears in sheep. (Letter on the Rickets in Sheep. Lond. 1772.) But to descend from the researches of the learned to the information of those who are observant of the manners and diseases of our domestic animals, curvature of the bones and swelling at the joints are not unfrequently seen in whole broods of young geese and ducks, when they have been continually exposed to cold and wet. The same affection is met with in young pointers, and more frequently in greyhound puppies, when kept in confined and cold damp kennels. In pigs, the same disease is in some places named krinckets; its causes are cold and moisture, and bad nourishment; and for its cure baths of hot grains are used, oily frictions, nutritious food, and removal to a warm and dry place.

* *David Whistler*, Dissertat. Inaugur. de Morbo Puerili Anglor. dicto "The Rickets." Lugdun. Batavor. 1645. This work, which preceded that of Glisson, is now exceedingly rare: a copy still exists in the Bodleian Library.

I. Rickets of Children.

1. **History.**—This disease rarely appears before the seventh month, and most commonly does not declare itself until the child first begins his attempts to walk, or until he suffers from the severity of the first dentition. Rickets has also been observed at birth, and in the fœtus: of the former Glisson (De Rachitide, p. 178), Henckel (Abhandl. Chirurg. Oper. Th. ii. p. 14), Klein, and Lepelletier (Maladie Scrofuleuse, Paris, 1830), have given examples; and of the latter Bordenave (Mém. de Mathemat. et Physique, tom. iv. p. 545), and Pinel.†

[Of 346 rickety children observed by M. Guérin, (*Gazette Médicale de Paris*, pp. 433, 449, 481, Paris, 1839,) 209 had been attacked with the disease at from one to three years old; three cases only had occurred before birth; and 34 at from four to twelve years of age. Girls appeared to be more liable to it than boys. Of the 346 individuals referred to above, 198 were females, and 148 males. (Guersant, art. *Rachitisme*, in *Dict. de Med.*, 2de édit. xxxii. 155, Paris, 1843.)]

When a child is about to be affected with rickets, he becomes dull and languid, the appetite is variable and capricious, the bowels are irregular, the stools unhealthy and usually pale. Constitutional disturbance now arises, and a febrile state is soon established: the limbs become emaciated, the belly tumid, the face full, and the head disproportionately large, the forehead projecting, and the sutures of the cranium remaining open or perhaps expanding slightly. The extremities of the long bones which are least concealed by muscle, as those of the wrists and ankles, and the sternal ends of the ribs, particularly these last, are swelled out into knobs. Some have doubted the tumefaction of the extremities of the bones in rickets, ascribing the appearance of swelling to the emaciation of the limbs; but an attentive examination of rickety cases has convinced us of the correctness of the former opinion. The firm texture of the bony framework of the body now begins to yield, and its increasing softness becomes apparent by the change of form which takes place. The sides of the chest are approximated by the combined operation or the pressure of the child's arms, the weight of the

† In Fourcroy's Journal, La Médecine eclairée par les Sciences Phys. tom. i. p. 111. This was the case of a rickety fœtus of eight months, in which the distortion was chiefly confined to the lower extremities. Farther illustrations of fœtal and congenital rickets will be found by referring to the following authorities.

Soemmering Abbildung, et Beschreib. Einiger Missgeburten, p. 30, pl. 11.

Otto. Seltene Beobachtung. I. Sam. tab. i. fig. 1.

Romberg. De Rhachit. Congenit. Berol. 1817, cum tabulis.

Sartorius. Rhachit. Congenit. Observ. 4to. Lips. 1826, cum tabulis.

Loder. Index Præparator. &c. Mosquæ, 1823. Sect. 11. D.

body when laid on its side, and the mode in which children are usually carried; and thus the sternum is made to project like that of a bird, or like the keel of a boat. The lower extremities bend under the weight of the body, while they yield at the same time to the action of the most powerful muscles: the knees are usually bent inwards and the feet thrown out, so that the patient when he walks rests on the inside rather than on the sole of the foot. At other times the whole of each lower extremity forms an irregular curve with its convexity looking outwards, and thus the knees, instead of knocking against each other, stand far apart. Among some of the native tribes of North America, this particular form of the limbs is esteemed handsome: and the utmost care is taken in early infancy to mould them by continued pressure into the admired shape, which, therefore, must not be regarded as any proof of the previous existence of rickets. In this disease the natural convexity of the thigh-bone is often so much increased as to form an elbow; and the angle between the neck and the shaft is converted from an obtuse to a right angle, or even to an acute one. The pelvis is usually deformed in the reverse direction of the chest, the pubes approaching to the sacrum; but in all cases where the pelvis suffers, its cavity is diminished, which to the female in after-life is necessarily attended with more or less dangerous consequences in the event of pregnancy. The vertebral column exhibits in a remarkable manner the effects of rickets in retarding the completion of the bones, and softening their texture: the spinous processes of the last dorsal and of the lumbar vertebræ are sometimes deficient, and the natural form of the spine is variously changed; its uppermost portion is often bent backwards, while the dorsal part projects into a hump, the loins fall in, and the extremity of the sacrum is unnaturally protruded: thus the gait of the hunchback, who has survived the severity of the disease, is stiff and formal, and the face directed upwards. The distortion of the arms of rickety children is usually outwards at the upper part of the humerus from the action of the deltoid, and in other parts also it is chiefly determined by the operation of the most powerful muscles; but much will depend on the positions in which the limbs may chance to be placed at the time when the bones are recovering their strength and firmness. Rickets is considered by some to produce little or no change on the bones of the cranium, face, hands, and feet. Those of the two last, we believe, are little affected; but the vertex in rickety children is, with few exceptions, unnaturally flattened, the centres of the parietals are expanded, and the forehead is prominent from an enlargement of the frontal sinuses: the bones of the face also appear in most cases to undergo some change of form, indicated by the shortness of visage and elongated under-jaw usually observed in those who have suffered from general rickets. In such children the process of dentition is protracted, and the teeth soon decay: the enamel of the permanent teeth is often craggy and worm-eaten, showing its imperfect formation, though sufficiently hard; but the fang during the progress of the disease has been found somewhat softer than natural. (*Wilson*, Lectures on the Human Skeleton.)

The rapidity with which the bones are softened by rickets is sometimes altogether extraordinary. Brunninghaüsen observed the whole of the bones in one instance become soft in the short space of six weeks, and the case proving fatal, he preserved the skeleton.

As the disease proceeds, the bones are readily fractured when even a slight force is applied, and it is remarkable that, softened as they are, they usually reunite: at length they become completely pliant. We have seen those of the fore-arm of a child of four years as flexible as a piece of soft gristle, bending with the weight of the hand whichever way it was turned. The muscles grow more and more flabby, the abdomen more tumid, the appetite becomes keen, and the bowels sluggish. The urine in rickets is rarely healthy, sometimes clear, but more frequently turbid, depositing a copious whitish or light brown sediment, indicating the very disordered condition of the digestive organs, and consisting in all probability of lithate of ammonia, with a large admixture of the phosphates. During the continued progress of rickets, the febrile excitement abates until its latter stages, when at length a regular hectic is established, and contributes by its perspirations and diarrhœa to exhaust and destroy the patient.

The intellect of the subjects of rickets generally possesses a degree of development far beyond what is usual in healthy children of the same age; the children exhibiting a quickness of perception and a fluency of language sometimes astonishing. In other instances, though much more rarely, they are taciturn and stupid, or even verge to a state of idiotcy. The frequent precocity of understanding has been ascribed to the expansion of the skull, and the earlier development of the brain consequent on that determination of blood to the head which appears always to exist at least in the first stages of rickets; but when this disease does not occur until the sutures of the cranium have closed, the same circumstance of an increased flow of blood acting on a part no longer capable of yielding has been assigned as the cause of the mental torpor or fatuity occasionally met with.

Almost all those who become rickety soon after birth perish, but many in whom the disease has appeared later recover before their fifth or sixth year; the general health gradually improving, the tumefaction of the abdomen subsiding, and the bones acquiring firmness, though retaining, with scarcely an exception, a certain degree of deformity. The head remains disproportionately large, the child preserving its acuteness and vivacity. At other times recovery takes place after smart febrile reaction, which is occasionally accompanied by the appearance of a cutaneous eruption. Sometimes the child at the approach of convalescence exhibits an extraordinary liking to particular articles of food. We have known the desire for common salt so strong that the little patient would devour it as others do sweetmeats. The quantity taken in one instance was very great, and to the parents it seemed as if the salt had proved the means of cure.

After the cessation of the disease, the bones acquire a degree of solidity and strength even greater than natural, and many persons whose form proves

that they were rickety in early years, are in after-life distinguished for robustness and activity. The deficiency of earthy salts in the bones, which existed during rickets, is succeeded by their excessive deposition; and that state is induced which has been named hyperostosis: the long bones become more rounded and massy; and the sutures of the cranium are often obliterated, and the lines of junction raised into flattened ridges. In some instances rickets has been followed after some interval by a remarkable tendency to the production of bony growths. There is related by the Bishop of Cork, in the Philosophical Transactions for 1740, 1741, the case of a man who had been so rickety in his youth that almost every bone in his body was distorted. At the age of eighteen he began to grow stiff, and at length, having lost all use of his limbs, he became like a statue: he survived till his sixty-first year, and at his death his skeleton was found to be one continuous bone from the top of his head to his knees. Many osseous growths, some of them of the most grotesque forms, branched from his head, back, and haunches; and a portion of fully-formed bone was also found imbedded within one of the large muscles.

Should the disease not yield before the seventh or eighth year, the individuals, if they survive, are condemned to a life of infirmity, which is seldom prolonged beyond middle age. Such persons suffer exceedingly from the unnatural pressure and displacement to which the organs of the chest, and even the most important of those of the abdomen, are more or less subjected. The stomach in these cases is frequently pushed as low as the umbilicus, and even the urinary functions have been disordered by a projecting vertebra pressing upon the kidney. These unfortunate individuals are remarkable for their shrill voice, dilated nostrils, and panting respiration; and life is generally cut short by one of those attacks of pulmonary inflammation to which they are peculiarly prone; at other times they are destroyed by the development of tubercular disease, and occasionally by dropsy.

In rickets, as in most chronic disorders, the change which takes place at puberty is productive of amendment, or of an increase of the disease. Ravaton has detailed a remarkable case, which serves well to illustrate this influence. A girl, whose legs were so deformed that at thirteen years she was only three feet high, was seized with continued fever; the catamenia appeared, the limbs then gradually straightened, and in less than three months her height was five feet one inch.

The progress of rickets is accelerated by confinement and exposure to cold and damp, by bad clothing, imperfect nourishment, and careless nursing; and retarded by circumstances the reverse of these: hence it may be that the disease is now of less frequent occurrence than in former times, and that it has been observed to make less progress in spring and summer, and to advance most quickly in winter and autumn. But the progress of rickets often varies without any obvious cause; it sometimes appears to be arrested as if recovery were at hand, then revive, and proceed with more rapidity than before. As the disease advances to a fatal termination, the little sufferer cannot bear even to be moved in bed, and the attempt is often productive of the fracture of some bone: hectic fever is now established, with its attendant colliquative perspirations and diarrhœa. At this period also, a variety of nervous symptoms sometimes present themselves; such as temporary deafness, or blindness, irritation of the bladder or inability to expel the urine, or paroxysms of epilepsy, or convulsions. Should these last not prove the cause of death, the patient at length sinks under debility, and dies exhausted.

On examining the bodies of those who have died while still labouring under rickets, the brain is found disproportionately large, but often in other respects quite natural; in some instances the ventricles are filled, or perhaps considerably dilated with a liquid fluid; and a similar fluid is also found in the basis of the skull and within the canal of the vertebræ. The cavities of the thorax and abdomen likewise sometimes contain serous or bloody liquid; the lungs are compressed and occasionally displaced by the alteration in the form of the thorax; marks of inflammation are often apparent in the pleura and pulmonary substance, which last is sometimes hepatized, and at other times contains numerous tubercles in various stages of advancement. It is remarkable that in some cases of rickety children from one to ten years old, the thymus gland has been found much enlarged, and the upper part of the sternum bulging out, so as to form a concavity, within which the overgrown organ was lodged. (*Lobstein*, Anatomie Patholog. t. i. p. 54.) The heart is not found diseased where death occurs during the active progress of rickets; but in those who have survived with deformity of the chest, the obstacle thus occasioned to the circulation, especially through the lungs, rarely fails to produce in the end hypertrophy of that organ. (*Hope*, on Diseases of the Heart, p. 194.) The liver and spleen of rickety subjects are almost in every case enlarged, the former in particular. The mesenteric glands are usually enlarged, and often filled with tuberculous matter; and the other absorbent glands, both within the abdomen and externally, present similar alterations.

In the soft parts little or no adipose substance is found; the muscles are pale, flabby, and wasted; and the rigidity of death is rarely met with in such subjects. The bones, during the active stage of rickets, are found to resemble very vascular cartilage; the medullary cavities are filled with a bloody gelatinous-like substance in place of marrow; and the osseous texture presents every where, even in the cortex, numerous minute cells, from which a thin bloody fluid can be pressed. The appearance of rickety bones has been well compared to that of a healthy bone deprived of its earthy materials by immersion in a weak acid; but there is this difference, that the rickety bone is much more vascular, and that the cartilage of which it consists is of so loose a texture, that it is soluble in the same acid which will deprive common bone of its earthy constituents. We are not acquainted with any analysis of recent bone affected with infantile rickets; and the examination of those which have been dried cannot afford much accurate information respecting the constituents of parts which obviously contain so unnaturally large a proportion of fluid and

easily destructible ingredients. Nothing, indeed, has tended so much to obscure the pathology of the bones as the almost exclusive practice of macerating and preserving them in a dry state. When the bones of those who have recovered from rickets are examined, their texture is found to be more dense, in consequence of a morbidly increased deposition of the earthy salts; even small exostoses and bony spiculæ are sometimes observed; and in cases where the spine is deformed, the bodies of many of the vertebræ are found united by new osseous substance. The bones of the cranium are observed to be much heavier and thicker than natural, the sutures often obliterated, and the grooves formed by the meningeal arteries greatly deeper than common. Wherever the bones have been bent during their yielding state, a larger deposition of earthy salts is observed in the interior of the curve where its weakness had been the greatest; and to such an extent does the deposit of osseous matter sometimes take place, that the bone at the point of curvature has been converted into a solid substance, the medullary cavity being wholly obliterated. (*Stanley*, Lond. Medico-Chir. Trans. vol. vii. See also Wilson's Lectures on the Human Skeleton.) Perhaps to some it may appear sufficient to say that the earthy salts are thus deposited, because they are most wanted at the weakest point of the bony shaft; but the real cause of this arrangement seems to be that the bending of the bone has compressed into the interior of the curve a larger quantity of cartilaginous substance, which is afterwards filled with an earthy deposit; while it stretches and attenuates that on the exterior of the arch, and so diminishes there the matrix for the reception of earthy materials. It may be observed also, that the effect of bending the pliant bone is to bring its opposite sides into closer approximation, and thus to prepare the way for that ossification throughout its whole diameter to which allusion has already been made. Bones which are distorted are commonly named rickety, whether in the active stage of that disease or after its cure, when they have acquired an unnatural density from hyperostosis: hence some confusion has arisen in stating the composition of rickety bones; and the assertion has been hazarded that a deficiency of phosphate of lime is not an essential, but merely an adventitious circumstance in rickets. Dr. John Davy found 100 parts of the dry tibia of a healthy subject of fifteen to yield 46.4 of animal matter, and 53.6 of earthy; while the same quantity of the dry tibia of a rickety child contained 74 parts of animal and 26 of earthy substance. (*Monro*, Elements of Anatomy, vol. i. p. 27.)

2. **Causes.** — Rickets appears under very different circumstances, and therefore may be supposed to derive its origin from a diversity of causes. It is met with among the children of the affluent, enjoying every advantage of careful nursing, warm clothing, nutritious food, and airy apartments; and it is found likewise in the damp unwholesome dwellings of the artisan and labourer, where the child is neglected, scantily clothed, and poorly fed. In the former of these classes it is almost always a hereditary disease, or if not, it exists in connection with a scrofulous habit transmitted from the parent: in the latter it may also arise from hereditary influence; but it seems more generally to originate from those unfavourable circumstances in the rearing of the child which have just been enumerated. Some writers have endeavoured to trace a connection between rickets and gout, syphilis, and scurvy; but it has not been satisfactorily shown that any of these diseases, either in parent or child, can operate as causes of rickets excepting by the debility which they may induce, and the predisposition to the malady which may thus be occasioned. Of scrofula, on the other hand, we would speak in very different terms; for the connection of this disease with rickets appears to be very intimate; although we are far from agreeing with Dr. Thomas Young in the propriety of classing rickets as a mere species of scrofula, *scrofula rhachitis*. (Introduction to Medical Literature.)

Rickets rarely occurs excepting in delicate and sickly children: instances are occasionally met with where robust children, born of healthy parents, have been attacked with the disease; but it may be questioned whether such cases were truly rickety, or if the yielding of the bones had not rather arisen from the great weight of the infant's body, and from too early endeavours to make him walk.

Many cases have occurred which prove the close connection which exists between rhachitic disease and affections of the encephalon, such as hydrocephalus and convulsions. Büchner (De Rhachitide in Haller. Disput. Medicæ, tom. vi.) relates that he saw almost the whole of a family of eleven brothers affected with rickets. Most of them died of the disease in an advanced stage, while the rest were carried off by convulsions.

Rickets has been observed to prevail in particular localities, probably from their unhealthiness, and the indigence and misery of their inhabitants. Hence it may be regarded as occasionally an endemic disease; it is so described by Glisson in reference to England, (De Rachitide, p. 3. Lugd. Batav. 12mo. 1761,) and instances are recorded where it assumed the same character in different parts of Germany. (Acta Nat. Curios. vol. ii. obs. 153. Ephemerid. Nat. Curios. cent. i. et ii. append. p. 23.)

3. **Treatment.**—During the existence of the acute febrile symptoms of rickets, it will be proper to administer moderate doses of antimonials, to employ the tepid bath, and in some instances even to apply leeches to the forehead or nape of the neck, according to the urgency of the case and the strength of the little patient. The impaired appetite, morbid stools, and disordered urine require the use of small doses of calomel or hydrargyrum cum cretâ; followed by magnesia and rhubarb, or rhubarb and soda, with an occasional dose of a more active aperient, such as castor oil or senna. If the disease have occurred at a very early age, it may be advisable to try the effect of changing the wet-nurse; and in general it will be proper to wean the child about the end of the ninth month, for protracted suckling is certainly one of the debilitating causes which dispose to rickets. While the child continues at the breast, the diet of the nurse ought to be carefully attended to, in order that her milk may prove

nutritious and easy of digestion: or its powers may be assisted by allowing the infant, in addition, small quantities of isinglass-jelly, beef-tea, or yolk of egg, provided the absence of febrile excitement will permit. After the child has been weaned, the diet must be suited to the degree of constitutional irritation which exists; but one leading principle should be to support the strength as much as possible without quickening the circulation or oppressing the stomach. Farinaceous food has been condemned by many writers as injurious to rickety patients, from its inferior nutrient properties; yet it will not be denied that, during the existence of febrile symptoms, the various preparations of starch will be found to yield a mild and appropriate nourishment. Whenever the state of irritation has so far subsided that a more substantial diet can be borne, it ought to be given freely, and even a little wine or sound ale may be allowed as long as it causes no morbid excitement.

In the second stage of the disease our principal objects in selecting the means of cure are, to give tone to the system, and improve its nutrient and reparative powers; and for these purposes the cold plunge-bath, the affusion of cold water with salt, careful friction of the whole body, and the employment of tonic medicines, will be found very useful. Among the tonics best adapted for cases of rickets may be enumerated sulphate of quinia, gentian, calumba, oxide of zinc, and various preparations of iron, of which, perhaps, the wine and carbonate are to be preferred. With many of these it will be found highly advantageous to combine the alkalies and alkaline earths, the choice of some of them being determined by the state of the bowels and the rapidity or languor of the circulation; carbonate of soda being preferable when the bowels are relaxed, and carbonate of ammonia when the action of the heart is languid. In rickety cases, where the nervous energy appears defective, it may be proper, in addition to the means of invigorating the frame already enumerated, to employ electricity or galvanism, but in a very cautious manner.

The clothing of the child ought to be warm, and great care should be taken to preserve it free from damp. The apartment in which he sleeps should be dry and well ventilated, and his residence should be in a pure temperate atmosphere, either in the country or on the sea-coast; and when the weather permits, he should be carried about in the open air as much as possible. When the rickety child is carried, it should be alternately in either arm; and when placed in a chair or laid in bed, his position should be such in regard to the various objects of attraction around him, that he shall not incline continually to one side only; or so varied from day to day, that the formation of any fixed deformity may if possible be prevented. His bed should be smooth and comfortably firm, and the head but little elevated; the bed-clothes light, yet sufficiently warm. As soon as the constitution appears to be rallying, and the bones acquiring renewed strength and firmness, attempts should be made to restore them to their natural shape by well-directed manipulations, and the employment of such mechanical contrivances as will give support without injurious confinement. Considerable success is known to have attended the treatment practised by the Baron Dupuytren (Répertoire générale d'Anat. et de Phys. Patholog. tom. v. p. 198,) in deformity of the chest. His plan is to place the child with his back against the knee or a wall, and make moderate and gradually increasing pressure with the palm of the hand on the sternum, so as to diminish the antero-posterior diameter of the chest, and force out the ribs towards their natural convexity. This practice is repeated day after day very frequently, and at suitable intervals, with increasing force and for a longer time, augmenting and relaxing the pressure so as to suit the movements of respiration; until at length, after long and careful perseverance, the natural shape of the thorax is to a certain extent restored.

II. Rickets of Adults.—*Mollities ossium.*

1. **History.**—The softening of the bones which is met with in persons of adult or advanced age, presents itself in various degrees of severity. Sometimes it is merely a protracted form of infantile rickets, which has continued with numerous checks and interruptions, and successive revivals and increase of symptoms, even to advanced life. On other occasions, and these are not rare, softening of the bones occurs during pregnancy or follows parturition, and increases in severity during each successive gestation. The parts of the osseous system chiefly affected in these cases are the spine and the pelvis; hence the difficulties of childbirth are usually augmented at every succeeding confinement. But the disease has been observed in its most aggravated form among males as well as females, although certainly more often among the latter. Several notices of this intense form of mollities ossium are to be met with among the early historians and biographers of modern times: thus Abbon, the monk, who lived in the ninth century, relates an extraordinary instance where a very large man was reduced by it to the diminutive size of a child. (Guerres de Paris.) And Abulfedda asserts that the body of the prophet Gatleb was without bones, so that his limbs could be folded up like a garment. (Vita Mohammed.) Perhaps the first medical writer who has made mention of mollities ossium is Hollerius (De Morbis Internis. Rara Quædam, No. 7. 4to. Paris 1609): he states briefly that there was a woman in Paris whose whole body was soft and flexible, and without solid bones. The next case on record, and it is a well-marked and interesting one, is that detailed by Abraham Bauda, which occurred at Sedan in 1650. (Microcosmus Mirabilis. Sedan, 1665.) Since that period many instances of mollities ossium have been published in different countries, references to the most important of which will be found in the present article.

The softening of the bones in this disease is preceded by severe and long-continued pains, which are usually confounded with rheumatism, and have sometimes been supposed to arise from syphilis: a gradually increasing debility seizes the limbs, the nervous system acquires an excessive morbid irritability, the patient walks with the utmost fearfulness, and the slightest jar or con-

cussion of the body causes agony.* Some bone now suffers fracture, which all the efforts of the surgeon are perhaps unable to unite; the patient being constantly confined to bed, the bones soften more and more, assume the most strangely distorted forms, and before death have in some cases been so completely disorganized that the extremities were as limber as a rag. (*Bevan*, in Philos. Trans. v. 42.) The patient lies coiled up in bed, sometimes scarcely preserving, except in countenance, the semblance of a human being; the limbs appearing more deformed, and the stature much more shortened than they are actually found to be after death. Every attempt to alter the position of the patient produces agonizing pain, and perhaps new fractures, if the bones be not already too much softened to snap asunder. In such circumstances it is truly astonishing to observe how little the general health suffers, the appetite, digestion, and excretions remaining unimpaired till within a few weeks of death, and the mind continuing calm and intelligent, almost to the last. The urine in such cases is frequently turbid, depositing a copious white sediment; and in some instances small urinary calculi have been voided. But this morbid state of the urine is not constant, for it becomes clear and then again turbid, and occasionally clear for weeks before death. At length hectic fever comes on, sometimes with a feeling of intense burning heat, such that the patient can bear with difficulty the thinnest covering, and requires the windows to be kept open even in the middle of winter.† Diarrhœa and perspirations now exhaust the patient, and death at length, after years of protracted suffering, comes to his relief.

The appearances on inspection after death from mollities ossium differ considerably from those which are observed in the bodies of rickety children. The bones, instead of presenting the appearance of cartilage, as in rickets, are reduced to a mere shell resembling the rind of cheese, and are sometimes described as soft and membranous, and of the thickness of the peritoneum; in one instance the form of some of the bones seems to have been preserved merely by the periosteum;‡ and in the case related by Saviard, (*Saviard*, Nouv. Recueil d'Observat. Chirurg. p. 276,) the remnants of the bones are described as crumbling between the fingers like the rotten bark of a tree. The cavity within the changed and wasted bone has been found filled with a soft red or liver-coloured substance, which in the living body has been ascertained to be devoid of sensibility, (*Thomson*, Med. Observ. and Inquiries, vol. v. p. 259); at other times the contents have been a reddish fluid of the consistence of thick honey, and free from any disagreeable odour. (*Bevan*, Phil. Trans. vol. xlii. p. 488.) In Mr. Howship's case (Edin. Med. Chir. Trans. vol. ii.) the contents of the wasted bony shell were various in their appearance: one mass resembled coagulated blood, another gorged liver, a third light fibrinous matter, and a fourth was like compact fleshy substance. The last portions of the long bones which undergo these remarkable transformations are the extremities; and the remnants of osseous substance which they present are found softened and honey-combed with numerous irregular apertures, appearing, when macerated, like a thin piece of ice when partly melted; thus affording unequivocal evidence of the powerful action of the absorbent vessels to which the osseous tissue had been subjected. The cartilaginous coverings of the articular extremities of the bones have sometimes been found entire, at other times attenuated, but the surface polished and raised into eminences; the cavities of the joints sound; and even when unused for six years, filled with healthy synovia. (Case by Thomson, Med. Obs. and Inquiries, vol. v.)

Although fractures of the bones have not appeared during the life of the patient to have united, yet after death a callus has occasionally been found to have formed, sometimes only within the cavity of the disorganized bone, occupying it completely at the point of fracture; at others it has appeared externally as a prominent ring, and formed within a solid osseous partition, (*Planck*, de Osteosarcosi Comment); thus proving that the solution of continuity had served to restore to the part its ossific powers while they were everywhere else deficient. The muscles, in cases of mollities ossium, are found pale, and in general totally altered in their appearance, so that it would be quite impossible from their adhesions and displacement to unfold them by dissection. The viscera of those who have died of this disease have sometimes been found quite healthy, (*Saviard*, Rec. des Observ. p. 276. — *Howship*, Ed. Medico-Chir. Trans. v. ii.); and in most of the cases they are not stated to have suffered much serious alteration; in one instance indeed the liver was enlarged, (*Bevan*, Phil. Trans.); in another the gall-bladder was contracted, and contained no bile, but many minute black calculi. (*Thomson*, Med. Ob. and Inq.) It is obvious, however, from the histories of other cases, that the lungs and mucous membrane of the bowels must in these instances, if carefully examined, have presented abundant traces of active disease.

2. The **Causes** of mollities ossium are exceedingly obscure: syphilis, gout, rheumatism, and scurvy, have all been accused as the sources of this singular disorganization of the solid framework of the body. The sagacious Saviard observes that syphilis produces caries; but this is a softening and melting down of a totally different nature: as to the other diseases named above, they possess nothing in common with that now under consideration, excepting pain, languor, and debility. In well-marked and extreme cases of syphilis, gout, rheumatism, and scurvy, where death has been the result, we do not meet with mollities ossium as a concomitant, yet authors gravely tell us that softening of the bones arises from the diseases now enumerated lying hid in the constitution and tainting the habit. This

* See a very interesting case by Mr. Howship, Ed. Med. Chir. Trans. v. ii.

† *Planck*, de Osteosarcosi Commentatio, 4to. Tubing. 1782. This writer has been quoted as an authority on osteosarcoma, but his essay refers wholly to mollities ossium, of which it contains a very interesting case with an able and learned commentary.

‡ Case of Madame Supiol, *Moraud*, in Mem. de l'Acad. R. des Sciences, 1755.—*Hosty*, in Phil. Trans. 1753, 54. — *Bromfield*, Surgical Cases, vol. ii. p. 35. Here she is called Queriot, her maiden name. The skeleton of Madame Supiol is still preserved in the Museum at the Jardin des Plantes in Paris.

affection appears to be closely connected with an enfeebled and relaxed state of the system. Long confinement to bed, after acute diseases in young persons, is often productive of some degree of softening of the ligaments and bones, and consequent deformity; we have seen the pelvis in a delicate boy, after tedious convalescence from measles, elongated diagonally, producing great deformity and lameness; in old age, we have known a lady, who was long bed-ridden, fracture her clavicle by the mere effort of attempting to raise herself in bed by the help of a cord. Indeed, the progressive alteration which the bones naturally undergo in advanced life is itself an approximation to decay, the cortical part becoming thin, and the medullary cavity enlarging; but the former still preserves its hardness of texture. A careful examination of the bones, after a long period of inaction, shows that their healthy state is almost as much dependent on the due exercise of the muscles as that of the muscles themselves. In the vegetable kingdom we see the effect of exercise remarkably exemplified by the increase which it occasions in the bulk and density of the woody fibre. The wood of forest-trees which have stood alone, and exposed to the full force of the blast, is much closer in its texture and more durable than timber raised in natural groves or crowded plantations; and the size and strength of the roots of trees is always much greater in the side which stands exposed to the prevailing wind.

Females are much more liable to mollities ossium than males; and pregnancy and parturition favour in a remarkable manner the progress of the disease. Under such circumstances, the weight to be supported, the drain of nourishment for the supply of the fœtus, and the distending throes and exhausting consequences of labour, must all prove powerful causes of relaxing the connections of the bones and lowering the strength of the system. Softening of the bones is observed to occur most frequently in persons of a strumous habit; and this peculiarity of constitution may be fairly regarded as forming at least a strong auxiliary cause in the development of the disease.

3. **Treatment.**—Mollities ossium, unlike the rickets of children, occurs at a period of life when the reparative powers of the system have lost their early vigour, or perhaps when they are already in a state of decay: hence a cure of this disease very rarely or never takes place; but it may proceed with greater or less rapidity, and may be checked in its progress by judicious management. We have been unable to discover any case of mollities ossium in which a satisfactory cure has resulted, either from the unassisted efforts of nature or from medical treatment; but instances of the milder form are known to us, where the disease has proceeded slowly for years, and some of the individuals have attained even an advanced age. The influence which pregnancy has been observed to exert in accelerating the progress of mollities ossium, renders it necessary that the patient should live as in a state of celibacy; and every thing which tends in any degree to weaken the frame ought to be carefully avoided. Frictions of the whole body, gestation in the open air, nutritious diet, mild tonics, great attention to the state of the digestive organs, and removal to a dry, warm, and pure atmosphere, are the principal points to be attended to in our endeavours to arrest the progress of this disease. Benefit is likely to be derived, also, from sponging the body with sea-water, or the strong acetic acid obtained from wood; and if the strength be not too far reduced, the cold shower-bath, or sudden immersion in sea-water, may be tried with caution.

Before concluding our account of the several species of softening of the bones, it is proper that we should say a few words on the subject of lateral curvature of the spine, which of late years has engaged so large a share of the attention of medical men of both branches of the profession. In rickets, the curve assumed by the spine is, with few exceptions, confined nearly to the mesial line; and in mollities it is sometimes so, and sometimes lateral; but a very large proportion of the cases of lateral curvature of the spine are wholly independent of both rickets and mollities ossium, and arise from debility or habitual malposition of the body, such as are too often induced by the restraints and fatigues to which young persons are subjected in the course of education. (*Shaw*, Essay on the Nature and Treatment of Distortions of the Spine and Chest.) Hence arise sinking of the spinal column into the flexures naturally assumed under feelings of languor and exhaustion, and twisting of a part of the vertebræ upon their axes: after a time they remain stationary in their new situations, both the ligaments and muscles being so changed that the latter are no longer capable of restoring the bones to their proper positions. Thus, lateral curvature becomes established, and the figure of the patient is permanently deformed.

On examining after death the individual bones of the spine in such cases, we often find them quite healthy and natural in their form, but more or less twisted upon their axes: in some instances we have seen traces of inflammation, and new bone formed uniting them to each other; and, more rarely, we have observed the bodies of the distorted vertebræ somewhat attenuated and expanded in the interior of the curve where they were most exposed to pressure—a change which was probably the effect rather than the original cause of the deformity.

The treatment of lateral curvature of the spine falls chiefly within the province of the surgeon; but it will be the business of the physician to direct the application of those means which tend to restore the general health of the patient, and thus render effectual the exercises and training, the manual efforts and mechanical contrivances of the surgeon, which would otherwise prove unavailing or injurious. A carefully regulated diet, strict attention to the bowels, mild alteratives and tonics, relief from the restraints of education, and removal to a pure air, friction of the body, gentle exercise in a carriage or on foot, sea-bathing, or the cold shower or plunge-bath, or tepid or warm bathing according to the circumstances of the case, constitute the principal remedies by which the physician is enabled to lend effectual assistance in the treatment of lateral curvature of the spine.

W. Cumin.

ROSEOLA.—This term is applied to a cutaneous efflorescence of a rose colour, not sensibly prominent, usually preceded and accompanied by mild febrile symptoms. In some cases the rash is diffused generally over the skin, but frequently it is partial or limited to certain regions of the body, as the face, neck, trunk, or extremities; in which situations it occurs in patches variously figured, and of more or less extent. It has not unfrequently, especially by the older writers, been mistaken for measles or scarlatina; hence, probably, originated the notion, which many entertain, that scarlatina, unlike other exanthematous fevers, may occur more than once in the same individual.

Roseola is generally preceded by smart feverish symptoms—irregular chills alternating with heat of skin—pain in the head and limbs—languor and lassitude—and sensation of faintness. After these symptoms have continued for a few days, the rash appears first on the face and neck, spreading in a day or two afterwards over the whole body, and is generally attended by tingling or itching. When it first comes out, the eruption is of a bright red, but it soon assumes its characteristic rose colour. It begins to decline about the third day, and on the fourth, a few dark red specks are only perceptible, which wholly disappear on the fifth, at which period the whole disorder in general terminates.

From the redness and sensation of roughness in the throat, it would appear that the efflorescence extends over the mucous membrane of the mouth and fauces; and this circumstance tends to render the diagnosis between roseola and scarlatina more obscure.

The efflorescence is not always so generally diffused over the skin; in many cases it is partial, appearing only in patches on the face, neck, breasts, or shoulders: it frequently recedes and comes out again, its recession being followed by symptoms of gastric disturbance, which cease when the rash re-appears. The recession and reappearance of the rash cannot often be traced to any evident cause, though in many instances irregularities in diet and other indiscretions have been supposed to be powerful agents.

Though roseola may occur at any season of the year, it is more frequently observed in summer, (*Roseola Æstiva*,) and is usually attended by smart feverish symptoms. On the first day the eruption is very liable to be mistaken for measles; but the peculiar character of the eruptive fever, the absence of the catarrhal symptoms, and the form, colour, progress, and duration of the rash, are sufficient to distinguish the two diseases. The rash, which is accompanied by sensation of itching or tingling, is observed first on the face and neck, and in the course of twenty-four to forty-eight hours spreads over the whole body. The spots are distinct and scarcely prominent, of a circular or oval form and deep rose colour, the intervening portions of the skin preserving their natural appearance. The patches are at first very small, but gradually increase in size. The duration of this form of roseola is from three to four days, unless, as sometimes happens, the rash reappears at irregular intervals, and then its course may be protracted indefinitely. It generally disappears without sensible desquamation of the cuticle.

A similar form of roseola is occasionally observed in autumn (*Roseola Autumnalis*). It differs from the preceding in being unattended by itching or tingling, or feverish indisposition, and in the eruption appearing chiefly if not exclusively on the arms.

Another variety of roseola has been described by Willan (*Roseola Annulata*), in which rose-coloured rings, with central areas of the natural colour of the skin, appear on almost every part of the body, attended with sensation of heat, pricking, and tingling, especially during the night. The eruption, which is preceded by symptoms of acute fever, rigors, headach, flushing of the face, nausea, and pain of limbs, may last four or five days, and disappear as the feverishness abates; or, as now and then happens, it may be unattended with fever, and be of much longer duration. In these latter instances the eruption generally appears most vivid in the evening, or when the individual becomes warm in bed, and continues till morning, when it fades. It is sometimes also sensibly elevated, and very often, more especially when the eruption suddenly recedes, attended with considerable gastric disturbance.

Though roseola is not confined to any period of life, it is a frequent cutaneous disorder of infants, more especially during dentition, derangement of the bowels, and various infantile diseases attended with fever (*Roseola Infantilis*). Dr. Willan states that this efflorescence continues in some instances for a night; in other cases it appears and disappears for several successive days, being attended with symptoms of violent irritation. He has seen, even in infants but a few days old, an efflorescence on different parts, in numerous coalescing patches, rounded, though not exactly circular, of about the size of a sixpence, and of a strong red colour. These continue five, six, or eight days, with a slight elevation of the cuticle, and terminate by desquamation, but are not always attended with constitutional disorder. Occasionally during the first stage of dentition, a single patch of efflorescence appears on one arm or on the neck: it remains three or four days, then disappears, and is in a short time succeeded by another, perhaps on the opposite arm. This fades and disappears in about the same period, when a fresh patch arises in another place, and thus the eruption may be continued two or three weeks.

Roseola occasionally occurs also previous to the eruption of both the natural and inoculated small-pox, but seldom in the former; and when it does occur in connection with the natural small-pox, it always indicates a severe and often fatal disease, though some inoculators deemed it an indication of a favourable variolous eruption. The early writers on small-pox observed this roseolous efflorescence, which they regarded as measles converted into small-pox. Dr. Willan, who applied the term *Roseola Variolosa* to the rash when it occurred in connection with small-pox, states that it appears in about one case of fifteen in the inoculated small-pox, on the second day of the eruptive fever, which is generally the ninth or tenth after inoculation. The rash is first observed on the face, breast, and arms, and on the following day spreads over the trunk and lower extremities. It sometimes assumes the form of oblong irregular patches; in other cases it is diffused with nu-

merous interstices; and occasionally it extends over the whole body, so that the skin presents a continuous redness, with slight elevation in some places. The rash continues about three days, on the second or last day of which the small-pox pustules make their appearance, and may be distinguished in the general redness by their prominence and hardness.

A similar efflorescence, but appearing generally in a congeries of dots and small patches, and slightly elevated, takes place in some children about the ninth or tenth day of vaccination, and about the same time that the areola forms around the vesicle. To this rash, which spreads irregularly over the surface of the body, Dr. Willan gave the name *Roseola Vaccina*. It is generally attended with slight febrile indisposition, though from the statement of Dr. Jenner it would appear to be seldom observed, as his notes did not furnish him with a single instance of it, nor did he recollect in any case more than one or two slight patches of redness, which very soon disappeared.

Lastly, roseola sometimes appears in connection with various acute disorders—miliaria, various forms of continued fever, acute rheumatism and with gout. When it occurs under such circumstances, it is to be regarded merely as an accidental complication or concomitant.

Though attention to the appearance of the efflorescence and the constitutional symptoms by which roseola is accompanied will seldom leave any doubt as to its nature, there are some acute eruptive disorders which it resembles in some particulars, and from which it must be distinguished.

Measles may be discriminated by the catarrhal symptoms which precede and accompany the eruption, which generally appears on the fourth day of the eruptive fever, and declines about the seventh or eighth; by the crescentic form and vivid red colour of the rash; by the tendency to bronchial or pulmonary inflammation during the course of the disease, and by its being propagated by contagion. In roseola, the patches are larger, more irregular, and more varied in their form; the eruption disappears after four or five days' febrile indisposition, is not preceded nor followed by any peculiar local inflammation, and is never communicated by contagion.

In scarlatina, the bright red or scarlet colour of the eruption, which is more generally diffused, and more evident about the flexure of the joints; its appearing on the second day of the eruptive fever; the peculiar appearance of the tongue; the affection of the throat when it exists; the desquamation of the skin at the decline of the rash, and its propagation by contagion, will seldom fail to distinguish it from roseola.

It is scarcely possible to mistake roseola for erythema, in which the diffused or continuous redness of the skin without any distinguishable efflorescence, the trifling amount or total absence of constitutional disturbance, and its being generally symptomatic of some other affection, render the discrimination sufficiently easy. (See ERYTHEMA.)

The treatment of roseola includes the adoption of an antiphlogistic regimen modified according to circumstances. The little constitutional disturbance with which it is usually accompanied, and the comparatively slight irritation which it in general induces, render any active measures unnecessary. All that in the majority of instances is required, is to keep the patient cool, to prescribe light diet and acidulated drinks, to administer from time to time a mild aperient; and as the mineral acids have been found useful, they may be ordered according to the feelings of the practitioner. Dr. Bateman was of opinion that the decline of roseola was expedited by the use of sulphuric acid in the infusion of roses, or the infusion of gentian, in combination with small doses of sulphate of magnesia. The occasional employment of the warm or tepid bath may be conjoined with these measures.

When roseola occurs as a complication of some internal disorder, the treatment must be directed to the removal of the disease of which it is merely symptomatic.

A. TWEEDIE.

RUBEOLA, *Measles*, derived from rubio, *red*. This word appears to be of Spanish origin, and probably emanated from the school of Cordova: it was formerly written *rubiola*, or *rubiolo*. Another term by which this affection has been designated is *morbilli*, or the minor plague, being the diminutive of *il morbo*, as the Italians called the plague. The restriction now adopted in the application of the term rubeola is of rather modern date, and owes its establishment to Sauvages, before whose time great confusion prevailed in the naming of several of the exanthemata: rubeola, in particular, was used to signify equally scarlet fever and measles. A similar inaccuracy was to be found among the French writers also, for the word *rougeole*, their common name for measles, meant at one time *scarlatina*, and that so decidedly, that when it was thought necessary to apply distinct names to the two diseases, in consequence of the difference between them becoming fully understood, Chevenan informs us that the Marsellois used the word rougeole to signify scarlatina, and distinguished measles by the name of senapion. (Obs. Med. 454.) In our own country, Morton maintained the identity of these two exanthemata, and considered the relation existing between them the same as that between distinct and confluent small-pox. (De Morbillis et Scarlatina, Exercitat. iii.) Even so recently as 1769, Sir William Watson confounded these two diseases, (Med. Obs. and Enq. vol. iv. p. 132,) the correct diagnosis between which ought probably to be referred to the time of publishing the second edition of Dr. Withering's Essay on Scarlet Fever in 1793. But this was by no means the only or the most remarkable inaccuracy which in former days prevailed on this subject, since we find Sennertus, in the middle of the seventeenth century, discussing the question "why the disease in some constitutions assumed the form of small-pox, and in others that of measles," (Medicin. Prac. lib. iv. cap. 12); and in a posthumous work of Diemerbroeck, published in 1687, it is laid down that small-pox and measles are only different degrees of the same affection; "Differunt (morbilli) a variolis accidentaliter, vel quod magis et minus." (Tract. de variolis et Morbillis, cap. xiv.) The same doctrine was still more recently maintained by Lange, a professor at

Leipsic: "Præterea tam morbilli quam variolæ sunt eruptiones in eo duntaxat discrepantes, quod vel minus vel magis appareant," &c. (Miscell. Med. Curios. § xxxiv.)

Later and more accurate investigations have very clearly shown the distinction that exists between these diseases, not only in their essential characters, but also in the treatment which they require; so that we no longer hesitate in separating them, or feel doubtful as to the elements of a correct diagnosis between them.

By the term rubeola, or measles, in modern times is understood a contagious inflammatory disease, affecting at once the skin and gastro-pulmonary mucous membrane, in which, after catarrhal fever has continued about three days, a rash appears on the skin, at first in small stigmatized dots, not unlike flea-bites, which presently coalescing, form patches of a crescentic or semilunar figure, first on the face, and thence spreading gradually downwards over the whole of the body and limbs, at the end of four days disappear by desquamation of the cuticle.

Rubeola occurs at every period of life, but infants and persons of advanced age are less frequently affected by it than those of the intermediate stage. In childhood and adolescence, however, the disease is most common. It is asserted by Rosen, Vogel, and others, that infants have been born with the traces of measles. Guersent mentions (Dict. de Méd. tom. xviii. p. 513) having seen an infant born with measles on it, having taken the disease from the mother; but we presume such instances must be of exceedingly rare occurrence.

Measles are not unfrequently epidemic; they generally prevail from the beginning of spring to the vernal equinox, and decline about the summer solstice, though this is only a general observation to which numerous exceptions occur. It has been frequently observed that whenever measles rage as an epidemic, small-pox prevails at the same time; and generally speaking, the rubeolous contagion, if received into the system previous to that of variola, has the power of suspending the variolous action till the measles have run their course. This has not, however, been invariably the case, for instances have occurred in which both diseases proceeded together; "this," we are informed by Dr. M'Bride, "was observed particularly in the Foundling Hospital of Dublin in 1769. A number of the children having been inoculated for small-pox, in the meanwhile were seized with the measles, and both species of eruption were perfectly distinct; they nevertheless all recovered;" (Practice of Physic, vol. ii. p. 112;) and Mr. Russell has described two cases in which the two eruptions ran their course together in the same individuals, when these diseases were epidemic at Aleppo in 1765.*

The general law with regard to measles, in common with others of the exanthemata, is, that they affect the system but once, and this peculiarity is maintained with much greater strictness and fewer exceptions than the statements we are accustomed to hear in society would lead us to believe; very many indeed of the cases of secondary measles so reported, originated merely in the parties having confounded roseola or some other cutaneous efflorescence with rubeola. Of this we have detected several instances, and almost invariably it has been acknowledged that the former disease had not been seen by any competent judge: that exceptions have occurred, however, in this disease, as in scarlatina and small-pox, cannot be denied, but that they have been very rare is proved by the few instances which have been recorded. Guersent mentions having seen children affected with the disease twice in the course of the same year; in one child he observed two very regular eruptions of measles in six weeks, and in the interval between their first and second appearance the child had a variety of small-pox. (Dict. de Médecine, tom. xviii. p. 512.) The cases of this kind related by Dr. Baillie (Trans. of Soc. for Improving Med. and Chir. Knowledge, vol. iii. pp. 258 and 263) are not only the most decisive of which we are aware, but also the most remarkable, as showing not merely an individual but a family susceptibility. In the first instance five brothers and sisters had it in succession a second time, four of them after an interval of six months, and the fifth after a lapse of twenty-one years. In the other instance two sisters had a return of the disease after four months. An observation of Dr. Burns (Principles of Midwifery, p. 546, ed. 7.) deserves to be noticed here: he observed that "When the measles were epidemic, it was not uncommon to find those who had formerly had the disease affected sometimes with catarrh without any eruption, sometimes with an eruption preceded by little or no fever and without any catarrh: this was very distinctly observed during every season when the measles were prevalent;" but he is doubtful as to the exact nature of the eruption. Frank (tom. ii. p. 367) says that a second attack of measles is more common than of variola, an opinion which appears to be at variance with general experience, and decidedly with our own. It is also a well-ascertained fact that the imperfect form of measles, generally denominated *rubeola sine catarrho*, does not afford any protection against a recurrence of the disease.

[Mr. Erasmus Wilson, however, (*Treatise on Diseases of the Skin*, Amer. edit. p. 71, Philad. 1843,) affirms that one point of difference between measles and scarlatina is, that the former "frequently (?) attacks the same person twice," whilst the latter rarely does.]

The contagious nature of measles is, we believe, universally acknowledged, and there is even reason to believe that it is infectious before the appearance of the eruption (See Rust's Magazine, Feb. 1827); but, as in other contagious diseases, there is a great difference in the susceptibility of different individuals equally exposed. We very lately attended a young lady with this complaint, whose younger sister slept with her during the whole of the eruptive fever, and for two nights after the eruption made its appearance, and yet escaped the disorder. Heberden mentions that an infant who sucked a nurse till the measles appeared on her was not affected.

* Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. ii. p. 90. See Frank, tom. ii. p. 367, French ed. See, also, a "Case of the Simultaneous Occurrence of Small-Pox and Measles," Med. Chir. Trans. vol. xiii. p. 163.

[The communicability of measles was denied by Dr. Dewees, (*Practice of Physic*, Philad. 1830,) but, evidently, on insufficient grounds.]

With regard to the latent period of measles, our own observation would lead us to fix it at about nine or ten days, but this is a point difficult to determine: after inoculation, the symptoms of fever appeared about the seventh day. Dr. Burns (Principles of Midwifery, &c. p. 642) states the latent period to be about twelve or fourteen days; Heberden (Commentaries on Diseases, p. 322) from ten to fourteen days; Dr. Gregory (Elements of Practice of Physic, p. 127, ed. 3) from eight to fourteen days; Dr. Elliotson (Medical Gazette, Oct. 1832, p. 99) from five days to a fortnight. Dr. Willan says he knew a person who passed through the measles and became convalescent, whose clothes infected a child in the country; this child had the eruption sixteen days after being exposed to the fomites.

[According to MM. Rilliet and Barthez, (*Traité Clinique et Pratique des Maladies des Enfants*, ii. 747, Paris, 1843,) it generally required an exposure of from five to twenty-five days in the wards before children exhibited the eruptive fever.]

Progress of the Disease. — The symptoms of the antecedent fever are not usually such as to excite much attention. The child appears at first not so well as usual, is less active, and out of spirits; the appetite is impaired, and the sleep is disturbed: this derangement of the system is presently explained by the patient exhibiting symptoms of catarrh, — frequent cough, sneezing, running from the nose and eyes, which are tender and generally itchy, so that the child frequently rubs the eyes, and picks the nose: the skin is hot and dry, with occasional chills; and the pulse is quickened. When these symptoms have continued about three days, the child feels on the fourth still more decidedly sick, and is unwilling to leave its bed. Sometimes the precursory symptoms are so slight as scarcely to be felt by the patient or noticed by others. We had lately under our care a young lady of seventeen, who was in constant attendance on her sister in measles, and the first notice we had of her having caught the disease was the appearance of the rash on her face. (See also Heberden, Comment. p. 317.) In other instances the precursory symptoms are very severe: there is high fever, with violent catarrhal symptoms, rigors, total loss of appetite, intense thirst, burning headach, suffused eyes, intolerance of light, constant somnolence, but little or no sleep, or if the patient happens to fall asleep, he starts from it as if frightened; the pulse is rapid and sharp, the throat sore, and the cough incessant, with pain or soreness in the chest. There is an evident exacerbation of these symptoms towards evening, accompanied often by difficulty of breathing, and not unfrequently by nocturnal delirium.

When the rash appears, which it usually does on the fourth day, it is not in general productive of much relief of the precursory symptoms, which are, indeed, more frequently somewhat increased: it is first perceived in general about the roots of the hair, on the upper parts of the forehead, and on the chin, in the form of small red spots somewhat resembling flea-bites, which are at first distinct, but soon coalesce and form patches of an irregular crescentic or semicircular figure, of a dull red colour, slightly elevated, and having between them portions of the skin retaining its natural appearance. If the finger be passed over the surface, the patches of eruption are felt slightly prominent and rough;* this roughness is frequently stated to be perceptible only on the face, but we have repeatedly found it most remarkable on the arms. In a case which we very lately attended, the elevation of the patches on the latter parts attracted our particular attention. In the course of the fourth day the eruption spreads over the face; spots also may be observed on the palate and fauces of a dark red colour, which are still more distinct after another day, the inflammation attending which causes a sensation of dryness and roughness in the pharynx, and increases the hoarseness. On the next day (the fifth) the eruption extends over the neck, breast, and upper parts of the trunk; it is now very vivid on the face, which is not unfrequently so much swelled, especially the eyelids, that the eyes are quite closed up as in small-pox, while the other features are from the same cause greatly altered. Towards the close of the same day, the eruption begins to appear on the arms, and spreads over the lower part of the trunk. On the sixth day the eruption is vivid on the trunk and arms, and appears on the lower extremities about as far as the knees, while it is declining or nearly faded on the face. On the seventh day it is fully out on the legs and feet, and on the hands, while on the body it is fading, which it does in the same order as to parts as it appeared on them. On the eighth day the rash is fading from the parts last invaded, so that on the ninth it is hardly perceptible, and by the tenth it has in general entirely disappeared. While the fading proceeds, the elevations of the cuticle drop off in the form of little scales, so that the surface of the body appears as if it had been sprinkled over with fine bran.

Such is the usual course of the disease in its simple and regular form; but we occasionally meet with deviations or peculiarities requiring to be noticed. Thus the eruption, sometimes anticipating the usual time of its appearance, comes out on the third or even the second day of the eruptive fever, while in other instances it has been delayed many days beyond the ordinary period. Buchobz gives an instance of its not appearing till the twenty-first day, and Dr. Elliotson in his description of the disease says, "these catarrhal symptoms will sometimes last two days, sometimes twenty, before the appearance of the eruption: in some instances the disease is ushered in by severe vomiting, and occasionally, though rarely, free salivation takes place." Heberden (Commentaries, p. 317; see also Frank, tom. 2, p. 370,) tells us of a patient who on the first day of the eruption "was seized with a spitting which continued to tease him for forty-eight hours, without suffering him to rest at all by day, or to sleep by night; the cough in the mean time al-

* It appears very singular that Rayer should describe the patches of eruption as not arising above the surface; his words are, "ces taches ne donnent pas sous le doigt la sensation d'une surface inégale et prominente."— Maladies de la Peau, tom. i. p. 18.

most ceased, and all the other symptoms were as mild as in a favourable sort of the measles." Convulsions also have occasionally preceded the attack, as happens sometimes in small-pox; and one person is mentioned by Heberden, who had a most excruciating pain in the back, which continued for a day or two after the eruption. In some instances the spots have appeared first on the body instead of the face, and in a few rare cases the rash has not spread to the arms during the whole course of the disease. Sometimes the eruption is not followed by desquamation. In many the rash is accompanied and intermixed with a very full crop of miliary vesicles of such size and distinctness as to lead to a suspicion of the approaching disease being small-pox. The production of these vesicles has been ascribed by some writers to an unusual intensity in the inflammatory action attending the disease, but this is certainly incorrect, as we have seen them very numerous in perfectly mild cases. It has happened, but we believe very rarely, that the eruption has broken out anew: Dr. Conolly (see article HYSTERIA in this work, vol. ii. p. 568,) relates the case of a young lady at school, who became the subject of a very singular hysterical affection a few months after having had rubeola in an unusual form; the eruption came out and seemed to be disappearing at the usual period, when it suddenly broke out afresh, and to such an excessive degree as to make it impossible to recognise the features of her face: very nearly the same thing was observed in a case detailed by Frank. (Tom. ii. p. 377.)

[In his examinations of the blood in measles, M. Andral (*Pathologie Hématologique*, Paris, 1843, or Amer. Translation, 1844,) found the proportion of fibrin to be the same as in health—3 parts in 1000. In many adults it was not more than from 2½ to 3½. This mean persists at the commencement of the disease; but after the eruption, and especially in the adynamic form of the disease, there is a tendency to the diminution of this principle. The proportion of the blood corpuscles is, however, augmented from their normal proportion, which is 127 in 1000. M. Andral has seen them raised to 137, 140 and 146. These modifications of the blood are very different from those seen in the phlegmasiæ, in which there is augmentation of the fibrin, which may exceed 10 in 1000, without any increase of the proportion of globules. So far, therefore, as the state of the blood affords an element for discrimination, measles is properly classed with the pyrexiæ or general fevers. (Guersant and Blache, art. *Rougeole*, in *Dict. de Méd.* xxvii. 676, Paris, 1843.)]

Treatment.—The treatment of measles in its ordinary and simple form may be comprised in very few directions. The patient should be kept in bed, with so much covering only as will secure comfort, avoiding equally too much heat or exposure to cold; on these points we almost always have to contend against one or other of two prejudices, the most common of which is, that a breath of cool air is most pernicious to a patient in measles, and in consequence of this belief the individual is kept constantly enveloped in a smothering heap of bed-clothes with drawn curtains and the room well heated by fire, by which means the fever and all its concomitant dangers are greatly augmented; others again, who have had children in the small-pox, insist upon the advantages of cold, not being able to discriminate between the widely different natures of the fevers accompanying the two diseases. The patient should be kept free from disturbance or noise, and, on account of the tenderness of the eyes, a subdued light only admitted into the chamber; he should be liberally supplied with mild mucilaginous drinks, and little or no food, and whatever is taken should be of the simplest kind; he should be solicited to inhale watery vapour by inclining the face over a basin of warm water or of chamomile infusion, by which means the tender eyes have at the same time the advantage of the soothing effect of the vapour; sponging the face, chest, arms, and hands with the same infusion, or with vinegar and warm water, is productive of great comfort by removing the heat, dryness, and itching of the skin, which are often distressing; for a similar reason mild diaphoretics should be given, which may be advantageously combined with gentle aperients in such quantity as the state of the bowels absolutely requires, active purgation being neither useful nor safe. In the opinion of some the administration of an emetic should form part of the treatment, but the propriety of such a remedy has always appeared to us doubtful, and we think we have had reason to be satisfied that its effects were often decidedly injurious by exciting disorder of the alimentary canal.

However favourable may be the condition of the case, we should guard against being lulled into security as to the event. There is no disease in which a change of symptoms occurs more suddenly, or danger more quickly takes the place of safety; we must therefore at every visit carefully ascertain the state of the head, chest, and abdomen; since from these, and especially the two latter, are likely to arise those dangers which may compromise the life of the patient. Thus the discovery, at any period of the disease, of severe headach, with pain piercing through the temples, and perhaps accompanied by delirium and suffused eyes, to which the least ray of light is torture, with a rapid hard pulse, is calculated to excite great apprehension, and demands the immediate adoption of very active measures. The state of the lungs should most particularly engage our attention, as being the organs most constantly and most severely affected in this disease. The period at which danger may generally be apprehended from this source is about the decline of the eruption, that is, from the seventh to the ninth day; but we should be equally on the watch at all times to detect the first symptom of inflammation within the chest, and for this purpose we would strongly inculcate the necessity, where there can be the slightest doubt, of always determining the point by auscultation, instead of trusting to the ordinary symptoms to be collected from the state of the pulse and respiration, or the expression of the countenance, all of which, under the peculiar circumstances of this disease, are but little likely to afford satisfactory information. When once we have satisfied ourselves of the presence of inflammation, our sheet-anchor is bloodletting. We should bleed at once; and if the symptoms are

not subdued bleed again ;* we would even say, if there be doubt bleed, but of course very cautiously, —carefully watching the effect, which, in ninety-nine cases out of a hundred, will be decidedly beneficial. Heberden (see Commentaries, p. 321), Cullen (Practice of Physic, vol. ii. p. 180 and 181), and others of our most celebrated physicians, appear to have considered bloodletting as an essential part of the treatment in almost all cases, and to have practised it in every stage of the disease. Mead (Medical Works, p. 261. Edit. 1767.) makes no exception, but directs it in every instance. We should, however, be very far from recommending an indiscriminate adoption of such a practice, which under the ordinary circumstances of the disease is not required, and might often be injurious. Bloodletting is seldom necessary during the eruptive fever; and when the rash has appeared we must take care not to fall into the error of mistaking the hurried and labouring respiration and quick pulse which accompany the disease during the height of the eruption, for proofs of pulmonary inflammation, these conditions being merely symptomatic, and subsiding after a day or two without any morbid condition of the lungs coexisting, as may be ascertained by the careful application of the stethoscope. Should the character of a prevailing epidemic or of a particular case be low, typhoid, or putrescent, the abstraction of blood would be altogether inadmissible; we must also bear in mind that a great majority of our patients are of tender years, and must be treated accordingly. In most cases all we desire may be accomplished by the application of a few leeches, which should always be applied over a part where there is a solid resistance to pressure, should it become necessary to restrain the bleeding; in general the back of the foot is preferred for this purpose in most of the diseases of children. If the object be to relieve the head, the leeches may be applied to the temples, or still more advantageously behind the ears. Whenever we find the patient harassed with an incessant hacking cough, complaining of pain or soreness within the chest, with a sensation of tightness or constriction across that cavity, increased by a full respiration, and with a full hard pulse, we should not hesitate to bleed, even though we may not be able fully to satisfy ourselves of the absolute existence of thoracic inflammation, the effects of which we shall too probably have to lament if we postpone the application of the most effectual remedy for its control.

We do not propose to enter here into the details of the treatment of pneumonia, bronchitis, or pleuritis, which may be consulted in full under their respective titles in other parts of this work: we will only here observe, that the remedial agents on which our reliance must be placed for subduing the inflammations incident to this disease are — bloodletting, leeches, blisters, or vesicating liniments, calomel, ipecacuan, tartar-emetic, and the warm bath. Vesicating liniments will often be found preferable to the common blister in treating this and other diseases of children, from the much greater quickness with which they may be made to act, and their not being nearly so apt to produce ugly sloughing sores,—an effect which is too often found to follow the action of the common blister, especially in measles; besides we can very conveniently regulate the degree of activity by altering the relative proportion of their components. A very eligible formula for such an application, the efficacy of which we have repeatedly proved, is three or four parts of linim. camph. comp. or linim. ammoniæ with one part of ol. terebinth. If this liniment be applied warm to the skin, by sopping it in a fold or two of lint of whatever size and shape may be thought necessary, it will produce vesication generally within twenty minutes. M. Luroth has recently recommended frictions with strong tartar-emetic ointment over the chest and epigastrium in this disease; but when we consider the extreme irritability of the skin in children, it would require a strong conviction of the indispensable necessity for such an application before we should venture to resort to it. Cold affusion has been recommended (see Bateman's Synopsis, p. 61, and Edin. Med. and Surg. Journ. April, 1814), and in a few instances adopted in the treatment of measles, and it is said successfully. Kœmpfer assures us that at Java the children die of measles if they are not washed with cold water; and Guersent says he would not hesitate to use it where there was pure debility free from disease in the chest. (Dict. de Méd. tom. xviii. p. 516.) We have never witnessed the adoption of this practice, and we confess that it appears to us so hazardous and so unnecessary, that it would be difficult to induce us to venture on the experiment.

It sometimes happens that the rash comes out imperfectly, or having appeared properly, suddenly retrocedes and disappears: under such circumstances the nurse will almost certainly, if not well watched, give the child a good dose of sulphur in diluted spirit, or a glass of punch containing saffron, which are considered specifics for helping to bring out the eruption. The pernicious results of such remedies it is unnecessary to point out, especially when we consider that in almost every such instance the retrocession is the effect of some internal disorder which is generally inflammatory, or of too high a degree of fever, the reduction of which should be the primary object of our treatment. If the retrocession have been caused by exposure to cold, the use of the warm bath, diaphoretics, and warm or perhaps slightly stimulating drinks, are all that will be required. Should debility appear to have been the cause, a stimulating plan must be adopted, not only because the rash has receded, but because it has done so in consequence of a condition of the system which, if allowed to continue, might place the patient in danger. The improper use of active cathartics may have been the source of the evil, or it may have arisen from a spontaneous diarrhœa setting in from the commencement; if so, the state of the alimentary canal claims our particular care. Should there be tenderness and other evidence of inflammation, we must bleed, or apply leeches,

* "I have with great success ordered even the tenderest infants to be blooded in the arm, in such quantity as their age and strength indicated. And sometimes also, when the disease (pneumonia) has been urgent, I have not feared to repeat the operation; and in reality, by bleeding, I have snatched abundance of children from imminent death. This disorder attacks children upon the departure of the measles, and proves so fatal, that it may justly be esteemed one of the principal ministers of death, destroying greater numbers than the small-pox."—*Sydenham*, p. 177-8.

and use the warm bath; if the discharges are ill-coloured and of very foul odour, we should give calomel, or mercury with chalk and rhubarb; afterwards an anodyne injection may be advisable. These observations apply to the treatment of diarrhœa when it comes on at the termination of the disease: Sydenham says, "Bleeding, also, cures the looseness which succeeds the measles;" (Works by Swan, p. 178;) but we must observe that we cannot always venture to bleed when there is tenderness present, which may exist without any other evidence of inflammation. On the contrary, there may be much debility; and here we must have recourse to blisters, irritating liniments, the warm bath, opiates, astringents, and a rice diet, with removal into the country to complete the cure.

Varieties of Rubeola. — 1. *Rubeola sine catarrho* is a form of the affection in which the eruption appears unaccompanied by the usual symptoms of fever and catarrh, and its invasion does not protect the individual against a second attack. This variety has been called by the German writers *rubeola spuria*, and by Dr. Good *rubeola incocta*. Rayer denies the existence of this form of measles, and maintains that such cases are merely roseola mistaken for measles; but the descriptions of Willan, Heberden, and many other very accurate observers, leave no room for doubt on the subject. The most satisfactory example the writer ever saw of it was in one of his own children; the rash was perfect, but the catarrhal symptoms were entirely absent. There is nothing peculiar in the management of this variety, but we should warn the parents that they may expect the occurrence of the disease in its usual form. Frank, in his general observations (tom. ii. p. 216, French edit.) on the exanthemata, maintains that as "there is no exanthem which does not occasionally exist without its peculiar fever, so on the other hand there is not one of the exanthematous fevers which does not in certain cases pursue its course without any cutaneous eruption, and *with the same consequences as in other cases*." This appears in some measure supported by the observation of Dr. Burns already quoted, but we confess that our own experience has made us very sceptical on the point. Rayer is of opinion that the cases which have been supposed *rougeole sans éruption* were neither more nor less than *catarrhes sans rougeole*; and it is to be remarked that Frank himself, speaking of measles, declares "he never met with the fever of measles without the eruption (febris morbillosa sine morbillis), and doubts its existence until it shall have been proved by inoculation that persons who have had such a fever are not susceptible of taking measles." (Tom. ii. p. 370.)

2. *Rubeola nigra*.—This designation is applied to a peculiar appearance which the rash occasionally assumes about the seventh or eighth day, the spots becoming of a livid colour, or, more properly, of a brownish hue, inclining to yellow. It is generally accompanied by languor and a quick pulse, but seldom lasts more than a week or two. Guersent, (Dict. de Méd. tom. xviii. p. 509,) however, met with a case in which it continued for more than five weeks; he thinks it ought to be distinguished from measles. Practically it is not a matter of much importance, as it is not productive of any bad consequence, the patient recovering quickly under the use of tonics, of which Dr. Willan preferred mineral acids, which may be very conveniently and advantageously given in combination with sulphate of quinine. It is to be recollected that this is a condition totally distinct from the presence of petechiæ, which mark a debilitated and broken-down state of the system, likely to occasion great danger.

3. *Rubeola putrida vel maligna*. — This distinction has been made to designate a class of cases in which the concomitant symptoms are such as accompany the low form of typhous fever, with a tendency to putrescency throughout the system. The form of disease described by Sir William Watson (Med. Obs. and Enq. vol. iv. p. 132,) as prevailing in the Foundling Hospital in 1769, which proved very fatal, was evidently scarlatina in its malignant form, and not measles. At that time the two diseases were confounded, and Dr. Watson was one of those who even thought that the term scarlatina might be altogether dispensed with.

This variety of the disease is said to have prevailed at Plymouth in 1745, in London in 1763, and at Edinburgh in 1816. (See Edinb. Med. and Surg. Journ. Jan. 1817.) In these epidemics the symptoms of the eruptive stage were particularly violent: the patients were early seized with extreme debility, restlessness, sometimes with coma; the tongue became dry, hard, and black; the fauces were of a deep red colour, accompanied with great irritability of the stomach; the eruption did not exhibit its usual characters; it frequently receded very soon after it made its appearance, was less elevated than it ought to be, and of a dark or livid colour. A large majority of these cases died, and on examination there were found well-marked evidence of inflammations within the thorax. In Edinburgh the retrocession of the eruption was almost always a fatal symptom. Such a form of the disease we believe to be extremely rare in this country, at least we have never met with it. At the same time, however, it is not to be doubted that in particular constitutions, or under certain contingencies, the complaint may assume these characters. Thus Dr. Perceval mentions that in a charity-school where measles prevailed, typhous infection was introduced, and a corresponding change was immediately observed in the character of the measles. Dr. Thompson saw a case in which the languor and state of the pulse were alarming, and the skin rubbed off like a moist cobweb, but the patient recovered by the use of wine and cordials, the administration of which, with the addition of some of the preparations of bark and ammonia, with the warm bath, constitute the chief remedial agents suited to such a condition of the system.

4. *Morbilli variolosi* is a variety mentioned by Dr. M'Bride, (Practice of Physic, vol. ii. p. 116,) in which he says "the eruption is prominent, the face swells greatly, and many pustules actually suppurate like those in the small-pox;" and he adds, "the cough and other catarrhal symptoms are the things which distinguish this from the small-pox." Such a disease as that here described

we have never seen, except it should be merely what we have already alluded to,—measles accompanied by a great number of miliary vesicles, some of which occasionally suppurate, but bear no resemblance whatever to small-pox: the occasional conjunction of the two diseases has been already spoken of.

Inoculation.—Some time about the middle of the last century it was proposed to adopt inoculation of measles for the purpose of rendering the disease milder; and Dr. Home (Clinical Facts and Experiments, 1758,) of Edinburgh performed several experiments on the subject, inoculating with a little blood drawn from one of the exanthematous patches. The result does not appear to have been either very decisive or satisfactory; nor has the eligibility of the practice been at all proved by subsequent trials, many of which failed altogether; and even where they succeeded in producing the disease, the operation did not always ensure a mild form of the complaint; on the contrary, many of the cases so produced were as severe as those arising naturally. On this point we have no evidence to offer from our own experience, never having seen the practice put to the test; and we can only find that authorities of equal weight are completely at variance on the subject. Theurmen and Tellegen, as we learn from Rayer, inoculated five infants without any other result than the production of slightly inflamed spots where the punctures were made. The same want of success attended the trials made by Dewees and Chapman at the Philadelphia Dispensary in 1801. The most recent trials of which we are aware are those made by Professor Speranza of Mantua: he inoculated in the first instance six individuals, and afterwards himself, with blood taken from a vivid patch of the eruption: in a few days the measles appeared, and proceeded mildly and regularly; in consequence of this he made further experiments, and he says they were all successful. Dr. Elliotson thinks it "likely that the vesicles which occasionally accompany the eruption may contain the contagion itself in a concentrated form."

Prognosis.—The prognosis in simple measles is almost always favourable; but nothing is more certain than that the mildest form may be speedily converted into the most dangerous; a sudden change taking place in the symptoms which could not have been foreseen, or produced by improper treatment, such as the administration of stimulants, by too much heat, or by exposure to cold. It is to be recollected that it is not the eruption or the mere disease which endangers the safety of the patient, but the internal inflammation which may accompany or follow it; and hence the great necessity for ascertaining exactly the degree of their development by a most careful examination of the organs of respiration and digestion, to enable us to form a correct opinion as to the probable result. There is a very general impression that adults are in greater danger from measles than younger subjects; but as far as our experience enables us to judge, we should pronounce exactly a contrary opinion, supposing each to be in an equally good state of health at the time of being attacked. Of course, if an adult encounters the disease with a constitution naturally delicate or previously broken up by intemperate habits, or with some old pulmonary complaint, such a patient would be in great danger; but as a general rule, young children are most likely to suffer severely, because they are most disposed to severe attacks of pulmonary inflammation; so that, in our opinion, the younger the subject the greater the danger. Pregnant women are known to bear all the exanthematous diseases badly, and especially small-pox; this might, *à priori*, be expected, because their system is already in a state very unfavourable for the reception of an inflammatory disease. Rayer considers measles under such circumstances peculiarly dangerous. The cases which the writer has seen have done well; and Heberden (Commentaries, p. 322,) expressly mentions that he "attended several who were greatly harassed by the violence of all the usual symptoms in this illness, but never knew it make one woman miscarry, or be in more danger on account of the pregnancy."

The character of a prevailing epidemic should always be taken into account: thus that of 1670, described by Sydenham, was particularly mild, while that of 1674 was remarkable for the frequency of pneumonia.* The season of the year also has no inconsiderable influence on the progress and issue of the complaint, which is likely to proceed more favourably and safely in mildly warm and temperate weather than when there prevails either extreme of heat or cold. When measles and some other disease are conjoined, as for instance variola or pertussis, or when measles follow close upon the subsidence of some other ailment, especially if that has affected the lungs, the danger to be apprehended will be greatly increased: the same may be said when this disease attacks persons of a scrofulous or a plethoric habit. The following may be considered as the general circumstances which should forewarn us of danger: great violence in the symptoms of the eruptive fever; the eruption appearing too soon or too late; the approach of pulmonary or abdominal inflammation; severe headache with delirium, suffused eyes, or coma; a hacking cough, with a hard pulse; extreme dyspnœa; retrocession of the eruption, which is generally owing to some serious internal derangement; the accession of typhoid symptoms; the appearance of petechiæ; profuse hemorrhages, inducing prostration of strength:† while, on the other hand, a favourable case may be known by the regularity with which the eruption appears and proceeds, and its equal distribution on the different parts of the body successively; by the absence or slightness of the symptoms of thoracic or abdominal inflammation; freedom from headach; the soft state of the pulse; the naturally moist condition of the skin; and the patient obtaining a sufficiency of refreshing sleep. From the London bills of mortality, it

* The number of deaths from measles that year amounted to 795; while for the three preceding years, taken together, they amounted only to 140.

† When females, especially girls, are the subjects of measles, it very frequently happens that during the eruptive stage of the disease the catamenia make their appearance perhaps a week or two before their natural period, and sometimes much more profusely than is natural; this we have repeatedly observed to happen, not only without injury, but we have thought with advantage.

appears that there died, from December to October 1831, of measles 532, of small-pox 436, and during the same period in 1832 the number of deaths were, of measles 508, of small-pox 532; making a total of measles 1040, of small-pox 968. Morton has given a very highly exaggerated account (Append. ad Exer. de Morb. Acutis, p. 427,) of the mortality during the epidemic of 1672, when he says the deaths from measles were *three hundred every week*; whereas it appears, from the public bills of mortality, that the whole number of deaths for that year by measles amounted only to 118. (See paper by Dr. Dickson in Med. Obs. and Enq. vol. iv. p. 256.)

Sequelæ.—Measles are very frequently followed by a train of symptoms indicative of serious pulmonary lesions, very generally by a distressing and tedious cough, by chronic bronchitis, chronic pleuritis, pneumonia,* tubercles and phthisis; chronic diarrhœa, generally of an inflammatory character, sometimes harasses and exhausts the patient; ophthalmia, ear-ach, and running of the ears, occasionally also supervene. There are several cutaneous affections apt to appear after measles; amongst them is a very troublesome eruption of inflamed pustules, sometimes terminating in ulceration. In a few instances gangrene of the inside of the cheeks, gums, and lips, in the horrid form of *cancrum oris*, has been observed; in other instances the mortification has affected the vulva. Anasarca has been known to appear after measles, as it very often does after scarlatina; but this is so rare an occurrence, that where anasarca is found, and said to have been preceded by measles, there is much reason to suspect that the previous disease was scarlatina. (Frank, tom. ii. p. 372, op. cit. Guersent, Dict de Méd. art. *Rougeole*.) Dr. Harty, who has had extensive opportunities of observing this disease, informed the writer that he has very frequently found during convalescence from measles that the pulse became unusually slow, about forty or fifty beats in a minute; but it did not appear to be connected with any thing unfavourable in the condition of the patients, whose recovery was uninterrupted.

WILLIAM F. MONTGOMERY.

RUPIA, from *ῥύπος*, *sordes*, may be characterized as an eruption of flattened and scattered bullæ, each surrounded with an inflamed areola; the bullæ filled with serous, purulent, sanious or dark bloody fluid, and succeeded by thick dark-coloured scabs covering unhealthy ulcerations. Bateman and Biett describe the varieties of rupia under three species or heads, viz. rupia *simplex*, rupia *prominens*, and rupia *escharotica*. The last of these, rupia escharotica, being the same disease as gangrenous or infantile *pemphigus*, and as such already fully described in the article PEMPHIGUS; the other two species, rupia simplex and rupia prominens, alone demand a place here: moreover, as these differ from one another merely in degree of severity, they may be comprised under one general description.

The bullæ of rupia are observed most often on the lower extremities, but are also frequently seen on the loins, the upper extremities, and about the shoulders. They are always few in number, and are generally scattered at some distance from one another. In the mild form, (rupia simplex,) one or more oval bullæ arise with little or no premonitory redness of the skin. These bullæ are flattened, and are filled with a sero-purulent fluid, and seldom exceed a sixpence in size. After the lapse of a few hours from their formation, they become partially flaccid; the contained fluid grows muddy and puriform, and dries into a dark-brown scab, thick in the centre, and thin towards the circumference. Around the scab there is a dusky red areola, the cuticle covering which is slightly raised or separated from the true skin, and continues all round with the thin edges of the scab. The latter is in general easily removed, or falls after a few days, leaving an unhealthy-looking ulceration of the skin, which either becomes crusted with a fresh succession of scabs, or heals, leaving a dark purple mark. In the aggravated degree of the disease, (rupia prominens,) a circumscribed inflammatory redness precedes the formation of the bullæ. The bullæ rise slowly, and, instead of serous fluid, contain purulent matter or a mixture of purulent matter and blood, which constitutes the blackish fluid already mentioned as sometimes found in the bullæ. The contained fluid dries into a very dark-coloured scab, which covers a deeper ulceration, and is surrounded by a wider inflammatory areola than in rupia simplex, and as the ulcerated surface is continually secreting pus, and at the same time enlarging in circumference, the scab is increased by successive layers, each wider than the preceding, and at length, at the termination of ten or twelve days, acquires a conical shape similar to a limpet-shell, sometimes extending at the base to the size of a dollar in area, and protruding in the centre an inch above the surface of the skin: hence the name of this variety of the disease — rupia prominens. This scab is superficial, and if removed is either replaced by a fresh scab, or leaves exposed a pale unhealthy spreading ulcer, bleeding on the slightest touch, of a depth proportionate to the duration of the scab, with livid swollen borders, and in old persons often very difficult to heal and even when healed leaving a dark-coloured cicatrix.

Diagnosis.—Rupia may be confounded with pemphigus, ecthyma, and venereal pustular eruption, but the bullæ of pemphigus are large, full, and very prominent, and generally contain a serous fluid, while the bullæ of rupia are small, flattened, quickly become flaccid, and contain a fluid, which, if not sanious or purulent from the commencement, very quickly becomes so. Gangrenous pemphigus pours out a sanious fluid, but does not form scales like rupia. The ulcerations of rupia are deep and indented, while those of pemphigus are superficial, resembling excoriations. The shape of the scab in rupia prominens at once distinguishes this variety from pemphigus. Rupia is frequently found in conjunction with ecthyma luridum and cachecticum, and Plumbe has classed rupia and ecthyma together. The two diseases

* Laennec thinks that the suffocating orthopnœa which sometimes very suddenly carries off young children after measles is produced by an idiopathic œdoma of the lungs. In the greater number of cases examined after death by the writer, the morbid alteration existing was the condensation of the pulmonary structure ordinarily found as the effect of pneumonia.

are, however, very distinct in their pathology and appearance. Ecthyma commences as a pustule, rupia as a bulla. The scab of rupia is generally easily removed; the scab of ecthyma is strongly adherent. Around the circumference of the scab of ecthyma there is deep-seated inflammatory hardness, extending into the subcutaneous cellular tissue; around the scab of rupia there is only a superficial red areola, the cuticle over which can be traced in continuation with the surface of the scab. The scab formed on some of the pustular venereal eruptions bears a very close resemblance to the scab of rupia; and as both diseases are likely to occur in the same broken-down constitutions, there is risk of confounding them. The venereal scab and pustule are, however, found to proceed from pustules with hardened bases, not from bullæ as in rupia, and they are generally surrounded with the peculiar syphilitic copper-coloured areolæ. These characters, with the presence of some of the usual constitutional symptoms of syphilis, will suffice to distinguish the two diseases. Plumbe speaks of having seen evil result from mercury being administered for rupia, under the mistaken supposition of its being a venereal affection. Few practitioners, however, in the present day, after the clear and lucid views laid down for the treatment of venereal affections by Mr. Carmichael, (an Essay on Venereal Diseases, and the Use and Abuse of Mercury in their Treatment, by Richard Carmichael, M. R. I. A., &c.), would push mercury to any extent for such appearances, even admitting them to be of venereal origin.

Prognosis.—The duration of rupia is very uncertain, running through its course in a few days, or extending to months. The disease is severe in proportion to the age of the patient, or weakness of the constitution. The slowly-healing ulcerations often keep up a low fever in the system, and thus injure the health, but rupia is scarcely if ever a fatal disease.

Causes.—Rupia may be considered as altogether a constitutional affection, being only seen in the aged, or in the debilitated from any cause, but particularly from intemperance, abuse of mercury, or want. Acute diseases affecting the skin, and leaving much debility after them, predispose to it; thus it appears as a sequela of small-pox and scarlatina. The scrofulous are peculiarly subject to it, and it is most prevalent during the winter season among the poor who are badly fed and clothed.

Treatment.—From what has been just stated relative to the causes of rupia, its treatment is easily anticipated. The remedies are a light nutritious diet, cleanliness, the warm bath, attention to the state of the bowels, and sarsaparilla or cinchona, with the mineral acids. Dr. A. T. Thomson, in his edition of Bateman, says that slight mercurial courses carried so far as to affect the mouth are sometimes necessary. Mercury, when used in this disease, should according to the best observers be used only as an alterative, and in its mildest forms, as in Plummer's pill. As to local applications, the scabs should be removed by a poultice, and the raw surfaces, if painful, are to be stuped with decoction of bran and poppy-heads. Relaxing or emollient applications, however, should be used only for a short time; the surfaces of the ulcers very soon require stimulating applications, and the strength of these must vary, according to the relaxed state of the ulcers, from a weak solution of nitrate of silver to the application of the solid nitrate, the strong nitric or muriatic acid, or ointment of red precipitate of mercury. Rayer recommends the ulcers to be dressed with saturine cerate, pledgets of lint to be placed over this dressing, and all to be confined with a bandage which shall keep up a moderate compression. He recommends the ulcers when indolent to be dusted with powdered supertartrate of potass, or a solution of it to be used as a lotion. In this, as in all skin diseases where there is ulceration attended with low irritative fever, internal opiates given at bed-time to procure sleep form an essential requisite in the treatment.

D. J. Corrigan.

[SALIVATION, See Ptyalism.]

SCABIES.—This is the classical word now universally used to designate the well-known contagious vesicular disease of the skin, called popularly, in English, *itch*, French, *gale*, German, *Krätze*, Italian, *rogna*, &c. These vulgar appellations, except the French, (the etymology of which is doubtful,) are derived from the property which our English expresses, the intense itching and irresistible scratching which it excites. Scabies is the word by which the Latins rendered the ψώρα of the Greeks, a term under which the latter comprehended a number of papular and squamous affections, although they at length appropriated it to the disease which we now denominate psoriasis. The confusion which for a long time attached to ψώρα necessarily involved its synonym scabies, and prevented it from becoming definite in its signification, until they were divorced by Celsus, who restricted the Greek term to scaly diseases, and excluded these from the comprehension of the Latin scabies. The Roman physician and his successors did not, however, confine its signification within its present limits, but included under it other pustular and pruriginous affections, and so caused an inaccurate latitude in its acceptation, which prevailed to a comparatively recent period. The advance of cutaneous pathology at length isolated the disease, but the verbal confusion was revived by Cullen and others, who, when scabies had been definitely fixed, chose for the designation of the itch the term anciently used in so indefinite a sense by the Greeks, *psora*, which (with a prolonged termination) Willan, with a greater regard to its old signification, appropriated to the scaly disease. No imputation of inexactness in this instance attaches to the old medical writers, for words must ever be varying and inconstant in their signification until the state of science permits the diseases which they represent to be investigated upon enlightened principles, and discriminated by a true nosology; but authors are to blame, who, after this period arrives, embarrass the received nomenclature by arbitrarily multiplying names, or changing them from their general acceptation.

Scabies is one of the cutaneous diseases the distinct identity of which is best confirmed by peculiar characters, yet in the description of which

such a variety exists as to render it extremely difficult to give a comprehensive account of its history and symptoms. An artificial arrangement would be very desirable for this purpose, but in seeking for such we find how difficult it is to fix arbitrary bounds within which natural phenomena may be circumscribed. "This troublesome disease," says Bateman, "from its affinity with three orders of eruptive appearances, pustules, vesicles, and papulæ, almost bids defiance to any attempt to reduce it to an artificial classification." (Synopsis, 7th edition, 1829, p. 278.) A ready illustration of this statement is found in the fact that while Willan has placed it in his order "pustulæ," Biett and Rayer, who have adopted his system, classify it among the vesicles; and again, Dr. Paget, the author of a late ingenious essay on the classification of cutaneous diseases, (Edin. Med. and Surg. Journal, vol. xxxiv. p. 270,) coincides with others who consider it as appertaining to the papulæ. It does not belong to our object to maintain the credit of the artificial arrangement, but we may remark that this discrepancy, which shows its defectiveness in this particular as a system, by no means detracts from its practical advantages; on the contrary, the purposes of study and description demand more urgently the aid of arbitrary methods of arrangement when the natural appearances are diversified.

It is admitted by the majority of observers, that by far the greatest part of the eruption of scabies is composed of vesicles, so that we unhesitatingly agree with the French authors above cited in regarding its type as essentially vesicular. The transparent apex of the elevation is often so minute or so fugitive as to give the idea of a papula, if not observed attentively and at the seasonable period of its course. With respect to the true papulæ, which are often interspersed amongst the vesicles, it is to be observed that in all eruptions of the skin (whether their real type be vesicle or pustule) there is a period at which the elevation is merely a papula, and it frequently happens that in a vesicular or pustular eruption some pimples proceed no farther in their development than the state of papulæ. Nothing is more common than to see among the pustules of porrigo several which have no purulent apex, having never advanced beyond the papular stage; but on this account their genuine character is not the less established, being properly regarded as *undeveloped* pustules. The papulæ which complicate the vesicles of scabies bear a larger proportion to the true type than in the example of porrigo, but they appear to possess a similar relation to it, being as it were *abortive* vesicles. The occurrence of pustules in scabies forms, indeed, a more decided variety, as one species of it seems to be truly pustular in its nature. Yet it is not to be overlooked that some of these apparent pustules are also primitively vesicles, in which an inflammation of more than ordinary acuteness has produced a purulent secretion instead of transparent serum. According, then, to the opinion here stated, we embrace the vesicular as the true type of the eruption, and regard the deviations of papulæ, and in part those of pustules, as caused by casual variations in the intensity of the inflammatory action. On the one hand, papulæ occur where the inflammation stops short of maturing vesicles; and on the other, pustules are met with when, proceeding to an immoderate degree, it fills the vesicles with pus in place of serum.

The contagious nature of this eruptive disease is the most essential character of its history. Its vesicles are minute and slightly acuminated, with a pearly semi-transparency at their summit. They may arise at any part of the body, and spread until it cover every part except the face, which appears to possess a singular immunity from their invasion. The hands and arms are always principally affected, and are often so when no other part of the body partakes of the eruption, which is sufficiently accounted for by the fact that infectious contact usually occurs in this situation. The vesicles are mostly distinct, but have a disposition to accumulate at the flexures of the joints; being almost invariably found confluent on the soft fold of skin between the fingers and at the joint of the phalanges and wrist, and often at the larger articulations, if the eruption be more extensively spread. The intense itching which is the characteristic feature of this troublesome disease accompanies the first appearance of the eruption, and, indeed, seems generally to precede it, as the inflammatory elevation which generates the vesicle is much promoted by the scratching, which the pruritus irresistibly induces. It increases from the commencement until each vesicle attains a certain degree of maturation, when it decreases. The annoyance which it produces is in proportion to the extent of the eruption; if the vesicles be few in number, are developed slowly, and confined to a circumscribed locality, it may cause little attention; but when they are numerous and extensive, and come out with rapidity, the pruritus rises to an intolerable height, and produces inexpressible irritation. The patient then seeks to assuage it by scratching, from which, howsoever he may be cautioned against it, he feels it impossible to refrain. Temporary relief may be obtained from this by changing the itching sensation into the pain of laceration, but he only lays up in store a future visitation of greater intensity. The action of the nails increases the inflammation, which causes new crops of vesicles to spring up, and aggravates the pruritus in the old. More or less of the same consequences flow from any other circumstances which give rise to even a transitory excitement of the cutaneous circulation, as the warmth of bed, the digestion of a stimulating meal, or the use of spirituous potations.

Several days elapse between the time of infectious contact and the manifestation of the pruritus, which period is called in this as in other eruptive diseases the incubation. Its length is much modified by the age of the individual, as connected with the susceptibility of the cutaneous surface to impressions. In childhood, when the skin is soft and active in its functions, the incubation has generally three or four days' duration; in adults it averages ten to fifteen, and in old age, when the skin is rigid and has lost its vascularity, this period is still more prolonged. In the bilious temperament, in which the skin's function is less energetic than in the lymphatic and sanguine, it is also comparatively protracted. The relations of climate and seasons, moreover, have a sensible

effect on it, cold and heat respectively retarding and accelerating the first appearance of the disease. The existence of an inflammatory affection of any internal organ is another condition which appears to diminish the susceptibility of the skin to its infection, and to add to the period of incubation. The circumstances connected with this latent period are worthy of attention, not only on account of their intrinsic interest as pathological facts, but because they afford an important practical deduction, which is as follows: the duration of this period has a relation to the actual course of the disease, and the facility with which it may be removed; when the eruption appears promptly after infection has been contracted, it may be inferred that the disease can be speedily conquered by the appropriate remedial applications; but if, on the contrary, the skin has exhibited a tardy inactivity in producing the eruption, when fully developed, the latter will be proportionately inveterate and less amenable to therapeutic means.

When scabies has fully appeared, although it may be modified as to its intensity by circumstances, it always assumes a progressive course, until arrested by treatment; it has no tendency like the exanthematous eruptions to a spontaneous cure. From its original seat it spreads until the whole surface is affected, but collects especially where the skin is disposed in loose folds, subject to friction, as the axilla, the internal parts of the thighs, and fold of the buttock, as well as the flexures of the articulations. The situation where it may first show itself appears to be entirely dependent on the liability of different parts to contact with infected persons. This is demonstrable from the consideration of it in different individuals, whose condition in life exposes one part of the body more than the rest: for example, in tailors, sempstresses, and shoemakers, it commences on the hands; in infants in the nurses' arms, the nates are frequently found to be the part first affected; and if, on the contrary, the nurse receive it from the child, it breaks out on the hands, and sometimes (which is more in point) on the breast. An exception to this rule would seem to exist in the case of dyers, smiths, and sawyers, whose hands and wrists are rarely primitively affected, and often escape, while it infests other parts: this is to be ascribed to the rough hardened state which the hands of these tradesmen contract from labour, and doubtless in the first two their immunity must be in some part owing to the chemical agents with which their employments bring their hands in contact. Sulphuric acid and other powerful astringents form a main ingredient in the dyers' liquors, and the iron and embers of the forge constantly impregnate the smiths' hands with sulphureous vapours, which are at once its best prophylactic and cure. Redi asserts that he knew an instance in which the face became the first part affected, from the contact of the collar of an infected mantle; but its appearance on the face at all is so contrary to experience deduced from innumerable observations, that this has been denied to be a genuine case of scabies by later writers.

Willan and Bateman divided scabies into four species, derived purely from the variety of form which the disease assumes. They have not been followed in this by the recent authors who have borrowed their arrangement. As the framer of a system, Willan was disposed to attach too much nosological importance to his divisions, and his followers conceiving that they imply theoretic error, have in many instances relinquished them. It does not appear, however, that by so doing they have attained either to more simplicity of arrangement or fidelity of description, but rather the contrary. In our opinion, the specific distinctions which Willan employed are as valuable as the grander divisions of his system, and to those who are jealous about natural arrangement they are less objectionable, as being the mere expressions of facts, which may be received without reference to any theory of classification. Artificial subdivisions of cutaneous diseases founded on real differences in external characters, if they have no other advantages, greatly facilitate their study, and without the aid derived from this source their description becomes necessarily either vague or defective. In scabies, these practical means of discrimination are particularly requisite, as its diagnosis, which is of great importance, is chiefly to be arrived at (where contagion cannot be proved) by an accurate knowledge of its external characters.

We now proceed further with its description, and in addition to the general remarks with which we commenced it, we recommend attention to the following divisions, which are the same as those proposed by Willan. Far from being the mere offspring of theory, they were suggested to him by their common use amongst the lower order, whose familiarity with it forces them to be intimately acquainted with the various forms in which it appears. Of these they distinguish four, designated the *rank*, *watery*, *pocky*, and *scorbutic* itch, which Willan adapted to his nomenclature under the following titles, viz.:—

Scabies papuliformis.
——— lymphatica.
——— purulenta.
——— cachectica.

Scabies Papuliformis, or Rank Itch.—In this form of scabies the eruption is generally extensive, and accompanied with slight inflammation in the vesicles, and intense itching. It is found chiefly to infest the fingers and wrists, but also spreads extensively upon the trunk, particularly the front part of the chest and abdomen. The elevations resemble papulæ, and thus seem to evince an affinity between this form and prurigo and some varieties of lichen; but where they are fully developed and unbroken by scratching, a close inspection may always detect the transparent apex which indicates its vesicular character. The itching is so troublesome that frequent scratching is resorted to, and the abrasion of the vesicles and even of the skin which ensues, changes the primitive appearance of the eruption; "long red lines are here and there left, and the blood and humour concrete upon the vesicles into little brown or blackish scabs." When it occurs in a sanguine habit, or if it be inordinately exasperated by scratching or other circumstances, some scattered pustules sometimes make their appearance, filled with thick yellow purulent matter.

Scabies Lymphatica, or Watery Itch.—The difference between this and the former is in-

considerable. The separate vesicles are larger and do not partake of the papular character, being full of serum to the base, which besides exhibits no inflammatory redness. The pruritus is extremely troublesome, and when the vesicles are ruptured, moist excoriations are apt to form, upon which after a certain time dark scabs concrete. The most ordinary appearance which this variety presents is a compound of the three stages just referred to, viz. the entire vesicle, the excoriation succeeding its laceration, and the scab which covers this ulcerated part when it begins to heal. It seldom extends like the former variety to the trunk, but is chiefly found collected at the lower parts of the extremities, on the fingers, wrists, back of the hands, and on the feet and toes.

Scabies Purulenta, or Pocky Itch.—This possesses more the characters of a distinct species than any of the other forms, and evinces the necessity of marking these varieties. As Bateman well remarks, "it is often mistaken by those who confine their notion of scabies to the ichorous vesicles of the varieties already noticed." Heberden had divided the disease into two species, comprehending in the first two former varieties under the name of "pustulæ exiguæ, aquâ plenæ." (Comment. de Morb. Histor. et Curat. Frankf. ad Mœn. 1804. P. 102.) The other he describes as "majusculæ cum fundamento rubro, et pure impleantur, fere tanquam variolæ." This resemblance of the round pustules which constitute this species to small-pox, caused the vulgar to denominate it pocky itch. They arise distinct, upon an inflamed base, above which they are considerably elevated: after a few days they maturate and break, having attained frequently to a diameter of two or three lines. The pruritus which they occasion is mixed with a painful tension of the part, different from that which occurs in the vesicular forms. After their breaking they leave a cracked ulceration behind, the heat and stiffness of which cause considerable pain. The pustules may spread like the vesicular form over the body, but seldom extend far from their original seat, which is usually the hands or feet. In these situations they are largest, and two or three of them sometimes coalesce between the knuckles, especially between the index finger and thumb. The scabby concretions which at length form upon the ulcerations adhere for a considerable time during the healing process. The pustular scabies occurs usually in children before the age of ten years.

Scabies Cachectica, or Scorbutic Itch.—This is not distinguished from the forementioned varieties by difference in external character; for it appears under the forms of the other varieties, at one time indiscriminately mixed, at another exhibiting them separately in different parts of the body. It mostly occurs in persons of debilitated constitution, brought on by indigence and intemperance, and is the most intractable form of scabies. It is not unfrequently combined in such individuals with other cutaneous maladies, as lichen, prurigo, ecthyma, and impetigo; and Bateman asserts that when the latter disease is superadded, it, as well as the scabies, possess a contagious character. He also remarks that the most severe degree of it which his experience made him acquainted with, exhibited itself in persons who came from India, and he had often observed it in children brought from that country. It is there denominated "courap," a term which is equivalent to itch, and is the same which Bontius (De Medicinâ Indorum, lib. iii. cap. 17) describes under the name of herpes, seu impetigo Indica, and Sauvages under that of scabies Indica.

It was, perhaps, superfluous to make a separate species of this, inasmuch as it possesses no particular form which distinguishes it from the others; yet, as it is so disposed in Willan's divisions, it might be invidious in such a matter to use an arbitrary power in altering an established arrangement, which we have taken advantage of for greater facility of description.

In whatsoever form scabies manifests itself, it is to be regarded entirely as a local affection, being never like other vesicular eruptions connected with disorder of the internal organs. It gives rise to no disturbance of the circulation, except in severe cases of the pustular scabies, which, from the inflammation sometimes attending it, causes slight febrile action in children. Some authors recount a list of the most formidable diseases as liable to be produced by its retrocession and the metastatic transport of the cutaneous irritation to the vital organs. These notions, however, are now disregarded, being justly considered as the imaginary fabrications of an exploded theory, which pretended that a specific virus residing in the serum of the blood was the cause of scabies. We conceive that the observations of others which assert that important diseases of the internal organs have been cured by its eruption are to be equally unheeded. Unprejudiced experience demonstrates that it exerts little or no pathological sympathy upon the internal organs, and therefore such cases as those narrated by Beer* and others can be only regarded as coincidences.

The disease chiefly shows itself amongst children; yet on this account it is not to be inferred that it shows a preference for youth more than age. This is to be attributed solely to the fact, that children are more brought in contact with infection than adults, from their heedlessness of exposure and inattention to cleanliness. It depends upon the same cause that amongst the working classes males are more generally affected with it than females. Climate does not appear to have much effect in modifying its prevalence,—although it is certainly more common in the northern parts of Europe than the southern, an observation which we think must be connected with the fact that individuals of sanguine and lymphatic are much more liable to it than those of bilious temperaments. Habits of uncleanliness, however, are more powerful than this predisposition arising from the temperaments, of which its great prevalence amongst the Polish Jews and Spaniards affords examples; for amongst these people, as is well known, the bilious preponderates beyond comparison over the opposite temperaments.

It prevails in so general and constant a manner in some countries that it may be said to be endemic. In Poland and Hungary the mass of the

*Geschichte eines geheilten vollkommenen, von zurückgetretener Krätze entstandenem, schwarzen Staars. (Account of an Amaurosis caused by Retrocession of Itch, which was perfectly cured.) 8vo. Vienna, 1798.

population are constantly more or less infected, and it is equally rife in Galicia and Asturias in Spain, in Lower Brittany in France, and in certain parts of the Highlands of Scotland. It is, however, no stranger amongst the indigent classes of every country, and where it is found to infest one region with peculiar pertinacity, this is not to be attributed to any special influence of the atmosphere or the soil, which alone would properly entitle it to be called endemic, but to the habits of the poor population. It has been suggested that salt diet and the neighbourhood of the sea were concerned in maintaining it in some districts, but these circumstances have no influence in producing it, although they are frequent concomitants of that which is its true promoting cause,—inattention to cleanliness of the person, and particularly of the habiliments. Change of linen is the surest protection from it in a family or in a country, and we may with certainty predict its prevalence amongst every people where custom or necessity has precluded this best preservative of the health of the skin.

This malady inspires, as might be supposed, no friendly feeling in communities, and it is curious in this respect to remark the difference between it and those contagious eruptions which put life in jeopardy, as small-pox, measles, &c. With whatsoever dread the latter may be contemplated, they do not produce disgust; but the itch, being free from danger, may be treated more disrespectfully, and is very generally regarded as contemptible. However, different nations have different opinions on this subject; it is reported of the inhabitants of the Spanish provinces before mentioned, that they retain it often from the cradle to the tomb, and that they are not only careless of its concealment, but regard it as a kind of hereditary possession; they even refuse to use means to be freed from it, alleging that they are not willing to change the customs of their ancestors. (Dict. des Sciences Méd. t. xvii. p. 183.) But in countries where civilization is more diffused, its residence is less tolerated. Here even the imputation of the itch becomes almost injurious, and sometimes engages philosophers in its refutation, of which the following is an example. "Laennec was a true Breton, fond of his country and jealous of its honour. It is amusing to observe the high tone he assumes in refuting a charge brought by a certain writer against his native country, for being infamous for an epidemic itch. He solemnly assures us, that if in very truth la gale s'observe quelquefois en Bretagne, on en doit moins accuser les localités, que le passage et le séjour des matelots." (Forbes's Translation of Laennec, Author's Life, p. xxviii.) Equally patriotic renunciations of it have been made in our own islands.

Diagnosis. — There is scarcely any disease compromising the general health in so trivial a degree in which it may be more important to the reputation of the practitioner to be able to deliver a categorical diagnosis than in scabies. He is in fact frequently consulted for no other purpose than to decide whether an individual has not brought this contagious affection into his circle; and as the physician's opinion on the one hand sets him free from this suspicion, and on the other sentences him to a temporary banishment from society or even from his employment, it is obvious how much it behoves him to be able to distinguish it without error. In forming his opinion, he should learn to be as much as possible independent of the criterion furnished by its contagious quality, for it will be generally where this point is yet undecided that his judgment will be sought for. When some evidence of exposure to infection exists in addition to the proper characters of the eruption, there is no difficulty; but if such be unattainable, it will often require all the resources which an accurate acquaintance with it and other affections which resemble it supplies to distinguish between them. The eruptions with which it is liable to be confounded are some forms of lichen, prurigo, and eczema. The papular elevations of lichen are attended with considerable itching, and are frequently abraded by scratching, so that considerable resemblance may exist between them and scabies, particularly the first variety of it above noted, (*s. papuliformis.*) If the latter be present, the apparent papulæ, examined in an unbroken state, will be found to be topped by a vesicular apex, and where they have broken spontaneously, a dark scab remains; but in lichen the papula is solid, even to the summit, and it passes away in a scurfy exfoliation. Lichen occupies the back of the hand, and the external surface of the limbs, and is seldom or never developed in the intervals of the fingers. Moreover the itching is not nearly so intense as in scabies, and is of a more remitting nature, and the papular eruption is commonly attended by some constitutional disturbance which is foreign to scabies. In the lichen *urticatus* the eruption is of a more acute nature, and has occasionally a few vesicles interspersed amongst the papulæ, which might confound an observer who relied on any single characteristic; but the diagnosis in this case is still easier than in the simple lichen—the inflamed wheel-like papulæ, causing rather a deep tingling than an intense itching, sufficiently distinguish this eruption. Finally, the suspicion of contagion will seldom attach to any form of lichen.

The itching of prurigo is of a still more vehement character than that of scabies; they were of old frequently confounded, insomuch that the former was sometimes erroneously denominated scabies *sicca*. (See Prurigo.) The diagnosis between them is not difficult if these points be held in memory. Prurigo occurs chiefly in elderly individuals; its papulæ are flat, and when abraded by the nails no serous fluid is effused, but a dark spot of blood concretes upon their surface. The situation also of the pruriginous eruption (as that of lichen) is distinguished from scabies by its preference to the surfaces of extension on the extremities, instead of those of flexion, which the latter particularly affects. Prurigo, moreover, is not contagious.

In eczema we have a vesicular eruption, which often bears a striking resemblance to scabies in the second variety, (*s. lymphatica.*) Its vesicles, however, are more flattened and confluent than those of scabies, which are acuminated and distinct. But when the disease is passed to an ulcerated and scabby state, such distinguishing characters may be wanting, and then other cir-

cumstances must be sought out. Eczema is for the most part a local affection, and when the itch has in any place assumed the ulcerations and soft scabs which resemble it, the eruption has proceeded to a considerable extent, and will doubtless show its proper form in the parts which it has most recently invaded. The irritation of eczema is a stinging or tingling sensation very different from the pruritus of the itch, and its origin may be often traced to the action of irritating causes upon the skin, as sugar, lime, and other acrid substances, or to exposure to the solar rays or great heats.

Very lately a female presented herself to the writer with an eruption at the root of the right middle finger, which from its situation and appearance was difficult to distinguish from scabies. She ascribed its origin to milking cows, whose teats were in a diseased state. The pruritus was not that of scabies, and after a careful examination it was concluded to be a vesicular form of impetigo. Bateman calls attention to the possibility of confounding the pustular form of scabies with impetigo, and even with ecthyma; and although this seems remote, it is yet only a prudent caution to keep in mind every form of cutaneous disease which bears any affinity to it.

A circumstance in the history of scabies of the greatest moment, is the simultaneous presence of the diseases which we have just contrasted with it for the sake of diagnosis. This is indeed rare in ordinary cases of itch, but the fact of its occasional occurrence forcibly impresses the necessity of cautious examination, and adds much practical importance to the diagnosis, because those complications require a line of treatment quite distinct from that of scabies. They are met with in the cases in which much inflammation has attended the scabid eruption, and (which serves to illustrate what we have said as to their different treatment) they are very frequently produced by improper applications for its cure, such as powerfully irritant lotions or frictions. The actual complication which may be present will be much influenced by the constitution and age of the subject; in young and vigorous habits, the excess of irritation will mostly take the form of eczema or of impetigo, while in those of an opposite condition pustules of ecthyma may appear, or the inflammation may seize on the cellular tissue, and an eruption of boils be the consequence. Cazenave and Schedel remark that the same subject may present at once "vesicles of itch, pustules of impetigo, pustules of ecthyma, and boils," (Abrégé Pratique des Mal. de la Peau, Paris, 1828, p. 120,) a case which would exercise the diagnostic tact of the physician to discover the primary contagious disease amongst so many complications.

Causes.—The universally diffused cause of scabies is contagion, and it appears to be the disease which of all is most readily communicated by contact. When it once gains admission into a family, the greatest caution often fails in preventing it from infecting every individual. A question exists undecided among pathologists as to whether it ever originates from any other source than contagion. It was observed by Sir John Pringle, that in military hospitals the patients often became the subject of itch after the crisis of fevers, (Bateman's Synopsis, p. 288, note); but there remains little doubt in our mind that this excellent physician in these instances mistook some of the papular eruptions, as lichen or prurigo, for scabies, for those are not uncommonly observed to occur when the skin recovers its tone in the convalescence from fever. We would make the same remark with respect to a kind of it which Heberden describes as primarily contracted by contagion, but which being cured by the customary remedies, "tamen non cessat redire semel vel bis quotamnis." (Op. cit. p. 102.) This is rather the description of the lichen simplex, occurring periodically in a person who has been once affected with scabies; for this faithful observer adds, that after its first attack it is no longer communicable by contagion, even to those who lie in the same bed, and that it as often terminated spontaneously as it was removed by any remedy. Bateman thought that it might originate without contagion in crowded, close, and uncleanly houses, and wherever the means of cleanliness were not obtainable. (Synopsis, p. 289.) These are, however, just the circumstances which facilitate the propagation of contagion. On the whole, there are no facts which contravene the opinion of those who assert that the latter is its sole origin, and it appears to us that it agrees best with every analogy.

We have reserved to this head the notice of a very remarkable circumstance connected with the etiology of scabies, the existence of the insect called by Linnæus and by preceding naturalists "*acarus scabiei*." First in the writings of Avenzoar, the Arabian physician, and subsequently in those of Ingrasias, Gabusinus, and Joubert, notices of a minute insect occurring in a certain disease of the skin attracted the attention of the English entomologist Thomas Moufet, who examined and described them with considerable accuracy. They are, according to him, minute animalcules similar to the acari of decayed cheese or old wax, which burrow under the cuticle, and excite intense itching, with an eruption of vesicles. His observations were repeated by various naturalists in different parts of Europe, and Hyacinth Cestoni, at the end of the seventeenth century, investigated the characters of this insect with much exactness, and was the first proposer of the theory which regards it as the proximate cause of the itch.*

This doctrine gave rise to a controversy which has continued ever since, and seems at the present day to be as far from being settled as ever. In the order of time, two questions are involved in this subject. By the first the acarus, or (as Latreille denominated it generically) *sarcoptes* scabiei, was universally received; but issue was joined on the opinion first mooted as a conjecture by Cestoni, that scabies is nothing else than the bite of these small insects, which produces the itching and an extravasation of serum collecting into vesicles; moreover that the contagion is effected by the transfer of those insects from one individual to another. Experiments were made, and opinions were contested negatively and affirmatively, by

* This was communicated by Cestoni's coadjutor, G. Bonomi, in a letter to an eminent physician, Francisco Redi, in whose works it was first published, in 1686. (Dict. des Sc. Méd.)

many eminent medical men in different countries. Redi, Wichmann, Osiander, Pringle, and many others, considered the contact of the insect as the only exciting cause of the itch; while as great a number insisted that the acarus was produced by the disease. Again, a middle opinion was embraced by the majority, to which Morgagni attached himself. They held that in most cases the insect was the product of the disease, but admitted that in some instances the latter owed its origin to the insect. M. Galès, apothecary to the Hôpital St. Louis in 1812, undertook a series of investigations, which he conducted with the greatest variety and perseverance, and which finally seemed to leave nothing undecided as to the whole subject. He observed with the microscope upwards of three hundred of the insects taken from the scabious vesicles.* He confined the insect upon his hand with a watch-glass, and observed it penetrating the cuticle, upon which, after a few hours, three vesicles appeared, the intense itching of which left no doubt of their identity with scabies. He inoculated in the same manner three children with the insect, who became covered with the itch. These experiments were testified to by many of the first naturalists in Paris; and as they appeared to have the force of demonstration, after their publication the opinion that the itch was produced by the insect was ratified by the assent of almost all. They doubtless proved the presence of the acarus, and moreover that its penetration of the skin is an occasional cause of scabies; but with all, this may be a very secondary matter in the production of the disease. In fact, it seems to us somewhat singular that these observations were permitted to prove more than that the insect taken from a scabious vesicle, *being charged with the virus, the fluid of the vesicle*, by penetration of the cuticle, inserted this virus, and produced the disease, like the inoculation of cow-pox.

At a later period, however, the opinion supposed to be thus incontestably fixed by M. Galès' experiments was not only called in question, but, singular to relate, the existence of the acarus was again doubted. M. Suriray of Havre, and afterwards MM. Lugol and Mouronval, revived the discussion of the subject, and, as the result of their researches, denied that any insect could be found. This extraordinary revulsion of opinion was confirmed by M. Biett, who, even with the use of microscopes of high power, was unable, in a great number of trials, to discover it in a single instance. Cazenaze and Schedel state that many others have made an equally unsuccessful search for the insect; and rejecting for themselves the idea of its existence, they announce a kind of challenge to M. Galès to transport himself again to the Hôpital St. Louis, and demonstrate it anew.

It would follow from these negative researches, that while at one period the disease is attended by the acarus, at other times it exists without it. In these countries it is a notorious fact that the insect is frequently found. Moufet originally stated that the common people were in the habit of extracting it from the vesicles with the point of a pin; but that more usually it may be found in a small channel which it frets from the vesicle in the adjoining cuticle. We have conversed with those who have frequently seen them, and whose description of their being found not in the vesicle but in the red streak adjoining it, exactly coincides with Moufet. Bateman and Mr. Plumbe bear the same testimony; and the latter adopts an hypothesis proposed by Galès and Fournier, (Dict. des Sc. Méd. art. *Gale*, tom. xvii. p. 109,) by which it is conjecturally affirmed, that when the elevation becomes large and full of lymph, it being no longer possible for the insect to exist in it, in obedience to a preservative instinct it makes its way laterally, and is then found beside and not within the maturated vesicle. He supposes, also, that it is sufficient to account for the ill-success of those who have not found it, to presume that they happened to select for their researches vesicles which had been evacuated by the acari. This does not occur to us as by any means satisfactory; but the opinion of Sauvages, adopted by Bateman, seems more plausible, that the insect is generated only in some instances of scabies, of which cases Sauvages proposes to make a particular species under the title of "scabies *vermicularis*." This is not irrational; yet we deem it more consonant with the varying history of the researches to suppose that there is a variation in the *disease itself* in this respect at *different epochs*. This view is more consistent with analogy, as we know how often the type of diseases changes at different epochs in the same locality, without therefore losing their identity. Of this fever is a familiar example, which it is unnecessary to do more than mention in respect to its change of type; but an occasional phenomenon which it presents (as was remarked by M. Ranque of Orleans) may be adduced, and reflected on in connection with the generation of the acarus scabiei. We allude to what is occasionally observed when a favourable crisis takes place at the last extremity of typhus; the head is sometimes swarmed by a sudden production of lice, so unaccountably numerous as only to permit the supposition that they are secreted by the skin.

According to the view here propounded, and in agreement with the analogy just mentioned, the animalcule of scabies is regarded as a secretory product of the disease, which at certain periods is endemic; but ignorance is professed as to the circumstances which give rise to it at one time more than another; and at the same time we agree with Bateman, that the contagious property of scabies exists in the fluid, and not in the insect, which, however, may be the occasional means of transport of the latter. We would finally remark, with regard to the whole controversy, that it includes a lesson at least to medical theorists: here many ingenious men oppose each other in a matter of fact and observation; with what sobriety, then, should dogmatic opinions be entertained, when it is often so difficult even to lay their foundation in certain facts!

[Most recent writers on the subject are disposed to consider the acarus as the cause of itch (E.

* His descriptions of the insect agree with those of Linnæus and Latreille, but are much more extended and exact. It has six legs, with a few filaments besides projecting from the body, and is not unlike the minute pulix sometimes accompanying prurigo. It lies in the centre of the vesicle, round the margin of which it deposits its ova.

Wilson, *Practical Treatise on Diseases of the Skin*, Amer. edit. p. 235, and W. Horn, art. *Scabies* in *Encyclopäd. Wörterb. der Medicin. Wissenschaft.* xxx. 138. Berlin, 1843.) Mr. Wilson classes scabies as the only example of inflammation of the skin induced by parasitic animalcules inhabiting the epidermis; yet it is not easy to understand how it is readily communicated by contact, under the idea that it must be conveyed by the insects, as it is by no means a matter of facility to extract them from the furrows where they are domiciliated.

It was not until the year 1834, and after several distinguished individuals had tried in vain, (Dr. Biett, art. *Gale*, in *Dict. de Méd.* 2de édit. xiii. 547, Paris, 1836,) that the manner of finding the acarus was clearly demonstrated. A medical student from Corsica, M. Renucci, had frequently seen the women of his country extract the insect, and had often done so himself; and he showed, that it must not be sought for in the vesicle, but in the furrow which sets out from it, and which is made by the insect beneath the epidermis.]

Treatment.—The cure of scabies appears to have been considered a matter of no slight medical interest. Treatises have been written upon it, and a vast variety of means discussed with so much earnestness, that we are led to the conclusion, (which we believe coincides with general tradition,) that it was formerly a scourge to the community of greater extent and virulence than at the present day. It is now regarded as of trivial importance. Never in itself dangerous, it gives much annoyance to the individual by its unappeasable itching; but the fear and restraint which it puts upon him of infecting others often causes as much discomfort to him as its action upon himself. Neglect of the appropriate means may indeed protract it to an indefinite length; but by their use its treatment is conducted with so much certainty that we have scarcely any other care in the choice of remedies than to select that which experience has approved of as effecting a riddance of the disease in the most secure and speediest manner. A multitude of such has been vaunted, but modern practice has contracted the most useful within a small circle; and it is unnecessary to enumerate here any of minor efficacy, as we are in possession of some whose virtues are almost infallible.

Sulphur is considered in the light of a specific remedy in the cure of itch. It is the basis of the applications which by universal consent are considered its most effectual antagonists. In the ordinary forms of the disease the common people have long used it as an ointment, mixed with equal parts of hog's lard or butter, with which they smear the parts on which the eruption exists once or twice a day. They administer it internally at the same time, in doses of from ten grains to half a drachm given in milk at bed-time. By this treatment they scarcely ever fail to cure it expeditiously. The internal use of sulphur is adapted for it in children, and is occasionally combined with magnesia; in adults, however, it is unnecessary to have recourse to any but the external use of the sulphur ointment. The assiduous use of it for a fortnight is sufficient to cure the common forms of it, if they be attacked with it speedily after its first appearance, as the duration of the treatment will be longer if long neglect has permitted it to gain a certain inveteracy.

A great improvement was made in the application of the sulphur ointment by the combination of an alkali with it. This adds to the specific effect of the sulphur the advantage of a detergent action, which loosens and dissolves crusts or scabs, and permits the skin to be well penetrated by the ointment. M. Helmerich, a French army surgeon, became famous for a method of using sulphur which cured the itch more promptly, and also permitted the greasy stain of the ointment to be removed from the linen by washing, obviating an objection to the use of unguents which was very generally felt. He kept it a mystery, but it was analyzed by M. Burdin, and found to consist of the following ointment:

Sublimed sulphur, two parts,
Sub-carbonate of potass, one part,
Axunge, eight parts, intimately mixed.*

This deserves a preference over all other methods of applying the sulphur externally. It has the most constant and prompt success, and is seldom attended by the cutaneous affections which sometimes result from the use of other stronger but more irritating sulphureous applications. It is the ointment which Biett has exclusively employed at the Hôpital St. Louis for several years. He orders half an ounce of it to be rubbed, morning and evening, over all the parts occupied by the vesicles. The action of this ointment is favourably promoted by the use of a tepid bath every second day during its application, which will rarely have to be continued beyond ten or twelve days. Another sulphureous friction which, in the Paris hospitals, rivals the reputation of the above-mentioned ointment, is made with the sulphuret of lime. A scruple or half a drachm of this powder is to be triturated with a small proportion of olive oil, so as to render it sufficiently fluid for using as a friction, and this quantity is to be rubbed upon the affected parts twice a day. This is a very effectual cure, but it is not so applicable as the former when the itch has already spread to any considerable extent.

[In more obstinate cases, the Unguentum Sulphuris compositum of the Pharmacopœia of the United States, which contains—in addition to the sulphur—ammoniated mercury, benzoic acid, oil of lemons, sulphuric acid, and nitrate of potassa, may be substituted. The writer is more in the habit of prescribing the Unguentum Sulphuris compositum of the London Pharmacopœia, which contains—sulphur, ℥iii.; veratr. pulv. ʒi.; potas. nitrat. ʒij.; saponis mollis, ℥iij.; adipis, ℥ix.; ol. bergamot, ɱ xv.]

The use of ointments over an extensive surface of the skin may be considered unadvisable in some cases, as interfering with the cutaneous transpiration. When these objections exist, substitutes of no less efficacy are found in the proper use of lotions. None of these is preferable with regard to activity to the solutions of sulphuret of potash, or of lime. These have been long known and ex-

* For the sake of depriving this ointment of the smell and appearance of sulphur, it would be agreeable to add to each ounce of the axunge a few drops of oil of lavender or bergamotte, and ten grains of the hydrargyri sulphuretum rubrum (vermilion).

tensively used in scabies, and a saturated solution of the latter is an excellent remedy in the mange of sheep or dogs. The following formula of a lotion was prescribed by M. Dupuytren, and highly extolled in France for the promptitude with which it effects the removal of the disease:

R.—Sulphureti potassæ ℥v.

Aquæ puræ lb. iss.

Acidi sulphurici ℥ss, dissolve ut fiat lotio.

Whatsoever part of the eruption has invaded is to be moistened by a gentle friction with this lotion twice a day. It has the advantage of not injuring the linen of the patient, nor does it compel him to renounce his employment during its use. However, it produces a smarting of the skin, which will sometimes require it to be used in much weaker proportions, and renders it not so appropriate in some irritable habits.

If the individual entertain insuperable objections to the use of sulphur from disgust to its odour, many other external remedies of approved efficacy are at hand. The ointment of white hellebore, in the proportion of a drachm of the powder to an ounce of lard, is both a safe and expeditious application. Solutions of the chloride of lime or of soda have been extolled as highly beneficial by some practitioners; they are used as a lotion in the proportion of an ounce to a pint of water. The aqua chlorinii applied in the same manner is also mentioned with applause. Heberden strongly recommended a lotion composed of a solution of the muriate of mercury, made with one drachm, or two, (according to the inveteracy of the disease,) to a pint of water. This is acknowledged to be a remedy of great power in curing scabies, but it is objected to by some as liable to produce the constitutional effects of mercury. We have, however, been assured that these fears are vain, by an esteemed practitioner, who has had a very favourable experience of this lotion, and has used it on his own person with success; and in our own more limited sphere of observation, we never saw any such effects from it.

[These ointments are less offensive than the ointments of sulphur, but they are certainly less sure. The same may be said of those of creasote and of chlorinated lime.]

Sulphureous baths are an excellent auxiliary means in many cases of scabies. In cases of very irritable skin they are frequently the only form in which general applications of this remedy can be made to the surface; in young children, therefore, they are a very valuable resource. The artificial are found to answer the purpose equally well with the water of sulphureous springs, and their employment possesses the advantage of being proportioned according to circumstances. They may be prepared by simply adding to an ordinary sized warm bath six ounces of the sulphuret of potash in powder, and agitating it until it be dissolved, and the water be reduced to a lukewarm temperature.

Sulphureous vapour baths are another means which possess great power in this as well as in some other diseases of the skin. This is evident from the testimony of all who have used them, from M. Gales, who was the first to construct an apparatus for their convenient administration, to Mr. Wallace, who has also ably illustrated their use. Dr. Bardsley informs us, that he has "always seen the most obstinate and neglected cases of it yield very speedily to a few fumigations." (Hosp. Facts and Observations, p. 198.) It is happily to such inveterate cases that they are mainly applicable; for even if they did possess the superior advantages over ordinary methods of treatment which are claimed for them, they are too stimulating to be employed in many cases except where the disease has become chronic through neglect, and has induced an unhealthy torpid condition of the skin. They are particularly contra-indicated where there exists any tendency to congestion in the gastric or pulmonary mucous membranes, and in females with complaints depending on morbid conditions of the uterine functions.

In the conduct of the treatment the practitioner has but little to be solicitous about; but, having used his discrimination in the adoption of the most appropriate remedy, he perseveres until the cure is complete. He should inculcate great attention to cleanliness and change of linen, especially during the convalescence. A vigilant inspection must be made for the purpose of detecting any of the complications previously noticed as apt to coexist with certain forms of the disease, or to spring up under improper treatment. If any of those be present, it will be necessary to modify his plan accordingly, and often to suspend the use of the stimulating remedies, with which he had commenced to combat the scabies. The state of the alimentary canal now demands particular attention; cooling laxatives and alteratives will be proper; and for topical applications recourse should be had to emollient fomentations, and the other soothing means specially adapted to the individual complication, for which we refer to Ecthyma, Eczema, Impetigo, Lichen, &c.

James Houghton.

SCARLATINA.—*Syn.* Morbilli Confluentes, *Morton:* Rubeola Rossalia, *Hoffmann:* Febris Scarlatina, *Sydenham:* Febris Rubra, *Heberden:* Scarlatina, *Sauvages*, *Vogel*, and *Cullen:* Purpura, *Shultz*, *Junck:* Enanthesis Rosalia, *Good:* Fièvre Rouge, Scarlatine, *Fr.:* Der Scharlachaufschlag, *Germ.:* Scarlet Fever. Scarlatina designates a contagious febrile disease, the distinguishing characters of which are, a scarlet efflorescence of the skin and of the mucous membrane of the mouth and pharynx, appearing on the second day (though often later) of a febrile disorder, and terminating about the fifth; accompanied, in the majority of instances, with inflammation of the throat, either of a phlegmonous or gangrenous character; and occasionally with tumefaction of the cervical absorbents and subcutaneous cellular membrane. Other organs become also sometimes involved in the progress of the disease, giving rise to lesions of greater or less severity. The type of the accompanying fever is various, and modifies remarkably the whole aspect of the malady. In some cases, the constitutional disturbance is so trivial as scarcely to attract notice; in others, the febrile symptoms are those of strong inflammatory excitement; while in individual instances, or during the prevalence of an entire epidemic, the fever

is of a low typhoid form, the local inflammation with which it is associated, partaking very much of the same character.

The origin of scarlatina is involved in great obscurity. It was evidently unknown to the ancients; no allusion to it can be discovered in the writings of Hippocrates, or in the early Greek and Roman writers; and, notwithstanding the opinion of some modern authors of the French school, that it was described about the middle of the sixteenth century, it is generally admitted that Prosper Martianus, an Italian physician, who gave a description of the disease as it prevailed in Rome about the middle of the seventeenth century, if not the first, is among the earliest writers on scarlatina. It made its appearance in London in 1689, and was described by Sydenham and afterwards by Morton, though it is evident by comparing the description given by these two writers, that they had observed different epidemics; the one described by Sydenham being a very mild disease compared with that of which Morton has given an account. From the various names, however, given to scarlatina on its first appearance, it is evident, that about the period to which we refer, the notions entertained with regard to it were vague and unsatisfactory; indeed, it was scarcely distinguished from measles, roseola, or purpura. For example, it was named by Morton *morbilli confluentes*; by Hoffmann, *rubeola rossalia*; by Heberden, *febris rubra*; and even till within a little more than half a century, both these diseases (measles and scarlatina) appear to have been considered by medical writers as the same, or at least as so closely allied, as only varieties of a common species. Morton, indeed, maintained their identity, and considered their relative connection to be nearly the same as that existing between the distinct and confluent small-pox. (De Morbillis et Scarlatina, Exercit. iii.) The description of the epidemic given by Huxham under the name malignant ulcerated sore-throat, which prevailed in the year 1734, resembles in almost every particular one form of scarlatina — that form in which the eruption is accompanied with affection of the throat. The treatise on this subject is a valuable record of the characters of this epidemic, the description being evidently taken from what he had observed in his intercourse with the sick. Dr. Fothergill also has given the history of a "sore throat attended with ulcers," which appeared in London in 1747–8, which there can be little doubt was an epidemic scarlatina; and from the remarks he has made, it is evident, that he had observed various forms of the disease, from the mildest to the more malignant. Dr. Withering published an essay on scarlet fever in 1778, a second edition of which appeared in 1793; to this author is due the merit of having first accurately described scarlatina as a distinct disease; since that period, various treatises have appeared both in this and other countries.

Causes.—Nothing satisfactory is known as to the exciting causes of scarlatina. It appears to be induced, like the other eruptive fevers, by exposure to the influence of a specific poison. Attempts have been made to induce the disease by inoculation, by inserting the thin scales, which are thrown off at the period of desquamation, under the skin of individuals who have never had scarlet fever, but hitherto without success. How far inoculation with the blood might be followed by different results is a question which can only be determined by experiment.

That scarlatina may be propagated by contagion is, we presume, admitted even by those who profess themselves sceptical on the question of contagion in general. Instances of the disease spreading in a manner which can only be explained by admitting its contagious origin are so numerous, that practitioners of the most limited observation must have had repeated opportunities of determining the question. We have known, in several instances, convalescents from scarlet fever, on their removal to a considerable distance from the situation in which they had passed through the disease, infect individuals with whom they came in immediate contact, though several weeks had elapsed from the period of desquamation. The period of invasion after exposure to sources of contagion is exceedingly various. Some individuals are seized within a few hours; others do not exhibit any of the peculiar symptoms for several days; and in some more rare cases, five or six weeks have intervened between the period of exposure and the accession of the disease. The poison also appears to affect individuals very differently. Of a number of persons exposed to the same source of infection, some may escape altogether; others have a mild form of the disease; or it may happen, perhaps, that in several, the disease proves severe. Even in the same family the various forms which scarlatina presents may occasionally be observed. One or more may have both the efflorescence and the sore throat; in others there may be fever with the characteristic rash but without any affection of the throat; another case may present the characters of the malignant disease; while, again, those who have been in constant attendance on the sick become indisposed with smart inflammation of the throat and a considerable degree of fever, which lasts for some days, and then subsides with the local affection. In these latter cases, (though there have been no efflorescence), desquamation of the cuticle occasionally occurs. Dr. Rush, in an account of an epidemic scarlatina which prevailed at Philadelphia, remarks that such was the prevalence of the contagion which produced the scarlatina anginosa, that many hundred people complained of sore throat without any other symptoms of indisposition. The slightest occasional exciting cause, particularly cold, seldom failed of producing the disease. (Medical Enquiries and Observations.) The same thing has been repeatedly observed in this country.

Although sporadic cases of scarlet fever are met at all seasons, it is more prevalent at the end of summer, and in the autumn, than at other periods of the year. Epidemic visitations have been most frequently observed after a warm summer, especially when the heat has been accompanied with continued rains; and when the succeeding winter has been open and mild, the disease has continued till it has been checked by frost. It generally disappears in the spring months, though it has been observed to continue uninterruptedly for one or more years.

It is necessary to advert in this place to the difference in the characters of epidemic scarlatina, though the causes of such remarkable variation are unknown. For a whole season, the disease may assume a mild aspect, so that a fatal case is rarely met with; in such instances, the danger is generally produced by some local inflammation which has supervened in the progress of the disease, or during the period of convalescence. On the other hand it should be remembered, that during a comparatively mild epidemic, one or more cases may assume a malignant character, and resist the best directed curative efforts. Sometimes an epidemic of a malignant form, or, as it is popularly termed, a *putrid* form of scarlet fever suddenly breaks out and proves extremely fatal. From its commencement the symptoms often denote a severe form; at other times on its first irruption the disease is mild, but suddenly, without any apparent cause, the symptoms assume an unfavourable appearance, which continues as long as the epidemic lasts. It is therefore of great practical importance to ascertain the prevailing type of the disease, as the character which it assumes must regulate the treatment to be adopted.

Dr. Willan observed, (On Cutaneous Diseases, p. 277 and 281,) that when the scarlatina spread widely, it exhibited in the different persons affected every gradation of appearances, from the slightest to the most malignant form of the disease; yet during its diffusion through some large families and schools, he had seen it uniformly retain the series of symptoms which occurred in the first patient, with nearly the same degree of fever. In the autumn of 1786, and occasionally since that period, the scarlatina maligna above described affected the inhabitants of several districts in London, comprising narrow courts, alleys, and close crowded streets, and afterwards extended to some adjoining villages in low, damp, or cold situations. It is, however, more frequently intermixed with the other varieties of scarlatina, and it sometimes unexpectedly supersedes the milder forms of the disease on the fourth, fifth, sixth, or seventh day of their course.

"It is truly singular," he adds, "that the slightest of all eruptive fevers, and the most violent, the most fatal disease known in this country, should rank together and spring from the same origin. Experience, however, decides that the simple scarlet fever, the scarlatina anginosa, the scarlatina (or angina) maligna, and the scarlet ulcerating sore-throat, without the efflorescence on the skin, are merely varieties of the one disease. That all of them proceed from the same source of contagion is evident, because under the same roof in large families some individuals have the disease in one form, some in another, about the same period."

Scarlatina occurs more frequently in the early than in the advanced periods of life, and in our own experience females are more liable to the disease than males. Dr. Withering states that the epidemic which appeared at Birmingham in the year 1778, affected children more than adults, but seldom occurred in the former under two years of age. In children, the number of boys and girls that suffered from it was nearly equal; but in the adults, the number of female patients considerably exceeded that of the male.

In order to determine its relative frequency in the sexes at different ages, we selected from the register of patients admitted into the London Fever Hospital, two hundred cases in the order of their admission. The following table gives the general results:—

Age.	Males.	Females.	Total.
From 6 to 10	7	8	15
10 " 15	8	15	23
15 " 20	17	40	57
20 " 25	14	39	53
25 " 30	8	21	29
30 " 35	6	10	16
35 " 40	1	2	3
40	1	0	1
42	0	1	1
48	0	1	1
57	0	1	1
	62	138	200

It is proper, however, to state that this table cannot be considered quite complete, the number of children under six years of age who take the disease not being ascertained, in consequence of the regulations of this hospital precluding the admission of children under six years of age. The table shows the great majority of females at every age, and also disproves the assertion of Sir Gilbert Blane (Select Dissertations, p. 213) and others, that the majority of those who are seized with scarlatina are under puberty.

Scarlatina in general affects the same individual only once during his life, and in this respect obeys the general law of exanthematous fevers. Occasional exceptions have certainly been observed by practitioners, though, from the testimony of Dr. Willan, a second attack of scarlatina in the same individual is extremely rare; he states that he had never seen such a repetition among two thousand patients whom he had visited in scarlatina. We certainly have met with several well authenticated instances of a second attack of scarlatina in the same person.

[Dr. Billing (*First Principles of Medicine*, Amer. edit. p. 191, Philad. 1842) states, that he has known it occur three times in the same individual,—frequently twice; in one instance, twice within ten months, in its exquisitely marked form, as to inflamed tonsils, appearance of tongue, eruption, and desquamation of cuticle. Recently, the writer attended a lady who, six years ago, was affected with it, for the first time, in childbed,—the child being born with the eruption: three years afterwards, her child had it for the second time, and died; and she also suffered severely from a second attack. Recently, from attending on a young gentleman who died of the disease, she had a third attack.

It is by no means uncommon for those who have had the disease, to suffer from sore-throat—*scarlatina faucium*—when they are in attendance upon one labouring under scarlatina. (See *Guersant & Blache*, art. *Scarlatine*, in *Dict. de Méd.* 2de édit. xxviii. 158, Paris, 1844.)]

It is proper to notice the discovery of the supposed efficacy of the extract of belladonna as a preventive of the infection of scarlatina. This was first suggested by Hahnemann, of Leipsic, in

1807. The belief that this narcotic possesses such a preventive power is gaining ground in some parts of the continent, and lately even in our own country. The following abstract will explain the views of Hahnemann on this subject. A favourite doctrine of this writer is, that diseases are to be combated by remedies, the effects of which are similar to the diseases for which they are given. This is the doctrine to which the term *homœopathia* has been given, and which has of late years gained many proselytes in Germany, France, and Italy. Hahnemann observed, that belladonna given in small doses produced heat and dryness in the throat, swelling of the submaxillary glands, and a cutaneous eruption, sometimes an efflorescence only, at other times a papular rash, like miliaria; he therefore inferred that this medicine, from its producing symptoms analogous to those of scarlatina, might prove a preservative against its infection. About ten years after Hahnemann had entertained this notion of the anti-scarlatinous power of belladonna, a severe and fatal epidemic appeared in several cities of Germany, and consequently the physicians were naturally desirous of adopting measures calculated to arrest its progress. From the result of the trials made by Berndt, of Custrin, who was the first who made a series of experiments, we find, that in an epidemic scarlatina which prevailed in Custrin in 1818 and 1819, he employed the belladonna as a preservative in one hundred and ninety-five children under fifteen years of age; though they were freely and constantly exposed to the contagion of scarlatina, only fourteen took the disease, and that after employing a stronger preparation of this drug, every individual escaped. A still stronger testimony in favour of its efficacy is given by Dusterberg, a physician of Warburg; he states, that every child who took the belladonna for a sufficient length of time before exposure to infection escaped; that when a child was left in an infected family to nature, (the belladonna not having been administered with the object of determining its efficacy) it was invariably attacked with scarlatina, while the others who took the remedy escaped. Behr, of Bernberg, also affirms that of forty-seven persons who took the belladonna as a preservative, only six were attacked. Professor Koreff, of Berlin, after extensive and long-continued trials, asserts that if the belladonna be taken in proper doses for eight or nine days before exposure, and be continued till the period of desquamation, there is little danger to be apprehended from free intercourse with persons affected with scarlatina. Similar testimony has been given as to the efficacy of this narcotic by Hufeland, Kunzman, of Berlin, and others.*

[On the other hand, the belladonna has failed to exhibit any prophylactic powers in the observation of many respectable practitioners, (Pereira, *Elements of Mat. Med. and Therapeutics*, Amer. edit. ii. 307, Philad. 1843, and Rilliet and Barthez, *Traité Clinique et Pratique des Maladies des Enfants*, ii. 641, Paris, 1843.) Dr. Pereira remarks, that whilst the facts brought forward in favour of the existence of the prophylactic fever are only negative, those which can be adduced against it are positive; for twenty cases of failure, he conceives, are more conclusive against it than one thousand of non-occurrence are in favour of it. The writer has repeatedly administered it; and, as elsewhere remarked, (*Practice of Medicine*, 2d edit. ii. 538, Philad. 1844,) until the winter of 1843, none took the disease. At that time, during the prevalence of scarlet fever in his own neighbourhood, the belladonna was sedulously administered to his children, five in number, — two of whom, the youngest three years old, and the oldest six, after having taken the belladonna for six weeks, were attacked,—the others escaping. The disease was severe, but it was not attended by any specially alarming symptoms.]

The quantity administered is very minute. Three grains of the extract of belladonna are to be dissolved in one ounce of distilled water; of this solution two or three drops are to be given twice a day to a child under twelve months old, and one drop more for every year above that age. In general, no sensible effect is produced by it, but in some instances, it brings out an eruption similar to scarlatina. It is also asserted by those who have tried this remedy, that even when it does not prove a preventive of the infection of scarlatina, which may be in consequence of its not having been administered for a sufficient length of time before exposure, it renders the disease more mild, and even that if it be taken for four or five days before exposure, the disease never proves fatal. As we have never employed the belladonna as an anti-scarlatinous remedy, we can offer no opinion of its merits, though we certainly profess ourselves sceptical as to the powers ascribed to this drug. The subject is, however, worthy of further experimental inquiry. It has one advantage, that of being perfectly harmless, if it do not act as a preservative.

Varieties.—Scarlatina occurs under several forms, to which it is necessary to advert. In the first, the affloresence is attended with mild febrile symptoms, but there is no inflammation of the throat (*scarlatina simplex*). In the second the fever is of a more severe character, and the efflorescence is accompanied with inflammation of the throat (*scarlatina anginosa*). In the third, the whole character of the disease is more severe than in either of the preceding varieties: the fever is of a low or typhoid type; the throat is affected with gangrenous inflammation, accompanied with tumefaction of the cellular tissue and absorbents of the neck, and in general with an acrid discharge from the nostrils and ears (*scarlatina maligna*). In other instances, the efflorescence is confined to the mouth and throat, and does not affect the skin. This form (to which no name has been given) is often observed during the prevalence of epidemic scarlatina; not unfrequently in adults, when some other form of the disease is prevailing in the family. It may be designated by the name *scarlatina faucium*.

1. *Scarlatina simplex.*—In this form of the disease there is only the efflorescence with a moderate degree of fever. The rash is preceded by slight symptoms of fever—irregular shivering,

* Vide Arch. Gén. de Méd. Juin, 1824. — Journ. Complement. Juin, 1824. — Hufeland, Journ. der practischen Heilkunde, Nov. 1815. — Rust, Magazin für die gesammte Heilkunde, xx. i. 182.

nausea, sometimes vomiting, thirst, and heat of skin. The degree of fever is by no means uniform; the symptoms are sometimes so moderate as scarcely to attract attention, though there is often smart constitutional disturbance, indicated by pungent heat of skin, flushing of the face, suffusion of the eyes, pain of head, restlessness, and occasionally delirium. The efflorescence or rash generally comes out on the second day of the eruptive fever, but in some instances it does not show itself till the third, and accordingly we find authors differing as to the precise period at which it appears. Sauvages and Cullen state that it does not come out till the fourth day after the accession of the febrile symptoms. Plenciz (Tractatus de Scarlatina, 1776,) does not limit the period, but affirms that the rash makes its appearance on the second or third day, or sometimes later. Heberden restricts it to the first or second day. It is, however, probable that in the majority of instances, the rash comes out on the second day of the fever, and that in cases in which it appears sooner or later, there is some peculiarity in the individual or in the disease to account for the variation.

The efflorescence, which is first perceptible on the face, neck, and chest, becomes gradually diffused over the body; in twenty-four hours or less from its first appearance the trunk is covered with the eruption; on the following day (the third) it extends to the upper and lower extremities, at which period the whole body is of a bright red colour, and pungently hot and dry. On the extremities, particularly the hands and fingers, the rash is diffuse and continuous, but on the trunk it is distributed in irregular patches, the colour being most deep on the loins, buttocks, flexure of the joints, and on those parts of the body which are subjected to pressure; it is generally more vivid in the evening, gradually becoming paler towards the morning.

This is the ordinary progress of the efflorescence in the skin: it is not, however, confined to the cutaneous tissue; the mucous membrane which lines the nostrils, mouth, and fauces being covered with the eruption, so that the lips, the tongue, the pharynx, the velum palati, the nostrils, and even the internal surface of the eyelids are of a bright red colour. The papillæ of the tongue become considerably elongated, the red points shooting through the white fur, and from which it derives its characteristic appearance. In cases where the tongue is clean, it has nevertheless a bright red colour, and the scarlet points may be seen shining through its polished surface.

The rash of scarlatina consists of innumerable red points or dots, which are at first of a pale red colour, but afterwards acquire a deeper hue, giving the affected portions of skin not only a uniform red appearance, but a perceptible roughness, which is most evident on the breast and extremities, in consequence of the greater determination of blood to the papillæ of the skin in those situations.

The efflorescence on its first appearance sometimes closely resembles a papular eruption, and occasionally small miliary vesicles make their appearance, though this latter phenomenon is rarely observed, except when the individual has been subjected to a heating stimulating regimen, or confined in a small, crowded and ill-ventilated apartment. These papular or vesicular spots, however, are now and then observed when the disease occurs under the most favourable circumstances. Dr. Mason Good (Study of Medicine, vol. iii. p. 13,) supposes that they arise from the great determination of blood to the cutaneous vessels producing an effusion of coagulable lymph, which is not entirely absorbed by the time the efflorescence subsides, hence there is occasionally, though not often, an appearance of vesicles, sometimes nearly empty, and sometimes nearly filled with a pellucid fluid, according as the effused fluid has been more or less carried off. The occasional appearance of these vesicles during the progress of scarlatina has been noticed by Rush, Withering, Plenciz, and other writers; Sauvages, indeed, under a mistaken view of their importance, has constituted a distinct species under the name *scarlatina variolodes*.

In ordinary cases of scarlatina, the eruption may be regarded at its height on the fourth day; it begins to decline on the fifth, disappearing in irregular patches; on the following day it is still more indistinct, and on the eighth day no trace of the rash is discernible. The various symptoms with which the eruption is accompanied gradually disappear with the efflorescence, but the tongue still remains morbidly red and clean. The desquamation of the cuticle, which begins about the end of the fifth day on the parts on which the eruption first appeared, proceeds, so that about the eighth or ninth, portions of cuticle are thrown off, the thickest and largest being those detached from the skin of the hands and feet.

2. *Scarlatina anginosa.* — In this form, the fever and efflorescence are accompanied with inflammation of the throat. The anginose inflammation sometimes precedes the fever, but most frequently appears at the same time with the febrile symptoms, though, in some cases, not until the rash or efflorescence is at its height: in the majority of instances, however, it is felt when the eruption appears, and goes through its progress of increase and decline with the cutaneous eruption.

The precursory symptoms of scarlatina anginosa indicate a more acute disorder than the scarlatina simplex. The headach is often accompanied with slight delirium; the heat of skin is more pungent, and the prostration more marked from the beginning. In the course of the second day, the patient complains of a sensation of stiffness or pain about the muscles of the neck, extending to the angles of the jaw and under the ears, with feeling of roughness in the throat, painful deglutition, and some degree of hoarseness. The viscid secretion from the mucous crypts of the tonsils and pharynx, which takes place in the more severe cases, aggravates the patient's sufferings, from the frequent and often ineffectual efforts made to expel it. On examining the fauces, the palate, uvula, and tonsils are red and swollen, and when the local inflammation is severe, coagulable lymph is effused in small irregular masses on the inflamed surfaces. These exudations are very liable, on a superficial examination, to be mistaken for ulcers, or, when the subjacent surface is tender

and disposed to bleed, the admixture of blood imparts to them a brown or almost black colour, and thus, more especially if there be fetor of the breath, they may be mistaken for gangrenous inflammation of the fauces. On attentive inspection, however, after cleansing the throat by acidulated gargles, the entire continuity of the membrane from which the crusts have been detached, at once distinguishes this form of acute symptomatic angina, from the gangrenous inflammation and subsequent ulceration observed in scarlatina maligna.

These exudations of lymph often extend to the lateral parts of the pharynx, and occasionally as far as the œsophagus, though, according to Rayer, they are never observed after death in the larynx or trachea. This coincides with our own experience, as in the dissections of scarlatina with anginose inflammation which we have made, we have not seen an instance of membranous exudation extending to the larynx.

As the anginose inflammation becomes developed, the febrile symptoms increase, the pulse rises, the respiration becomes oppressed, the skin more pungently hot and dry, (sometimes rising to 106°, 108°, or even as high as 112° of Fahrenheit,) and the thirst urgent. The mucous lining of the mouth as well as the tongue, especially at its point and edges, assumes a florid red colour, the papillæ being much elongated and protruding their inflamed points over its surface. All these symptoms are increased towards evening, at which period, the febrile restlessness is often succeeded by delirium.

The rash does not appear so early as in the simple form of the disease. It is sometimes perceptible on the second, but more generally on the third day, and comes out in irregular patches on various parts of the body, particularly about the elbows and wrists. It has been occasionally observed that when the attack is severe, the eruption is sooner thrown out, a circumstance which was noticed by Dr. Clark, who informs us that in an epidemic which broke out in Newcastle-upon-Tyne, in the year 1778, when it began with great vehemence the eruption was often observed on the first day, though commonly it did not make its appearance till the second or third, and sometimes not until the fourth. It evinces also a great tendency to recede or entirely vanish the day after it first comes out, and in these cases, it re-appears partially and at uncertain times, but without any perceptible change in the other symptoms, only that the duration of the disorder is protracted. About the fifth or sixth day of the disease, the fever and inflammation of the throat begin to abate; at the same time the rash declines, becoming faint first on those parts on which it first came out, its disappearance being generally followed by desquamation of the cuticle. This process is, however, uncertain. When the rash is slight, or recedes soon after it comes out, desquamation does not take place; in the more severe cases, the cuticle begins to separate after the eruption and febrile symptoms decline, and continues to desquamate to the end of the second or third week, or sometimes later, during which large portions are thrown off; sometimes the cuticle of the whole hand and fingers is completely detached, resembling precisely a glove in shape.

Though this is the usual progress of scarlatina anginosa, the disease frequently assumes a still more severe character. Thus we observe, in some instances, acrid discharge from the nostrils or ears, often accompanied with deafness; enlargement of the parotid or cervical glands, appearing sometimes at the commencement of the disease, at other times about the fifth or sixth day, but occasionally not till the decline of the eruption, and followed in some cases by abscess of the surrounding cellular tissue: and towards the decline of the disease, ulceration at the corners of the mouth, or of the tongue. Though these local affections are painful, and keep up or even increase for a time the constitutional excitement, they are seldom attended with danger; and in general, after continuing a short time after the prominent symptoms of the disease have disappeared, they subside under judicious treatment.

In scarlatina, as in all febrile disorders, the condition of the several internal organs demands attention. We have often remarked, in investigating the complications of scarlatina, the great disposition to inflammation of serous membranes; therefore, when an organ becomes inflamed during its progress, its investing membrane is much more generally the seat of inflammation, than the substance or parenchyma.

In some cases, the general symptoms are accompanied with evidence of gastro-enteritis. The tongue is morbidly red and clean, and the patient is harassed with sickness, vomiting, and diarrhœa. These symptoms are not uncommon when scarlatina prevails in the autumn, at which season bowel-affections generally prevail, and constitute a leading feature of an epidemic.

As we have already, in the article Fever, detailed the various complications which arise, and the symptoms by which they may be detected, it is unnecessary in the present article to enter into more minute details, especially as the exanthemata bear so close a resemblance to the other forms of fever. We deem it, therefore, sufficient earnestly to impress the necessity for minute inquiry into the condition of the several organs in scarlatina, and more particularly for watching the convalescence. Cases, apparently mild, are often rendered alarming from an attack of inflammation in some organ: the suddenness of the seizure and the rapidity with which it often proceeds, prove the necessity for vigilance, however mild the symptoms of the disease may be at its commencement. Dr. Armstrong has well observed, "that scarlatina anginosa is sometimes attended with moderate, and at other times with severe symptoms; and it is of great consequence to bear this in mind, more especially as the severe may follow the moderate symptoms at any period of its progress. In those cases where the symptoms are moderate, the inflammation is chiefly limited to the throat and mucous membrane of the nose, and the excitement of the arterial system subsides without inducing actual inflammation of the viscera; yet where the symptoms are comparatively severe, the inflammation is not limited to the throat and nasal lining, but attacks some of the viscera commonly under a sub-acute character." (Practical Illustrations of the Scarlet Fever, &c. by John Armstrong, M. D.)

3. *Scarlatina Maligna.*—This variety has been described by some writers by the name of *angina gangrænosa* or *cynanche maligna*. Thus Cullen, in his nosology, places it as a variety of cynanche, and likewise makes it one of the species of scarlatina, from which circumstance much unnecessary confusion has arisen. He was, however, candid enough to remark, that the scarlet eruption appears on the skin under the same form in both diseases, adding, that he had five or six times seen the angina maligna united with the common scarlatina; and that in different epidemic constitutions, sometimes one disease predominated, and sometimes the other.

In fact, two names have been given to one disease, which has almost invariably the same characters, and requires nearly the same treatment, making due allowance for the variation observed in epidemics, and the ever-varying circumstances under which it occurs. Indeed, we are inclined, from our own experience, to affirm that the scarlatina simplex, scarlatina anginosa, and the scarlatina or angina maligna, and the sore-throat without efflorescence on the skin, are merely varieties of one and the same disease.

Though several Spanish and Italian physicians had described the angina maligna, which raged with great violence and mortality in Spain and Italy in the beginning of the last century, Dr. Fothergill was the first writer in this country who described this malignant form of scarlatina as it prevailed in London in the years 1747–8. (An Account of the Sore-throat, attended with Ulcers, by John Fothergill, M. D. 4th edit. London, 1754.) From the description he has given, it is evident, that he witnessed during this epidemic the various forms of the disease, and consequently the malignant variety. This is apparent from the following passage: "Thus much, however, seems to be true in fact, that, in some cases, the disease appears to be of so mild a nature, and so benign, as to require but little assistance from art. Persons even recover from it under the disadvantages of unskilful and injurious management, whilst in others the progress of the symptoms is so rapid, and the tendency to corruption so strong, that nothing seems able to oppose it. Just as it happens in the small-pox: the benign and the distinct sort bears ill treatment without injury; in the malignant flux kind, the utmost art and experience are too often insufficient to conduct the distemper to a happy issue. Whether this diversity in the sore-throat we are speaking of is owing to difference of constitution or of seasons, to the different quality or quantity of the contagion, or the manner of receiving it, or whether there are in reality distinct species, may perhaps hereafter be more certainly determined."

A few years afterwards Dr. Huxham gave a faithful account of a similar epidemic as it appeared in London from the end of the year 1751 to May, 1753, and was very mortal. It is evident, however, that in this epidemic, as well as in others which have been subsequently described, the malignant form was only occasionally observed.

In this form of the disease, the symptoms assume very early a malignant or typhoid character; to the affection of the throat and skin are superadded great cerebral disorder, and often inflammation of the pulmonary and gastric mucous membranes. On the first appearance of the disease, the symptoms may differ little from those of the other forms of scarlatina. The pulse is at first soft and frequent, but soon becomes small, rapid, and often irregular: the patient is restless, and at times delirious, the delirium being sometimes so violent as to require restraint, though more generally it is of the low muttering kind. The rash comes out later and is very uncertain in its duration, often suddenly disappearing a few hours after it is first perceptible; and, five or six days afterwards, coming out again for a period of perhaps two or three days. It may thus suddenly recede and re-appear several times. The colour of the rash is at first faint, except in a few irregular patches, which assume a deep rose hue, but the whole efflorescence is speedily changed to a dark livid red, and in the worst forms is interspersed with petechiæ. The temperature of the skin is generally cool on the trunk of the body, and cold on the extremities; the eyes are suffused and often covered with a film of mucus; the countenance is pale and dejected, while the cheeks are of a dusky red colour; the tongue is covered with dry brown, or almost black fur; in other cases, it is smooth, red, and glossy, and often so tender and fissured that it easily bleeds; the odour from the skin and breath is extremely fetid.

The throat is not much swollen, but appears of a dark red hue, and covered with small ash-coloured sloughs surrounded by a livid base; the gangrene often extends with alarming rapidity, destroying the uvula and arch of the palate. A viscid secretion with which the fauces are covered aggravates materially the sufferings of the patient by increasing the difficulty of swallowing, as well as by the obstruction which it offers to the breathing, so that when symptomatic bronchitis occurs during the progress of the disease, there is great danger of fatal asphyxia. The inflammation generally spreads from the throat to the cervical glands, giving rise to enlargement and sometimes abscess; and when the inflammatory action extends to the nostrils, as it almost invariably does, there is an acrimonious discharge, at first thin but afterwards thick and yellow, which produces excoriation of the nostrils, lips, and angles of the mouth, which are generally in these instances covered with black crusts.

In the more severe cases of malignant scarlatina, the symptoms are more alarming from the first appearance of the disease: the pulse is small, rapid, and indistinct: there is more marked cerebral disturbance,—stupor, coma, or violent delirium; the ulcerations of the throat are more extensive, and covered with dark sloughs, and the colour of the rash becomes livid. We frequently also observe pulmonary disease in the form of latent bronchitis, which is often combined with inflammation of the gastro-intestinal mucous membrane, giving rise to diarrhœa and its pathognomonic signs. Some writers mention that hemorrhage from different surfaces,—from the mouth and throat, lungs, intestines, or bladder, takes place, under which the patient in general rapidly sinks, unless the constitutional powers have been unusually vigorous.

In a severe epidemic described by Dr. Withering, after detailing the ordinary progress of the disease, he gives the following outline of a fatal form which it frequently assumes:—"In children, the delirium commenced within a few hours after the first seizure. The flesh was intensely hot; the scarlet colour appeared on the first or second day, and they died very early on the third. In others who escaped this rapid termination, when the scarlet colour turned to brown, and their recovery might have been expected, the pulse still remained feeble and quick, the skin became dry and harsh, the mouth parched, the lips chapped and black, the tongue hard, dry, and dark brown; the eyes heavy and sunk; they expressed an aversion to all food, and extreme uneasiness upon the least motion or disturbance. Thus they laid for several days, nothing seeming to afford them any relief. At length a clear amber-coloured matter discharged in great quantities from the nostrils, or the ears, or both, and continued so to discharge for many days. Sometimes this discharge had more the appearance of pus mixed with mucus. Under these circumstances, when the patients did recover, it was very slowly: but they generally lingered for a month or six weeks from the first attack, and died at length of extreme debility. In adults, the rapidity of the fever, the delirium, &c. was such that they died upon the fourth or fifth day, especially if purging supervened. Some survived to the eighth, or to the eleventh day: in all these the throat was but little affected; the eyes had an uncommon red appearance, not that streaky redness which is evidently occasioned by the vessels of the cornea being injected with red blood, but an equal shining redness, resembling that which we remark in the eye of a ferret. But notwithstanding this morbid appearance in the eye, the strongest light was not offensive. This redness might often be discovered, by lifting up the upper eyelid some hours before it showed itself in the part of the eye that is usually visible: and it was of some consequence to attend to this circumstance, as it greatly influenced the event of the case. These patients were extremely restless, clamorous, and desirous to drink; but after swallowing one or two mouthfuls, upon taking another they seemed to forget to swallow, and let it run out at the corners of the mouth; whilst others spurted it out with considerable force, and were very angry if urged to drink again. In these cases, the scarlet colour appeared very soon after the attack, but in an unsettled irregular manner, large blotches of red intermixing with others of white, and these often changing places. Besides the full scarlet colour described as above, there were frequently small circular spots of a livid colour, about the breast, knees, and elbows. The pulse from the very beginning was so quick, so feeble, and so irregular, that it was hardly possible to count it for half a minute at a time. It is needless to add, that the greater part of those who laboured under these dreadful symptoms died. A few recovered, and others fell into a state of debility bordering upon idiotism, from which they were rescued by time and generous living. In one patient, a man, the jaw was so perfectly locked upon the third day, that it was impossible to get any thing down his throat, and he died early upon the fifth day." (Account of the Scarlet Fever and Sore-Throat, p. 18.)

In a few instances, we have seen the large joints suddenly become extremely painful, to which swelling with evidence of fluctuation succeeded, and the patient was destroyed in a very short time.

In many instances this malignant form of scarlatina proves fatal on the third or fourth day, though the patient often lingers till the second or third week: it is not uncommon for the patient to die suddenly on the second, third, or fourth day, without the practitioner being able to assign any satisfactory reason, or discover any lesion on the most careful examination of the body. Sometimes, on the other hand, recovery takes place under the most unfavourable circumstances, but the convalescence is exceedingly tedious, and often retarded by the recurrence of some local inflammation, which had arisen during the progress of the disease.

It should not be overlooked that, when the early symptoms have been comparatively mild, the disease may suddenly assume the malignant character. Indeed this form (scarlatina maligna) is more frequently intermixed with the other varieties of scarlatina, and it sometimes unexpectedly supersedes the milder forms of the disease, on the fourth, fifth, sixth, or seventh day of their course. (Willan.)

4. *Scarlatina faucium.*—It has been frequently observed, that when scarlatina prevails epidemically, cases occur in which there is no appearance of rash on the skin, the efflorescence being confined to the throat and mouth. In some cases, the characteristic red appearance in the throat is unattended with swelling; in others, the efflorescence in the throat is accompanied with swelling of the tonsils, and consequent painful deglutition. Dr. Willan states, that this complaint seems peculiar to adults, and is evidently a species of scarlatina, because it affects some individuals of large families, while the rest are labouring under other forms, and because it is capable of communicating by infection all the varieties of that disease. It is sometimes succeeded by an enlargement of the parotid glands, but not by dropsical swellings. Persons who have previously gone through the scarlatina anginosa, experience, while conversant with the sick, very uneasy sensations in the throat: in some there is a swelling and inflammation, or ulceration of the tonsils, producing considerable pain and irritation, but without the specific fever and efflorescence. (On Cutaneous Diseases, p. 274.) Similar instances have been related by Dr. Johnstone, in the description of the epidemic scarlatina which prevailed at Worcester in 1778. Some individuals, at the first seizure, were more or less severely attacked with the scarlet eruption, with swelling, redness, and ulcers in the throat; yet others in the same family, infected from them, and by them, often had the ulcerated sore throat, without any efflorescence or eruption on the skin. Again, the first seized sometimes had the simple ulcerated sore-throat only, and yet the others infected by them had the more severe attack of the disease, of fever, and scarlet eruption, as well as sore-throat.

(Memoirs of the Medical Society of London, vol. iii.)

In a paper by Dr. Lettsom, entitled Cursory Remarks on the Appearance of the Angina Scarlatina in the spring of 1793, several cases are given of this form of scarlatina. In one case the disease assumed the characters of scarlatina maligna, but without efflorescence. The sister of this patient, a day or two after, became also the subject of the disease; but in this case, the affection of the throat and fever of the malignant kind were accompanied by general florid efflorescence. In another family, one of the children had ulceration of the throat, but no eruption: a second, about a year older, caught the disease, but had both the affection of the throat and the efflorescence. In another family, some had the sore-throat without any eruption, others had the eruption with a very moderate degree of sore-throat; and this was observed not only among the children, but also among the servants. (Memoirs of the Medical Society of London, vol. iv.)

These statements accord exactly with our own experience of epidemic scarlatina. We had very lately an opportunity of observing in one family the simultaneous appearance of the various forms of the disease. In one of the children, who was the first subject of it, the symptoms early assumed a most malignant aspect; the velum and uvula were destroyed by gangrenous inflammation, and death took place about the fifteenth day. Some days after the disease had appeared in this child, one of the servants became ill, and passed through a mild form of scarlatina anginosa without any untoward symptom. No sooner had this servant recovered than the father of the child began to be indisposed, and in a day or two, considerable fever, with efflorescence of the mouth and throat, and inflammation of the tonsils, came on. The fever and anginose inflammation lasted for several days, and terminated in desquamation of the cuticle.

It appears, then, that the various forms of scarlatina may be produced by exposure to the same exciting causes, and that the differences observed depend on some individual peculiarity or idiosyncrasy, which cannot, *à priori*, be ascertained.

[The blood in scarlatina has been examined by M. Andral, and found to be constituted as in measles,—preserving, in other words, pretty nearly its mean proportion of fibrin—3 in 1000, with an augmentation of the proportion of globules, 127 in 1000. In four patients, he found the ratio of fibrin to be 3, 3½ and 4; in two others, that of the globules 136 and 146. (*Cours de la Faculté*, 1841, cited by Guersant & Blache, *op. cit.*)]

Sequelæ.—Scarlatina is occasionally followed by troublesome local affections—ophthalmia—enlargement and frequently suppuration of cervical glands—abscess in the pharynx—laryngitis—chronic bronchitis—inflammation of the ear, ending in purulent discharge from the meatus externus, or suppuration and consequently destruction of the internal ear.

In some instances, dropsical effusion comes on during the convalescence from scarlatina, and always proves an alarming affection.

Anasarca is the form in which the dropsy more generally appears, and though the fluid may be confined to the subcutaneous cellular tissue, it sometimes accumulates in the different cavities; when this is the case, the patient may be considered in great danger. It is singular, that the dropsy has been remarked to succeed as often to mild as to the more severe forms of the disease; but it has never been observed to supervene in cases of malignant scarlatina: it would, therefore, appear to be connected with the acute or subacute forms of scarlatina only. It is almost entirely confined to children, rarely occurring after puberty; Dr. Wells, however, had occasion to treat one case which occurred at the age of seventeen. It seems peculiar to some epidemics. We have seen it occur in several children of the same family, who had passed through scarlatina at the same time. Some writers seem to view this secondary affection as of trivial importance; others regard it as more serious than the primary disease. Plenciz, indeed, affirms that more persons die of it than of scarlatina. This, however, is not the result of the cases which we have witnessed, though in this country it occasionally proves fatal. It generally comes on ten or twelve days after the period of desquamation, and often without any evident cause: sometimes it does not come on for two or three weeks after the disappearance of the rash; and in one case which came under our care, the dropsical symptoms did not appear till five weeks after the desquamation. Previous to its appearance, the patient, after perhaps satisfactorily proceeding in his convalescence to a certain point, finds he does not advance, but rather retrogrades: he complains of unaccountable languor and lassitude, loses his appetite and strength, his sleep is disturbed, his pulse becomes quick, the bowels costive, and the urine scanty: sometimes there is considerable gastric disorder, indicated by sickness, vomiting, and purging. The swelling is first observed in the face and upper parts of the body, to which it is sometimes confined, though more generally it extends over the whole body, and occasionally effusion takes place in the brain, cavity of the chest, or belly. In fatal cases, fluid has been effused in these three cavities in a very short time. In an epidemic scarlatina, described by Dr. Hamilton, which occurred among the boys in Heriot's Hospital, in three cases the disease proceeded with a rapidity which afforded little opportunity for deliberation or action. The stomach gave way; all food, cordials, and medicines were rejected by vomiting. The watery effusion rapidly filled the cellular membrane, and inundated every cavity. Within less than six-and-thirty hours from the occurrence of the ailment, the boys died, labouring under symptoms denoting ascites, hydrothorax, and hydrocephalus.

In this form of dropsy, the urine generally coagulates by exposure to heat or the addition of nitric or muriatic acid, alcohol, or a solution of the chloride of mercury. Sometimes it deposits a dark-red or brown sediment, which seems to arise from the admixture of the red globules of the blood.

[Not unfrequently, in these cases, the kidneys exhibit signs of glandular disease; so that a question has even arisen, whether the anasarca may not be owing to the renal disease. (Guersant et

Blache, *Op. cit.* See, also, Rilliet and Barthez, *Traité Clinique et Pratique des Maladies des Enfants*, ii. 613, Paris, 1843.)]

As dropsical effusion is to be regarded only as a secondary affection, it is of importance to ascertain its source. We have always regarded the dropsy succeeding to scarlatina as of an acute or subacute kind, arising from increased action in the sanguiferous system; the consequence of this increased action is the effusion of serous fluid into the external tissues of the body, or when there is a still greater degree of vascular excitement, into one or other of the cavities. That this is the cause of the effusion, if not invariably, at least in the majority of instances, and certainly in all those which have come under our observation, was evident from the character of the pulse as to frequency and power, the coagulable urine, the rapidity with which the fluid accumulated if not arrested by prompt treatment, and from the efficacy of bloodletting, purging, and other antiphlogistic measures, which were generally necessary to remove the dropsical effusion.

Burserius, (Instit. Med. Pract. vol. ii.) in the account he has given of an epidemic scarlatina which prevailed at Florence in the year 1717, mentions that on opening the bodies of several persons who had died of this disease, the lungs, pleura, intercostal muscles, diaphragm, kidneys, and intestines, were more or less inflamed: that peripneumony having been considered as the primary disease, and the dropsical swelling only a consequence, blood was taken from the arm in the succeeding cases, once or oftener, as the occasion required; and that no one afterwards died of the dropsy who was thus treated.

[Effusions, of fatal tendency, occasionally take place into the larger joints. Gangrene of the extremities likewise occurs at times. In an account of scarlatina that prevailed in the London Foundling Hospital, Dr. Watson gives one case that died of mortification of the rectum; and six others that died sphacelated in various parts of the body. In the girls, some had the pudendal region mortified; two had ulcers of the mouth and cheek, which sphacelated externally; whilst one had the gums and jawbone so corroded, that most of the teeth fell out before she died. The lips and mouth of many that recovered were ulcerated, and continued so for a long time.]

Morbid Anatomy.—In scarlatina the appearances on dissection are by no means uniform; indeed, we have frequently been surprised, in examining rapidly fatal cases, to find no morbid appearances that could explain the cause of death: in such instances, it is more than probable, that the diseased condition of the blood and fluids has had an important share in the fatal issue. The skin runs rapidly into putrefaction: it is generally of a dark red colour, the redness being of a deeper colour in different parts, and frequently interspersed with livid spots. When there have been violent delirium and other symptoms of cerebral excitement, the arachnoid membrane is vascular or even opaque, with effusion of a serous or sometimes milky fluid underneath. In such cases, the substance of the brain is also unusually vascular. The mucous membrane of the mouth, cavity of the nose, pharynx, and sometimes even of the trachea and bronchi, is often red from sanguineous injection; and when there has been considerable acute anginose inflammation, there is swelling of the tonsils with exudation of lymph. In the malignant scarlatina, there is little or no swelling, but the membrane of the pharynx is sometimes of a dark livid colour, and occasionally in a sloughing state. In some cases, there is a small quantity of puriform fluid in the sacculi of the larynx, and in two or three instances we have seen ulceration of the cartilages. These appearances in the throat are, however, by no means uniform or frequently observed, and the state of the throat after death very often presents no appreciable morbid appearance, even when there has been considerable anginose affection during the disease. In the chest, redness and thickening of the bronchial membrane, the smaller bronchial tubes and air-cells being filled with a viscid secretion, and a gorged state, with extreme softening and tendency to rapid decomposition of the pulmonary tissue, are the principal morbid appearances. In the abdomen, there are seldom any appearances that can be called morbid; in some cases, the mucous membrane of the stomach or of some portions of the alimentary canal has been slightly injected, though more frequently this membrane throughout the whole tract of the intestines retains its natural colour. When purulent deposits take place in the joints—a complication or sequela which we have occasionally observed—there are not always marks of inflammation of the synovial membrane. In the last case of this kind, however, which we examined, in which pus was deposited in the left wrist and in both ankle joints, there was deposition of pus exterior to the wrist joint, among the carpal bones. The synovial membrane of the wrist and ankles was evidently redder than natural, but there was no abrasion. We are therefore inclined to think, that these purulent formations in the joints may occur without antecedent inflammation; and even in the case alluded to we doubt the co-existence of inflammation: it is more probable that the pus which was deposited was not the consequence of the inflammatory action, but that the purulent fluid was deposited from the blood in the same way as it is sometimes deposited in other parts of the body.

Diagnosis.—It is seldom difficult to distinguish scarlatina from other acute eruptive diseases. There is some resemblance, in the cutaneous efflorescence, to *measles* and *roseola*.

It may be distinguished from measles, 1st, by the period at which the eruption appears; 2d, by the accompanying symptoms; 3d, by the character of the eruption; and 4th, by symptoms which are frequently observed after the disappearance of the rash. In scarlatina the efflorescence generally appears about the second day of the fever, attended (with the exceptions stated) by affection of the throat, and the characteristic appearance of the tongue: in rubeola the rash does not come out till the fourth day, its appearance being preceded by sneezing, coryza, inflamed and watery eyes, cough, and other catarrhal symptoms, which continue during its progress. The eruption in scarlatina consists of innumerable minute dots or points, diffused in patches with uneven edges, of various

sizes and forms, and gives to those portions of the skin on which it appears a diffused bright red colour. In measles, the efflorescence comes out in irregular semilunar or crescent-shaped patches, distinctly elevated, the spots being of a deeper red in the centre than in the circumference, and leaving intervening spaces in which the skin retains its natural pale colour. The desquamation of the cuticle is besides more general and more considerable in scarlatina than in measles. The sequelæ of measles are principally affections of the organs of respiration, croup, bronchitis, or pneumonia, which are more liable to come on towards the decline of the eruption. In scarlatina, there is more frequent affection of the glandular system, and liability to inflammation of the joints and serous membranes, and to anasarcous and dropsical effusion into the cavities.

Roseola is always a much milder disease than even the simple form of scarlatina: the efflorescence is more continuous, of a deeper rose colour, and does not terminate by desquamation. Besides, in roseola, the anginose inflammation and appearance of the tongue peculiar to scarlatina are awanting. The whole duration of roseola too is short, seldom exceeding five or six days, and it cannot be propagated by contagion. It is also often symptomatic of other disorders.

Prognosis and Mortality.—It has been generally observed, that scarlatina proves more severe to adults than to children, and that when it attacks pregnant or puerperal women it is often fatal. It has been also noticed, that it is generally mild in spring and summer, but severe during the winter months.

Simple scarlatina is in general a very mild disease and seldom proves dangerous unless some local inflammation supervene during its progress; but thus a form of scarlatina, mild in the beginning, may be rendered suddenly and unexpectedly dangerous.

Scarlatina anginosa is always a more severe disease than the scarlatina simplex, since to the more acute form of fever there is superadded inflammation of the throat. The anginose inflammation, however, seldom of itself renders the disease dangerous, especially if proper measures be adopted at the beginning. There is in general a manifest disposition in the affection of the throat to terminate in resolution, and it is often surprising how readily it yields to general or local depletion. A moderate degree of swelling, with bright red efflorescence in the throat, is a more favourable indication than when there is little or no swelling, and the redness assumes a dark or livid appearance. It was stated in the description of this variety of scarlatina, that the inflammation sometimes extended from the throat to the larynx: when this takes place, the danger is imminent; since if œdematous swelling of the glottis ensue, death almost inevitably ensues. Danger may also arise from inflammation in some of the cavities—cerebral, pulmonary, or abdominal disease being thus superadded to the anginose and cutaneous inflammations.

A favourable or unfavourable prognosis may be often, in some measure, inferred from the cutaneous efflorescence. In the scarlatina anginosa, the rash appears late in the disease, and though in most instances, it is diffused generally over the surface, it is often only partial, coming out in small irregular patches on different parts of the body. In these latter cases, it is more apt to disappear suddenly, which is a less favourable circumstance than when the rash is general and remains out for several days. The colour of the eruption seems also connected with the general character of the disease. A bright red or scarlet efflorescence is more favourable than the dark red, crimson, or brownish colour which it sometimes assumes. A very pale rash, more especially if it be partial and evanescent, is also unfavourable; and when the eruption, whatever be its colour or the extent of its diffusion, disappears suddenly, and afterwards reappears, or if it do not again come out, more especially if it have receded at the beginning of the disease, the danger is considerable. The more perfectly the desquamation takes place, the case is to be regarded as the more favourable, as secondary disorders are less likely to arise.

From the description which has been given of the scarlatina maligna, the danger in almost every case must be apparent, though it does not appear to arise from the visceral complications which occasionally supervene, as in fatal cases there is seldom discovered in the internal organs satisfactory evidence of the cause of death. In estimating the amount of danger and probable issue of the case, however, it should be kept in view, that though this form of scarlatina proves fatal in a much larger proportion of cases than any of the other varieties, there is every intermediate shade or gradation between the less severe and most malignant cases. In this more severe form of scarlatina some particular symptoms or appearances however modify the prognosis. Children are observed to struggle better against it than adults, though in some epidemics no age seems to be exempt from its ravages. The existence or non-existence of local inflammation in any organ must also be taken into account, in estimating the degree of danger, and it should be kept in mind how little such topical inflammations are under the control of the treatment, which it is necessary to modify according to the general powers of the patient; if active measures be resorted to in cases of malignancy with the hope of subduing the low forms of visceral inflammation, the powers of the patient would be endangered if not irrecoverably sunk.

With regard to the prognosis of malignant scarlatina to be deduced from particular symptoms, a favourable result may be predicted from the following circumstances—mild fever and moderate affection of the throat—early and copious eruption succeeded about the third or fourth day by gentle moderate perspiration, and general desquamation of the cuticle—the throat assuming a florid red colour, and if there have been sloughing, the ulceration looking clean and healthy—diminution in the frequency, with firmness and equality of the pulse—the breathing becoming soft and free, while the eye resumes its brilliancy, and the countenance its natural expression. On the other hand, the prognosis may be deemed unfavourable, when the following symptoms occur—a partial eruption disappearing suddenly—or assuming a dusky or livid colour, more especially if accompanied with

petechiæ — smallness and great rapidity of the pulse—frequent sighing with sensation of great faintness — hot dry skin—hurried breathing not depending on disease of the lungs — acrid discharge from the nose and ears—ulceration of the lips and angles of the mouth—paleness or shrinking of the features—sunken eyes—partial cold sweats—coldness of the extremities—low muttering delirium—coma—hiccup—subsultus tendinum —involuntary stools—gangrenous inflammation of those parts subjected to pressure, as the sacrum and hips—swelling and purulent deposits in the larger joints. Huxham observed in some individuals previous to the fatal issue, the face bloated and shining, and the neck swollen and of a cadaverous appearance, the whole body even became in some degree œdematous, so that the impression of the finger remained.

[The form of scarlatina, which has been termed the *hemorrhagic*, is almost always fatal. It is indicated by the ordinary signs of purpura,—dark spots appearing here and there, followed by exudation of blood from the mucous membranes—of the mouth and nose especially, which is occasionally so profuse as to cause death. In these cases, if a puncture be made, it becomes the seat of hemorrhage. In a case of the kind referred to by Dr. Morton, (Mackintosh's *Principles of Pathology*, 2d Amer. edit. i. 224, Philad. 1837,) an abscess in the neck suddenly filled with blood, and this, making its way through a leech-bite, flowed out as if from a divided artery, and destroyed the patient in a few hours.]

The *mortality* of scarlatina varies much in different epidemics, although nothing has been satisfactorily established as to the causes which influence the fatality of the disease. The difference observed in epidemics is not confined to scarlatina, but occurs in every variety of fever, whether of the continued, periodic, or eruptive form. In some epidemics scarlatina is a very mild disease throughout; and when it does prove fatal, the cause may often be traced to the supervention of some accidental inflammation; or it may happen, that in particular instances, the symptoms may assume a malignant character, though the general aspect of the epidemic be very mild. It is unnecessary to pass under review the histories which have been recorded of epidemic scarlatina which have at various times appeared; they are alluded to, principally with the object of directing attention to the influence which certain, though unknown circumstances exert over the character and symptoms of this disease. It is often sufficient for the practical inquirer to be a diligent and faithful observer of nature, without attempting to discover the hidden causes, and invent explanations of her secret operations. The extreme mildness of some epidemics has induced many to assert, that the mortality of scarlatina has been overrated, and even Sydenham from his observance of the disease (its milder forms only having evidently been presented to his notice), came to the conclusion that it scarcely required medical aid, and when it did prove fatal, this result was to be traced to the *nimia medici diligentia*. Had the attention of this illustrious physician been directed to the epidemic described by Morton, a very short time after this opinion was delivered to the world, his candour would have compelled him to acknowledge, that the views he entertained and promulgated of the nature of scarlatina had been formed on too limited experience of the disease. The rapidity with which patients are hurried off is often striking. In an epidemic scarlatina which prevailed in Paris in 1743, we are told that every individual who was attacked perished—many indeed within nine hours from its first invasion. That which raged at Bromley, near Bow, in Middlesex, in the year 1746, it is stated by Dr. Fothergill, seemed to yield to no remedies or applications; several of the inhabitants were greatly alarmed by it, some losing the greater part of their children after a few days' indisposition. These are by no means solitary examples of the great fatality of scarlatina, as similar epidemic visitations have been recorded by Huxham, (Dissertation on the Malignant Ulcerous Sore Throat,) Cotton, (On a particular kind of Scarlet Fever, prevalent at St. Alban's in the year 1748,) De Haen, (Philos. Trans. 1749,) Johnstone, (Remarks on the Angina, and Scarlet Fever of 1788, in the Memoirs of the Medical Society, vol. iii.,) Rush, (Medical Observations and Enquiries,) Lettsom, (Memoirs of the Medical Society, vol. iv.,) Sims, (Ibid. vol. v.,) Willan, (Miscellaneous Works, edited by Ashby Smith, M.D.,) Bateman, (Reports on the Diseases of London,) Blane, (Med. Chir. Trans. vol. iv.,) Macgregor, (Ibid. vol. v.,) Tweedie, (Clinical Illustrations of Fever,) Carbutt, (North of England Med. and Surg. Journ., vol. i.,) Sandwith,* and others.

Dr. Willan has given the result of his experience of an epidemic scarlatina, from cases which occurred in his own practice in the year 1786. Of 251 cases, there were 152 of scarlatina anginosa, 42 of sore throat without eruption on the skin, and 39 of scarlatina maligna. Dr. Clark, in the description he has given of an epidemic scarlatina which prevailed at Newcastle in 1778, observed, that of 131 patients, 75 had the eruption with sore throat; in 33 the disease occurred with every distinguishing symptom of scarlatina maligna; and that in 23 cases it was succeeded by dropsy. He adds, when it is considered that great numbers had the distemper in such a mild manner as to require no medical assistance, and that application was only made for the advice of a physician when the patients were severely attacked, perhaps the malignant cases ought not to be estimated higher than as one to twenty in all who took the disease.

No deductions however can be drawn from these averages, as they have reference only to solitary epidemics, and it is well known that in one or several epidemics a large proportion of the cases assume the characters of a malignant disease, while, as was formerly stated, a few malignant cases only may occur out of a large number of individuals affected.

We find from the register of cases kept at the London Fever Hospital, that the mortality of scarlatina shows great variation. In the years 1822 and 1823, the disease appears to have been extremely mild, as none of the patients died during these years. In 1824, the mortality was one in

* Edin. Med. and Surg. Journ., No. cxvii., (a most excellent practical paper.)

twenty-one; in 1825, one in thirteen; in 1826, one in twenty-nine; in 1827, one in forty-one; in 1828, one in ten; in 1829, one in six; in 1830, one in six; in 1831, the disease was not prevalent, and none of the cases proved fatal; in 1838, the mortality was one in forty; and during the last year, the average has been about one in twenty-two. Of 644 cases treated at this hospital, the gross mortality was thirty-eight; of these there were thirteen males and twenty-five females. The following table exhibits the comparative ages of the fatal cases:—

	Males.	Females.
7 years of age	0	1
10 ditto	1	1
11 ditto	0	2
12 ditto	0	1
13 ditto	1	1
18 ditto	0	1
19 ditto	2	3
20 ditto	0	2
21 ditto	0	2
22 ditto	1	2
23 ditto	1	1
24 ditto	2	2
25 ditto	2	1
26 ditto	2	1
27 ditto	0	2
30 ditto	0	1
33 ditto	1	0
40 ditto	0	1
	13	25

[In England and Wales, the number of deaths amongst children from scarlatina was in 1838, 5802; in 1839, 10,325; less than the mortality from measles. (W. Farr, *Third Report of the Registrar-General*, Lond. 1841.) If, however, the year 1840 be reckoned, the preponderance is on the side of scarlatina:—the deaths during that year being 19,816; whilst those from measles were 9326.

In all the Atlantic cities of the United States, so far as statistical examinations have been made, scarlatina appears to be a more fatal malady than measles. In an inaugural "Essay on the Comparative Mortality of Measles and Scarlet Fever," presented to the faculty of Jefferson College in Feb. 1844, Dr. George King Smith makes the number of deaths from measles in Philadelphia, from 1807 to 1841 inclusive, 1376; from scarlatina during the same period, 2226. In New York, from 1819 to 1834 inclusive, the deaths from measles were 1337; from scarlatina, 1500. In Boston, from 1811 to 1840 inclusive, from measles 700; from scarlatina, 970.]

Treatment.—From the description which has been given of the various forms of scarlatina, it is obvious that the measures to be adopted for its treatment must have reference to each individual case, as well as to the various circumstances with which it may be associated.

It is also indispensably necessary that the treatment should have reference to the prevailing type or character of the fever, an indication which it is of the utmost importance to bear in mind in the management of this disease. We have already endeavoured to impress this circumstance strongly in a former part of this article, so that it is sufficient merely to advert to it again.

1. In the *scarlatina simplex*, the symptoms are generally so mild, that it is only necessary to confine the patient to bed, to keep the apartment cool, to prescribe occasional aperients, cooling drinks, and abstinence from animal food, so long as there is any febrile indisposition. Should the skin feel hot at intervals, it is advisable to sponge the surface with cold water, by which the morbid heat is rapidly dissipated, and the feelings of the patient are rendered more comfortable. It is seldom necessary in this form of scarlatina to abstract blood, unless it be deemed expedient in cases where the fever runs high. In those cases, it may be prudent to take away a moderate quantity of blood, with the view of subduing the vascular excitement, and preventing the local inflammations which frequently arise in scarlatina. Whether bloodletting be deemed expedient or not, an emetic is often attended with good effects; after which the bowels should be freely opened by brisk aperients, and the various saline remedies, in combination with antimony, administered as circumstances require. It is necessary to watch every case of scarlatina, however mild at the beginning, as the character of the disease is often materially altered by the sudden accession of inflammation in some internal organ, by which a mild disease may in the space of a few hours be converted into one of severity and danger.

2. We have pointed out the more active nature of the symptoms in *scarlatina anginosa*. In adults of a plethoric tendency, more especially if the patient be young, bloodletting is sometimes necessary; and even in children, a moderate bleeding from the arm, when there is much excitement at the beginning, is often useful in moderating the fever, and diminishing the tendency to visceral inflammation. General bloodletting has been strongly recommended by several continental physicians in this form of scarlatina, more especially when there is much cerebral disturbance. Morton employed it with success in the epidemic he has described; and in the scarlatina which prevailed at Edinburgh in 1733, we find it stated, that few died who were timely and plentifully blooded, which weakened the fever, relieved the throat, and was the only medicine that removed the vomiting and diarrhœa. (Edinburgh Medical Essays, vol. iii. p. 27.) Huxham advocates this practice at the commencement of the fever, when the blood was often sizy, but recommends one moderate bleeding only, as patients did not bear a large bleeding, and scarcely any a second.

On the other hand, in some epidemics, evacuations of blood are less efficacious, or wholly inadmissible, either from the form of fever being of a less acute character, or from the tendency of the general powers to decline, when active depletion has been adopted. The successful treatment of the disease by bloodletting and other antiphlogistic measures at one season, does not warrant the practitioner in employing the same plan in another epidemic; the type of the fever, the pulse, and the general aspect of the symptoms must be his guide. In the epidemic described by Dr. Withering, such was the state of the pulse, that bloodletting was inadmissible, unless in the autumn, when the

colour of the rash was not intense, or did not appear at all, the swelling of the throat great, and the pulse firm. Dr. Willan also states, that during the years 1785, 1786, 1787, and since, when the scarlatina anginosa was epidemic in the metropolis, he never saw a case in which bloodletting appeared to be indicated. Whenever it had been employed, great depression and faintness were the immediate consequences, the pulse becoming more weak and frequent, and often irregular. Of two adults who had been bled largely, one died before the period of desquamation, the other lingered in a very precarious state upwards of twenty days, but at length recovered.

It is therefore almost impossible to lay down general rules for the treatment of a disease which varies so much in its character at different times. At one season, or in one epidemic, bleeding may be required — at another, the lancet is to be employed with the greatest caution, and not unless some urgent circumstance arises to require its use. We have seldom had occasion to bleed from the arm, unless in particular instances of unusual febrile excitement, or when some important organ was threatened with inflammation. We generally prefer the free topical abstraction of blood by cupping behind the neck, which is the most effectual mode of relieving the inflammation of the throat, or by the application of leeches under the jaw, or behind the ears. We have seen great benefit also from the free scarification of the tonsils when skilfully performed, though many patients object to this mode of topical bleeding, which is also often not easily performed in timid persons.

We have seldom observed any decided benefit from the use of gargles, indeed the inconvenience felt by the patient in their employment often precludes their adoption. The inhalation of the vapour arising from warm water gives much more decided relief.

The exhibition of emetics in the commencement of scarlatina anginosa as well as of the other forms, has been strenuously recommended by some physicians. Dr. Withering prescribed them not only in the beginning, but even in the later stages of the disease. Their employment, however, should be restricted to the period of invasion, as it has been observed that they are much more beneficial at this stage than when the symptoms are more advanced. The shock which is given to the system by the action of vomiting in the early stage of eruptive fevers is often followed by most decided improvement in the general symptoms and feelings of the patient. Dr. Rush exhibited an emetic, combined with calomel, in every case he was called to, which, besides inducing vomiting, seldom failed to produce two or three stools; in several cases he was obliged, by the continuance of the nausea, to repeat the emetic, and always with obvious and manifest advantage.

The abatement in the symptoms which is generally observed after the bowels have been freely evacuated, has induced physicians to purge freely in the early stages of scarlatina anginosa, and certainly no class of remedies is more entitled to confidence than purgatives, when administered with discernment. Many writers have expressed their doubts of the safety of this practice, from the fear of inducing debility and repelling the efflorescence. Dr. Hamilton, however, has adduced powerful arguments in support of it, and has illustrated his views by an appeal to the result of cases treated in public and private practice. No variety of the disease, as appearing in different epidemics, or in the course of the same epidemic, has hitherto prevented this distinguished physician from following out this practice to the necessary extent. The pungent heat of surface, violent headach, turgescence of features, and full and quick pulse, the earliest symptoms in some epidemics of scarlatina, and which may have suggested and warranted the practice of bloodletting, are often quickly subdued by one or two brisk purgatives. Dr. Hamilton states, that full purging is not required in the subsequent periods of the disease, in which the sole object is to remedy the impaired action of the intestines; to secure the complete and regular expulsion of their contents; and thus to prevent the accumulation of fæces, which never fails to aggravate the symptoms and to prove the source of further suffering to the patient. He has added some very useful hints as to the same activity not being required in the exhibition of purgative medicines in every case of scarlatina, acknowledging, that he had not ascertained to what this different state of the bowels in scarlatina is to be ascribed, and observing that on whatever cause the difference depends, it is necessary to adapt our practice in the use of purgatives to the nature of the prevailing epidemic.

In the early stages, when there is nothing to contra-indicate the use of purgatives, a brisk aperient may be exhibited daily. We generally prescribe a combination of calomel and rhubarb at bed-time, and on the following morning a moderate dose of castor-oil, or infusion of senna with manna and sulphate of magnesia. When the cuticle begins to desquamate, and the febrile symptoms decline, active cathartics are improper; at this stage of the disease, it is necessary only to ensure the regular evacuation of the bowels, for which purpose the mildest aperients are best adapted.

Though we have advocated the employment of purgatives in the more severe cases of scarlatina, they are to be prescribed with the greatest caution, if not altogether withheld, when the mucous membrane of the intestines betrays signs of irritation or of inflammation. In such cases, the bowels are generally purged, and the dejections of an unhealthy appearance. Under such circumstances the gastric irritation must be allayed by leeches applied to the abdomen, counter-irritation, and bland nourishment. Aperients, even of the mildest class, must be withheld, until the intestinal derangement is allayed; and should it become necessary to administer an aperient occasionally, the least irritating should be selected; none is preferable to castor-oil suspended in mucilage, with the addition of a few drops of laudanum.

The free application of cold is decidedly beneficial in the acute stage of scarlatina, and more especially in the anginose form. The bed-chamber should always be properly ventilated by frequently renewing the air, and allowing a current of cool fresh air to pass round the patient. If the skin be hot, the body should be occasionally sponged with cold water, by which the morbid heat is rapidly abstracted, and the patient refresh-

ed. The sponging should be repeated when the skin feels pungently hot. The testimony of Dr. Bateman, as to the efficacy of this practice, is very strong: — "We are possessed," he says, "of no physical agent, as far as my experience has taught me, (not excepting even the use of blood-letting in acute inflammation,) by which the functions of the animal economy are controlled with so much certainty, safety, and promptitude, as by the application of cold water to the skin, under the augmented heat of scarlatina, and of some other fevers. This expedient combines in itself all the medicinal properties which are indicated in this state of disease, and which we should scarcely *à priori* expect it to possess: for it is not only the most effectual febrifuge, (the "febrifugum magnum," as a reverend author long ago called it,) but is, in fact, the only sudorific and anodyne which will not disappoint the expectation of the practitioner under these circumstances. I have had the satisfaction in numerous instances of witnessing the immediate improvement of the symptoms, and the rapid change in the countenance of the patient produced by washing the skin. Invariably, in the course of a few minutes, the pulse has been diminished in frequency, the thirst has abated, the tongue has become moist, a general free perspiration has broken forth, the skin has become soft and cool, and the eyes have brightened; and these indications of relief have been speedily followed by a calm and refreshing sleep. In all these respects, the condition of the patient presented a complete contrast to that which preceded the cold washing: and his languor was exchanged for a considerable share of vigour. The morbid heat, it is true, when thus removed, is liable to return, and with it the distressing symptoms, but a repetition of the remedy is followed by the same beneficial effects as at first." (Practical Synopsis of Cutaneous Diseases.)

[The use of ice internally is the best and most grateful refrigerant. Chlorinated soda, chlorinated lime, or the aqua chlorini, is sometimes added to the water.]

Little confidence should be reposed in any of the ordinary saline remedies. We prefer the mineral acids, more especially the saturated solution of chlorine, prepared according to the directions given in the Dublin Pharmacopœia, which contains about twice its volume of chlorine. Of this remedy a fluidrachm and a half, mixed with eight ounces of water, and two drachms of syrup of lemons, may be taken in divided portions during the day, For children, ten or twelve drops every six or eight hours is a sufficient dose.

The solution of chlorine is readily decomposed by exposure to light and air, and in this state it is very apt to disorder the stomach and bowels, producing sickness, griping pain of the bowels, or diarrhœa. It is therefore necessary, that the remedy should have been recently prepared before it is exhibited. If recently prepared chlorine cannot be readily procured, (though it is obtained by a very simple chemical process,) the diluted sulphuric acid may be substituted.

In the advanced stages of scarlatina anginosa, when the general fever has declined, and the efflorescence has disappeared, it is often necessary to give, with due caution, a little support. Mild nourishment is often sufficient, but should the pulse be soft and rather weak, with a cool skin, small doses of quinine in acidulated infusion of roses are generally very beneficial. It is seldom necessary to administer wine, except under circumstances of unusual debility after a protracted illness. The moderate use of it in such cases tends much to assist the convalescence.

When visceral inflammation arises in the progress of scarlatina anginosa, no time should be lost in endeavouring to arrest it. In such cases, the judgment of the practitioner must direct him as to the extent to which it is necessary to carry the antiphlogistic treatment. We have already entered so fully into the management of the various local lesions which arise in the progress of fever, (and the indications to be observed in scarlatina are precisely similar,) that we deem it unnecessary to repeat what has been already advanced, (see Fever,) though the necessity of watching narrowly the state of the several organs, and of adopting suitable measures on the first evidence of local inflammation, cannot be too forcibly impressed on those who may not have had much experience in the treatment of this disease.

3. In *scarlatina maligna*, the acute stage, in which only antiphlogistic measures can with safety be employed, soon passes off, and is succeeded by a low depressed state of the general powers, which renders any form of depletion not only doubtful but hazardous. If the practitioner be called on to treat this form of scarlatina at its very commencement, and before it is fully formed, an antimonial emetic is generally very beneficial, more particularly when the bowels are afterwards evacuated either by the antimony, or by an active aperient. If, however, those means be insufficient to subdue the excitement, moreover if the pulse be rapid and firm, the skin hot, and there be much pain in the head, or delirium, a moderate quantity of blood should be taken from the arm, and another aperient given. This treatment, if adopted at the onset of the symptoms, will generally not only moderate the fever, but shorten the duration and violence of the disease. In many cases, however, such is the violence of the symptoms, more especially if they have been neglected in the beginning, that the acute stage is speedily followed by symptoms of a low typhoid character, which requires a cordial tonic plan of treatment. It then becomes necessary to support the sinking powers by animal broths, quinine, and a moderate allowance of wine.

The volatile alkali has been strongly recommended in cases of malignant scarlatina; it was considered by Dr. Peart to be endowed with a specific power over the malignant scarlet fever and sore throat. He directed two drachms of the carbonate of ammonia to be dissolved in five ounces of water, of which the dose was two spoonsful every two, three, or four hours, according to the urgency of the symptoms. This remedy was administered in every form and stage of the disease, and were we to judge from the result of the cases in which this remedy was given, it would appear never to have failed even in the worst. We certainly have tried this remedy repeatedly, but our experience of it does not warrant such an inference; nor do

we deem it preferable to other diffusible stimulants. Capsicum is a remedy which appears to have been employed with much success by Dr. Stephens, in an epidemic scarlatina which prevailed at St. Christopher's in 1787, and of which an account was published in the second volume of the Medical Communications, and also in Duncan's Medical Commentaries for the year 1787. This remedy was used in the form of infusion prepared according to the following formula: two tablespoonfuls of small red pepper, or three of the common Cayenne pepper, and two teaspoonfuls of fine salt are to be beat into a paste, to which half a pint of boiling water is to be added. When cold, the liquor is to be strained off, to which half a pint of very sharp vinegar is to be added. Of this mixture, the dose for an adult is one tablespoonful every four hours, the quantity being diminished in proportion for children. This remedy has been commended by several writers who have employed it successfully; but having never employed it, we cannot offer an opinion of it.

When topical inflammations arise in scarlatina maligna, general bleeding is seldom admissible, unless they supervene in the beginning of the disease: the application of leeches, in numbers proportioned to the age and powers of the patient, is better adapted to the low forms of local inflammation which arise in this malignant disease.

With regard to the local treatment in scarlatina maligna, we may observe, that in the very beginning of the disease, the inflammation in the throat is best managed by the application of leeches under the jaw or behind the ears; but this treatment must be confined to the very onset of the anginose affection, since the inflammation in most cases very speedily passes into gangrene. The vapour arising from warm water may be frequently inhaled. Some physicians recommend the occasional exhibition of an emetic with the view of dislodging the viscid secretion with which the fauces are clogged, and unless the powers be so feeble as to render the shock of an emetic hazardous, benefit is often derived from their employment.

Acidulated bitter effusions, as of cinchona, cusparia, serpentaria, contrayerva, or an infusion of capsicum, prepared as recommended by Dr. Stephens, may be used as a gargle.

A weak solution of the nitrate of silver, or of sulphate of copper, applied by means of a proper syringe, after the throat has been well cleansed by warm water, often improves the aspect of the ulceration.

Dr. A. T. Thomson recommends the chlorosodiac solution of Labarraque in the proportion of f.ʒxii of the solution to f.ʒvss of water and ʒiv of honey, as an excellent gargle. The same solution in the proportion of ʒvi to ʒv of water, without the addition of honey, if frequently thrown into the nostrils by means of an elastic bottle mounted with a tube, soon removes the coryza. (Bateman's Practical Synopsis of Cutaneous Diseases, edited by Anthony Todd Thomson, M. D.)

Fumigations by the nitrous acid gas, (separated from pulverized nitre by the strong sulphuric acid,) or the nitro-muriatic acid gas, (chlorine,) (separated from a mixture of equal parts of pulverized nitre and of sea-salt, by the strong sulphuric acid,) have been strongly recommended by Willan.

It is almost superfluous to state, that proper ventilation is most essentially necessary in this, as in the other forms of scarlatina. The admission of fresh air around the patient generally invigorates his powers, and often proves a most excellent tonic. Warm sponging, a tepid bath, or if there be much cerebral disturbance, fomentations to the extremities may be employed in addition to the other means.

The treatment of the dropsical effusion which we have described as an occasional occurrence towards the termination of scarlatina, is to be regulated by the condition of the system, and more especially of the several internal organs. The effusion in general speedily disappears under judicious treatment; in all the cases which have fallen under our notice, the dropsy has been evidently dependent on general or local excitement, which it was necessary to subdue by bloodletting and purging, after the adoption of which measures the effusion quickly vanished. In some instances, when the state of the pulse did not require the abstraction of blood, a few doses of brisk purgatives have carried off the fluid: in others, the activity of the circulation, the heat of skin, scanty urine, and oppressed breathing, at once suggested the necessity of bloodletting, from which the most decided relief was immediately obtained, after purgatives and diuretics had completely failed. The efficacy of the antiphlogistic treatment of dropsy succeeding to scarlatina has been corroborated by many practical writers in other countries as well as our own; and though some still hesitate to adopt the practice, we are satisfied that in cases accompanied with phlogistic symptoms, it is the only safe and rational mode of treatment. Besides, when we consider the condition in which the internal organs have been occasionally found in fatal cases of scarlatina complicated with dropsy, the propriety of vigorous antiphlogistic treatment is apparent. We admit that in some instances, in which the symptoms are of a less acute character, bloodletting may be dispensed with: we allude more particularly to those in which, though the general powers be feeble, there is congestion or chronic insidious inflammation in some organ. Under such circumstances, topical bleeding, mild purgatives, and diuretics, with a bland diet, will be found more appropriate measures. As to the employment of tonics, on the supposition that the dropsical effusion depends on loss of power or tone in the exhalants, we confess we are sceptical as to this being the pathological state of the vessels in any case of dropsy succeeding to scarlatina, and therefore we are disposed to place little or no confidence in this class of remedies. When the effusion has been removed by suitable measures, pure air, mild nourishment, and attention to the bowels will be found the best mode of invigorating the general powers.

A. Tweedie.

SCIRRHUS.—The term σκίῤῥος, from σκίρος, marble, was given by the Greek physicians to certain tumours characterized chiefly by a great degree of hardness; but the application of the term

scirrhus has for a considerable length of time been limited to tumours or portions of organs or tissues which present not only this character, but which terminate in the disease called cancer. Hence the state of induration to which the appellation of scirrhus is given is regarded as the first stage of cancer. We shall overlook for the present the propriety of this distinction, and instead of confining ourselves to the consideration of scirrhus, shall in the present article give a general view of those morbid conditions which have been denominated scirrhus, cancer, fungus hæmatodes, and the several kinds of sarcoma, under the generic term of *Carcinoma*. The reasons for our grouping together under the term carcinoma so many diseases which have generally been described as differing widely from that which is commonly known by this designation, will be fully exposed as we proceed. In the meantime, however, the following may be regarded as the more remarkable phenomena which these diseases, considered in a general and anatomical point of view, present in common with one another, and which we conceive, while they express in a concise and conspicuous manner those characters by which they are distinguished, justify our having brought them together under the same general denomination:—1. They are essentially composed of a solid or fluid substance, different from any of the solids or fluids which enter into the healthy composition of the body. 2. They often present in the early periods of their formation certain characters common to all of them, however much they may differ from each other in the subsequent periods. 3. They all terminate in the gradual destruction or transformation of the tissues which they affect. 4. They have all a tendency to affect, successively or simultaneously, several organs in the same individual. 5. They all possess, although in various degrees, the same reproductive character.

Specific Divisions of Carcinoma.—When we examine the several morbid conditions which we have included under the genus *carcinoma*, we find that they present differences, some of which are of considerable importance, others less so; and therefore it becomes necessary to separate them into distinct groups, and to arrange them into species and varieties. The differences to which we allude are referable to two states of the carcinomatous substance to which the diseases in question owe their origin. The first is that in which this substance has little or no tendency to become organized: its form and arrangement appear to be determined chiefly by external circumstances, and its formation and subsequent increase are entirely dependent on the nutritive function of the organ in which it is contained. In the second state this substance exhibits, on the contrary, a greater or less tendency to become organized: although it may at first assume a determinate form and arrangement, in consequence of the influence of external circumstances, it possesses in itself properties by means of which its subsequent arrangement and development are effected, independent of the nutritive function of the organ in which it is formed, except in so far as the materials of its growth may be derived from this source.

On account, therefore, of these two opposite states of this particular substance, carcinoma may be divided into two species, the first of which we have called *scirrhoma*, the second *cephaloma*. Although neither of these terms expresses the essential characters of the respective states to which they are applied, we have not been able to find or devise others better calculated to accomplish this object; it is therefore necessary to bear in mind that they indicate only one of the characters of these states, viz. a certain degree of consistence, and which, it may be observed, is far from being constant in either, because of various circumstances, which we shall afterwards endeavour to explain.

In these two species, scirrhoma and cephaloma, the carcinomatous substance presents itself under various forms, which may be regarded as constituting so many varieties of each species.

Varieties of Scirrhoma.—The varieties of scirrhoma are determined chiefly by the relative quantity of the carcinomatous substance, the manner in which it is distributed, and the difference of colour and consistence which it presents. Thus it may be collected in numerous points in the form of a hard, grey, semi-transparent substance, intersected by a dull white or pale straw-coloured fibrous or condensed cellular tissue, and, as such, is commonly denominated *scirrhus*. When it assumes a regular lobulated arrangement, so as to present an appearance similar to a section of the pancreas, it forms what was called by Mr. Abernethy the *pancreatic sarcoma*. (Surgical Observations, London, 1804 and 1816.) Again, it may be disseminated uniformly throughout the texture of an organ, which it converts into a solid substance, resembling a slice of raw or boiled pork, and is then called by the French *tissu lardacé*. Lastly, when it presents the appearance of firm jelly, and is collected into masses of greater or less bulk in a multitude of cells, it is the *matière colloïd* of Laennec, the *cancer gélatiniforme* or *aréolaire* of M. Cruveilhier. (Anatomie Pathologique, Dixième Livraison.)

Varieties of Cephaloma.—The principal varieties of cephaloma are derived from the appearances which the carcinomatous substance presents either in different organs or at different stages of its development. When it presents the appearance of firm coagulable lymph, or fibrine deprived of the red colouring-matter of the blood, possessing a uniform, fibriform, or lobuliform arrangement, with a certain degree of transparency and vascularity, Mr. Abernethy gave to it the name of *common vascular* or *organized sarcoma*. In this state the carcinomatous substance is generally collected into a mass of greater or less bulk, in which few or no traces of the proper tissue of the organ in which it is contained are observable. If, on the contrary, it be uniformly disseminated throughout the texture of an organ, so as to transform it into a substance resembling a section of the mammary gland, or the udder of the cow when boiled, the appellation of *mammary sarcoma* was given to it by Mr. Abernethy. When it presents an appearance similar in colour and consistence to the substance of the brain, it was called *medullary sarcoma* by the same distinguished surgeon; *matière cérébriforme* or *encéphaloïde* by Laennec, (Dict. des Sciences Méd. art. Encéphaloïdes), and *spongoid inflammation* by Mr. Burns. (Lec-

tures on Inflammation.) The *milk-like* tumour of Dr. Monro, (Morbid Anat. of the Human Gullet, Edinb. 1811,) the *soft cancer* of various authors, and the *pulpy* testicle of Dr. Baillie, (Morbid Anatomy, London, 1795,) are names which have been given to the same state.

Of all the varieties of cephaloma, the last is that in which a vascular organization is most conspicuous, and as the coats of the vessels with which it is supplied are remarkably delicate, the circulation of the blood through them is readily interrupted; hemorrhage from congestive rupture takes place, and the effused blood is mixed in greater or less quantity with the brain-like matter. From this accidental circumstance, together with the protrusion of this substance through the ulcerated integuments for example, in the form of a bleeding fungus, it has been described by Mr. Hey (Pract. Observat. on Surgery, London, 1803) and also by Mr. Wardrop, (Observat. on Fungus Hæmatodes, Edin. 1809,) under the appellation of *fungus hæmatodes*. Sir Astley Cooper calls it *fungoid disease*.

Such are, we conceive, the principal varieties of scirrhoma and cephaloma, and the general characters by means of which they may be recognised. But although we have said that the essential difference between the two species of carcinoma consists in the former having little or no tendency, the latter a greater or less tendency, to become organized, it is by no means always easy, nay, it is sometimes impossible, to draw a distinct line of separation between them; for the carcinomatous deposit when first formed, and, indeed, frequently for a considerable length of time after its formation, does not furnish us with any signs which show that it will or will not become organized. We cannot determine what those properties are by means of which it is afterwards to assume a definite arrangement, or to possess within itself the powers of contributing to its subsequent development. These facts may be illustrated by the two following circumstances: 1. the carcinomatous deposit may exist as we have described it in the form of scirrhus, pancreatic sarcoma, or the lardaceous tissue, without its presenting any trace of organization; the textures which it invades being gradually destroyed by its presence, and both ultimately converted into a soft, granular, pulpy, or liquid mass, of the colour and consistence of cream or milk. 2. The same deposit may exist under the same forms as those we have just named, but it undergoes changes of an entirely opposite kind; that is to say, it assumes the characters of the mammary or medullary sarcoma, becoming more or less soft and vascular, and frequently terminating in hemorrhage by the rupture of its vessels, or in that state called fungus hæmatodes. Numerous examples might be given of scirrhus, medullary sarcoma, and fungus hæmatodes, as they are commonly called, originating in the same morbid state, and passing successively from the one into the other in the order in which we have named them. Indeed, we often met with all the varieties which we have enumerated of both species, not only in different organs of the same individual, but even in a single organ.

If such are the successive changes observed to take place in carcinoma, the distinction of the disease into species and varieties may be considered by some to be of little importance. Such, however, cannot be the case, for we know that the curability of a disease often depends on the time at which a remedy is employed, or varies with the state or period of the disease; and therefore it is obvious that whatever means may be adopted for the cure of carcinoma, we can form no precise opinion as to their relative efficacy, unless the particular condition or variety of the disease be kept in view. And it is far from being an unimportant fact that several of the varieties of both species of carcinoma differ materially from one another as regards the comparative rapidity of their development, as well as their reproductive tendency. Thus in both these respects the pancreatic differs from the lardaceous, the lardaceous from the mammary, and the mammary from the medullary sarcoma; the first often remaining stationary for a long space of time, months or years; the last frequently acquiring its maximum of bulk in a few weeks, and when removed being sometimes reproduced with a degree of rapidity which is never observed in any of the other varieties. It may be said that the more the varieties of both species of carcinoma partake of the characters of those accidental formations which resemble the healthy tissues of the body, as the cellular, cellulo-fibrous, and fibrous, they are, *cæteris paribus*, the less rapid in their development, and have less tendency to be reproduced.

Before proceeding to the description of the physical, anatomical, chemical, and physiological characters of carcinoma, we shall endeavour to establish on the evidence with which our anatomico-pathological investigations have furnished us, the seat, origin, and mode of formation of this disease; for unless we possess clear and accurate notions on these important points, we should meet with numerous difficulties besides those which are inseparably connected with our subject, under the several points of view in which it is necessary to consider it.

Seat, origin, and mode of formation of Carcinoma.—Various opinions have been entertained regarding the seat, origin, and mode of formation of carcinoma, some of which have attracted notice merely from their novelty, others from their possessing much higher claims to our consideration, and to these we shall more particularly allude.

There are several organs subject to carcinoma which, from the peculiarity of their structure or other circumstances, afford us the means of ascertaining the precise seat of this disease, its origin, and mode of formation. But to derive all the advantages which these circumstances are capable of affording, it is necessary to catch, as it were, the disease at its earliest period, that is to say, when the peculiar substance of which it consists has just been deposited, and has not effaced the texture or structure of the part in which it is contained. Investigated in this its first stage, we ascertain with greater or less facility that this substance becomes manifest to our senses either as a product of nutrition or of secretion. In the former case it is deposited in the same manner as the nutritive element of the blood enters into the molecular structure, and assumes the form and

arrangement of the tissue or organ into which it is thus introduced. In the latter it makes its appearance on a free surface, after the manner of natural secretions, as on serous surfaces in general.

Such are two of the modes in which the formation of carcinoma takes place, and also two of the principal differences in regard to the seat of the disease. Proceeding, however, still farther in our researches, we arrive at the important discovery that the carcinomatous matter exists in the blood under circumstances which can leave no doubt as to this fluid being the primary seat of its formation. As, in our opinion, too much importance cannot be attached to these three positions, viz., the formation of carcinoma in the molecular structure of organs, on free surfaces, and in the blood, we shall endeavour to demonstrate the truth of them by a statement of the evidence derived from our own researches on the subject.

1. The liver and stomach, organs in which carcinoma is of frequent occurrence, afford us the most striking examples of the formation of carcinoma in the molecular structure of organs. If we make a section of a liver containing what are commonly denominated carcinomatous tumours, that is to say, round or irregular masses of a substance resembling one or more of the varieties of scirrhoma or cephaloma, we shall often be able to detect the first stage of these tumours, and discover the manner in which they are formed. Thus, the first thing which we have frequently been able to perceive in those portions of the liver in which the carcinomatous matter was just making its appearance was a slight change of colour, observable only in a very limited and well-defined space, and which could be distinctly seen to exist in those minute divisions of the organ denominated *acini*. This change of colour may take place in a single acinus, or in several of these bodies successively or simultaneously. The red or yellow colour which they naturally present gradually disappears, and is succeeded by a pale milk-white or straw-colour, accompanied by an increase of the consistence. But the most important circumstance is, that while these changes of colour and consistence are taking place, the *form* and *bulk* of the acini remain *unaltered*. Now it need hardly be remarked that the form and bulk of the acini could not remain unaltered unless the foreign substance, to which their change of colour and consistence must be ascribed, were introduced into them in the *same order* as the normal element of nutrition, unless it were deposited in the *molecular structure* of the acini in a manner precisely similar to that in which their *nutritive function* is carried on. Otherwise, along with the change of colour and consistence which they present, we should have a simultaneous increase of *bulk*. The more we examine the acini in this state, the more shall we be persuaded that they are thus *transformed* by the molecular deposition of that peculiar substance which constitutes the essential anatomical character of the disease in question.

By tracing the transformation of the acini from a lesser to a greater degree, we can perceive them forming groups, for example, of three, four, ten, or twenty, the reunion of which constitutes tumours varying from the size of a hemp-seed to that of a cherry, in all of which the structure of the liver as characterized by the form, bulk, and arrangement of the acini, is more or less conspicuously marked, but becoming gradually less so with the increasing bulk of the tumours, until it entirely disappears, being transformed into a uniform lardaceous mass, or into some one or other of the tissues or substances which belong to either of the species of carcinoma.

We have said that a similar mode of formation of carcinoma is observed in the stomach. It is, however, chiefly in the muscular coat of this organ that it is most conspicuously seen, on account of the difference between the natural colour of the muscular fibres of this coat and that of the cellular tissue which enters into its composition. The change of colour which accompanies the presence of the carcinomatous deposit is, therefore, hardly perceptible except in the muscular fibres. These, however, become pale and acquire an increase of consistence; but their bulk does not appear to be increased at first, and they retain their form and distribution. Such, also, is the state of the intermuscular cellular tissue at the same period, except as to colour, which is not sensibly changed on account of its being naturally pale. By-and-bye both acquire a greater or less increase of bulk, become remarkably distinct, and present that fibriform arrangement, hardness, and transparency which are regarded as so characteristic of scirrhus. At a more advanced period of the disease we no longer trace this nutritive process of transformation, the muscular and cellular tissues being converted into a homogeneous mass, which is afterwards softened down, or assumes the mammary, medullary, or hæmatoid forms of carcinoma.

2. The fact of carcinoma forming on the free surface of serous membranes is strongly corroborative of the accuracy of the preceding remarks; for although in the former case we refer the presence of the carcinomatous deposit to a modification of nutrition, and in the present to a modification of secretion, the difference is merely nominal. The distinction, however, between nutrition and secretion is valuable as regards the formation of carcinoma; for considered as a modification of the latter, we possess ourselves of the advantage of studying the disease where it presents itself under, perhaps, the most simple of its forms, viz., on extensive serous surfaces, such as that of the pleura or peritoneum. Here the carcinomatous substance is found to be effused on the free surface of these membranes, without our being able to perceive that they have undergone any previous change whatever. Multitudes of tumours are sometimes found on these two surfaces, varying in bulk, consistence, and colour. Some of them are as large as a plum or an orange; others of the size of cherries, peas, hemp, or millet-seed, and composed of a substance resembling pork, the mammary gland, brain, or a mixture of the latter, fibrine, and blood. We may, in fact, have almost all the varieties of carcinoma formed in these membranes, and, as we have said, without their having undergone any previous change. Under such circumstances we must refer the presence of these tumours to the separation of the carcinomatous matter from the

blood, which, being effused in the form of a secretion, afterwards undergoes changes peculiar to itself.

3. The presence of carcinomatous formations in the blood is a circumstance of great importance, and unless it be clearly demonstrated that their presence is the consequence of a modification of the blood itself, in whatever manner produced, we should find it impossible to explain many of the phenomena which the disease presents, and more especially those which accompany its formation in molecular structure and on the free surface of the membranes.

The following facts may be adduced as furnishing strong evidence that the formation of the carcinomatous substance takes place in the blood, whether it be found in this fluid alone or in other parts of the body at the same time: 1. the presence of this substance in the vessels which ramify in carcinomatous tumours or in their immediate vicinity; 2. in the vessels of a portion or of the whole of an organ, to the former of which the carcinomatous substance is exclusively confined, and can be traced from the trunks into the branches and capillaries; 3. in vessels having no direct communication with an organ affected with the same disease, as, for example, when it is confined to a small extent of the vena portæ; and, lastly, in blood which has been effused into the cellular tissue and on the surface of organs.

The appearances which the carcinomatous matter presents in the blood are very various: sometimes they are perfectly similar to those which mark its presence in the substance or on the surface of organs. When contained in large veins, such as the vena portæ and its branches, the emulgent vein, &c. it may present the lardaceous, mammary, medullary, or hæmatoid characters, all in the same venous trunks. These varieties of the disease may be found mixed together in minute quantities, or isolated into masses so conspicuous that we can readily distinguish them from one another. Sometimes they lie merely in contact with the internal parietes of the vein; at other times they are united with these by means of a thin layer of colourless fibrine; or minute blood-vessels pass from the one into the other, and are often very numerous and remarkably conspicuous in the cerebriform matter.

The divisions of the vascular system in which the carcinomatous substance has been observed, are the venous and capillary, — a circumstance which may be ascribed to the contractile power of the arteries preventing, under ordinary circumstances, the blood from accumulating, and consequently this substance from forming within them, and not to any peculiarity of function exercised by the former. The presence of the carcinomatous matter in the veins might be, and indeed is, in general, supposed to be owing to its having been absorbed by these vessels; but without entering into minute anatomical details which disprove such to be the case, we shall again repeat the fact that there are cases of carcinoma in which the venous blood alone is found to be the seat of the disease. There is no accumulation of the carcinomatous matter either in the vicinity of the veins in which the blood is thus affected, or in any other part of the body; and in those cases in which this complication exists, as well might we refer the presence of this matter in the veins to the exercise of the function of venous absorption, as that of cellular, fibrous, osseous, and cretaceous formations in the same vessels to a similar process, which we know not to be the case.

From this view of the origin of carcinoma in the blood, its formation in the intimate structure and in the free surface of organs, after the manner of nutrition and secretion, follows as a natural consequence. The material element of the disease is separated from the blood and deposited under a variety of circumstances which modify in a greater or less degree the form, bulk, colour, and consistence which it afterwards presents, in the several periods of its development. We cannot therefore limit the seat of the disease to any one tissue, or ascribe its origin to any modification of structure or special organization, as has been done by several pathologists.

Perhaps the most ingenious attempt that has been made to explain the local origin of carcinoma is that of Dr. Hodgkin, published in the fifteenth volume of the Medico-Chirurgical Transactions. Dr. Hodgkin has endeavoured to show that the presence of a serous membrane, having a cystiform arrangement, is necessary for the production of carcinoma and some other diseases of a malignant character. The existence of the former precedes, he believes, the formation of the latter, and consequently is at once the seat and origin of the disease. That such is the manner in which carcinomatous formations are sometimes formed, we can have no doubt, inasmuch as we have had occasion to see them as they have been described by Dr. Hodgkin. But we have here no new law in operation, nor even an exception established to that the principles of which we have several times alluded to. Cysts are a very simple modification of a serous membrane; they partake of the structure and functions of the latter, and, consequently, are subject to similar diseases. If, therefore, such cysts should exist in an individual having the cancerous diathesis, they may, in the same manner as a natural serous membrane, become the seat of any variety of carcinoma. But although carcinomatous tumours, such as those described by Dr. Hodgkin, are found in cysts, attached, single, or in groups, and covered by a reflected serous membrane, these tumours may, and frequently do, not originate in the cysts. They form in the cellular tissue external to the cysts, and during their development project inwards, carrying before them as their common envelope the internal and serous lining of the latter. Such, in fact, is seen to be the origin of these tumours in most of the cysts represented by Dr. Hodgkin in the work referred to. They are situated external to the cyst, are supplied with vessels which do not belong to the cyst, and are placed in the same circumstances as tumours formed in the cellular tissue where no cyst is present.

As an objection to the general application of the cystic origin of tumours, it may be observed that there are numerous organs in which the presence of cysts is not to be detected at any period of the development of carcinoma; and therefore, when they do occur in other organs, they must be looked upon as a mere coincidence, or as a conse-

quence of the disease, and not as a cause or necessary condition of it.

After what we have just said on the cystic origin of carcinoma, it will not be expected that we shall do more than notice the theory which maintained that the formation of this disease depended on the previous existence of an accidental organization, which received the name of *hydatid*: how far such was the appellation it should have received, must now be a matter of indifference.

Mr. Abernethy referred all adventitious formations to the coagulable part of the blood as their origin, and fixed their seat in the cellular tissue, in the parenchyma, and on the surface of organs. This plastic substance was supposed by him to be effused in one or other of these situations, to become organized, and to derive the materials of its subsequent growth from the vascular system of the surrounding parts.

According to Andral, the cellular tissue is in general the seat of carcinomatous formations; but, that as they depend on a modification of secretion, they may form wherever this function is accomplished; the speciality of each being determined by a previous modification of the economy in general, or of the functions of nutrition, innervation, or hematosis in particular.

The only other opinion to which we shall allude regarding the seat and origin of these formations, considered in an anatomico-pathological point of view, is that of Cruveilhier. This pathologist regards all organic transformations and degenerations (as he calls them) as exclusively the result of the deposition of morbid products in the *cellular element* of organs. He believes that the *tissus propres* of organs are incapable of undergoing any organic lesion except hypertrophy and atrophy. Both these statements we have shown to be discordant with facts. The source whence these products are derived is, according to the same author, the venous capillary system, to which we formerly alluded, and we assigned a reason for their being found in these vessels, and especially in the venous trunks and their larger branches.

[Although cancer in its various forms may be a mere local degeneration, it can scarcely be doubted, at the present day, that such degeneration is connected with a special condition of the system, or is a cachexia. Accordingly, this has been made to enter into the definition of the disease by pathologists. One of the most recent, Dr. W. H. Walshe, (*Op. cit.*) properly defines cancer to be,—"a disease anatomically characterized by the presence of scirrhus, encephaloid or colloid, originating in a general vitiation of the economy, and possessing the properties of assimilation, of reproduction, and of destroying life by a peculiar cachexia."

J. Müller, from his anatomical researches, is disposed to consider, that no division of pathological structures into *homologous* and *heterologous* can be established; and he maintains, that the elementary structures of all morbid growths, hitherto examined, resemble, in every respect, the structures presented in the several stages of development of the elements of the healthy tissues of the body; and as the element in the healthy tissues is a nucleated cell, so also cells growing upon nuclei, and developing new cells within themselves, or elongated into caudate or spindle-shaped bodies, or in a still higher stage of development forming fibres, are conceived to form the main structure of all morbid growths. Blood-vessels are later formations, as they are known to be in the materials that constitute the embryo. It appears clear, however, that even if we admit the nucleated cell to be the same in the healthy and the heterologous tissue, there must be an impulse seated in the one which is not present in the other, and which leads to a different development; and hence we may, with much propriety, regard cancer as a heterodite or heterologous formation. (For the microscopical characters of cancer, see J. Müller, *Op. cit.* and Walshe, art. *Cancer*, in Cyclop. of Surgery, or Amer. edit. by Dr. J. M. Warren, p. 12, Boston, 1824.)]

Physical characters of Carcinoma.—The physical characters of this disease comprehend the form, bulk, colour, and consistence which it presents in the different tissues and organs of the body, and in the several periods of its development.

Form.—Carcinoma presents considerable variety of form. In its first stage, and when the material of which it is composed is deposited after the manner of nutrition, carcinoma assumes the particular form or structure of the organ which it affects, as that of the liver and stomach, the acini of the former, and the muscular, cellular, and mucous tissues of the latter, determining in these organs respectively the primary form of the disease. In the brain, lymphatic glands, testes, we cannot, however, perceive any particular arrangement of the carcinomatous matter at this early stage, either on account of the colour, homogeneous aspect, or minute structure of these organs, preventing us from detecting its presence, and the manner in which it is deposited.

At a more advanced stage of the disease, the forms which the carcinomatous matter derives from the structure of the parts in which it is deposited disappear, and those which it afterwards presents are determined chiefly by external circumstances. The most important of these forms are the *tuberiform*, *stratiform*, and *ramiform*.

1. *Tuberiform* carcinomatous matter is by far the most frequent, and presents considerable variety. When this matter is deposited in organs possessing a uniform density, and in parts submitted on all sides to an equal degree of pressure, it assumes a globular form. Although at first globular, it becomes pyriform on natural and accidental serous surfaces, either on account of the mode of its attachment, or of less resistance being opposed to its growth in one direction than in another. It assumes a fungiform shape when placed in circumstances which facilitate its lateral, and retard its peripheric development, as when it passes from a dense into a soft tissue, or escapes from beneath the skin to the surface of the body. It often presents a lobulated appearance when accumulated in separate portions of the cellular tissue into rounded masses, grouped together and included within a common capsule; and in the submucous tissue in particular it frequently exhibits the external arrangement of the cauliflower or mulberry. That appearance of carcinoma which resembles the structure of the pancreas depends generally on

the agglomeration of very small globular or pyriform tumours, separated from one another by cellular or cellulo-fibrous tissue, but enclosed in a common capsule.

2. *Stratiform* carcinomatous matter is chiefly met with in the subserous cellular tissue. Although it may be deposited in layers of various extent, which present no definite arrangement, it more frequently assumes the form of thin circular patches, varying from the breadth of a pin's head to an inch or more in diameter, and presenting an appearance similar to what might be imagined to follow the infusion of a small quantity of milk into a number of isolated points of the subserous cellular tissue. Patches of this kind, which are composed of a substance having the colour and consistence of cream or milk, are most frequently met with beneath the pia mater and pleura pulmonalis, and are remarkably conspicuous in the latter situation, on account of their white pearly aspect contrasting so strongly with the surrounding dark colour of the lungs. These patches may occur in the situations we have named without the substance of the brain or lungs presenting any trace of carcinoma; but we have never met them unless when the disease existed in some other organ, as the breast, eye, liver, stomach, kidney, or uterus. In some cases, lymphatics filled with fluid carcinomatous matter are observed to communicate with the patches; in other cases no such vessels are observed.

3. We formerly alluded to the *ramiform* arrangement, when treating of the seat and mode of formation of carcinoma in the molecular structure of organs and in the blood. This arrangement, as well as the seat of the carcinomatous matter in the veins on which it depends, may readily be detected in the liver, where this matter is collected in the form of tumours of various sizes. When such tumours are divided and submitted to pressure, we can often perceive the carcinomatous matter issuing from a number of small circular orifices in the state of a creamy fluid; and if these orifices are attentively examined by a careful dissection of the tumour from its cut surface towards its circumference, we find that they are the cut extremities of veins filled with this matter to a greater or less extent beyond the tumour. But there is no organ in which the ramiform arrangement of the carcinomatous matter is so conspicuously seen as the kidney. The whole of the venous system of this organ, including the emulgent vein to its termination in the vena cava, is sometimes found completely distended with this matter, either in a fluid state, of the consistence of brain, or as firm as the pancreas. When the kidney thus affected is divided, it appears as if it were formed of a multitude of encysted tumours of various sizes, on account of the carcinomatous matter being contained within, and bounded by the walls of the cut extremities of the veins. This form of carcinoma of the kidney is easily ascertained by dissection, or by the introduction of a probe from the emulgent vein into its branches.

A similar arrangement is also remarkably conspicuous in carcinoma of the stomach. Not only are the minute veins, which ramify beneath the mucous membrane in the vicinity of the disease, filled with the carcinomatous matter, but also the larger branches seen on the external surface of the stomach, and the coronary veins in which they terminate. The abdominal division of the vena portæ furnishes us with a remarkable example of the ramiform arrangement of carcinoma, isolated from any organ affected with the disease.

There is another variety of form of the carcinomatous matter which may be noticed in this place, as it may be regarded as a modification of the preceding. It is that which is observed when this matter is contained in the lymphatics and lacteals, and which is derived from the particular form of these vessels. The lacteals, more frequently perhaps than the lymphatics, contain this matter, and are sometimes seen in great numbers quite filled with it on the surface of the stomach and intestines, and between the folds of the mesentery, in carcinoma of these organs.

Such are the principal forms of carcinoma, whether we consider the disease in a general or special point of view. They are certainly not equally prevalent, nor precisely the same in both species, viz. in scirrhoma and cephaloma, nor in the several varieties of each; but they are found to occur in all of them; and as the modifications which they present in this respect are very unimportant, it is not necessary to allude to them more particularly.

Bulk.—The quantity of the carcinomatous matter deposited in the molecular structure or on the free surface of organs is extremely various, but it is perhaps never so great in the former as in the latter. In the liver it may vary from the size of a pin's head to that of an orange. In softer or more yielding organs, as the lungs, testes, and even the mamma, it may equal in bulk the head of an infant or of an adult; and in the intermuscular and subcutaneous cellular tissue its bulk is sometimes still more considerable. We now speak of individual tumours, and not of those masses formed by the aggregation of tumours, during their progressive development, as occurs in the liver, lungs, &c. nor of those produced in a similar manner in the abdominal cavity, posterior to the peritoneum, in carcinoma of the mesenteric glands.

The influence of pressure in favouring or retarding the development of carcinomatous tumours, and consequently in modifying their bulk, is most conspicuously seen when they are situated near the external surface of the body. So long as their progress outwards is obstructed by an unyielding fibrous membrane, they often remain for a considerable time nearly stationary; but so soon as this obstacle is removed, they acquire a rapid increase of bulk. This rapid increase of bulk on the removal of all pressure is still more remarkable when these tumours project through the ulcerated integuments in the frightful form of bleeding fungi. But the best illustration of the influence of pressure on the development of these tumours is met with in carcinoma of the eye. A tumour which may have required several months before it reached the external surface of this organ, will, after it has been removed, together with the whole contents of the orbit, reappear, and in the course of one or two weeks acquire a much greater bulk than before the operation.

Independently, however, of this physical circumstance, which modifies so conspicuously the bulk of these tumours, there is another of an opposite nature, which requires to be particularly noticed on account of its constituting the distinctive character of the second species of carcinoma. We allude to the physiological properties of the cephaloomatous tumours, by means of which they possess within themselves the power of increasing their development to an almost unlimited extent. It is to the vascular organization, which we shall afterwards describe, of the tumours of this species, that the rapidity of their growth and the great bulk which they attain are to be attributed, and which renders them less subject to the influence of pressure than those of the species scirrhoma. However, unless we were aware of the modifying influence of pressure, we should often be unable to explain why tumours possessing the same characters are subject to differences both as regards the rapidity of their development and the bulk which they acquire.

Colour. — The colour of carcinoma differs greatly from that of any of the other adventitious formations. It is, therefore, a character of considerable importance, inasmuch as it frequently enables us to distinguish this disease from others of the same class; and we have already seen that it is chiefly by the same means that we are led to a knowledge of the seat and forms of carcinoma in the early stages of its formation. It is most frequently white, with a shade of grey or blue; sometimes it inclines to yellow, brown, or red, in consequence of the colour of the organs affected with the disease, of the presence of blood, bile, pus, or other fluids in various proportions, or of some other accidental circumstance. But the principal modifications of colour of carcinoma are seen in the several varieties of both species of the disease, these varieties, as we have already stated, resembling more or less in colour that of the organ or tissue whence have been derived their respective appellations; as that of cartilage, of the pancreas, of fresh boiled pork, of coagulated albumen or fibrine, of the mammary gland, of the substance of the brain, or a mixture of the latter and blood.

Consistence.—To none of the physical characters of carcinoma has so much importance been attached as to that of consistence, but more especially to an increased degree of this property when considered in relation either to the disease itself or the tissues of the affected organ. Hence the term *scirrhus*, which implies a state of induration, in consequence of its being frequently not only one of the first, but likewise one of the most marked changes which we are capable of perceiving in the affected organ, has been employed to characterize the early or occult stage of carcinoma. The opposite condition of carcinoma, that in which this disease presents a degree of consistence less than that of the organ which it affects, has been considered as a change succeeding to the state of induration or scirrhus, and the result of a process of softening; consequently, as indicating a more advanced period of the disease. But the degree of consistence of the carcinomatous formations is not an invariable character of a particular stage of their development; for these formations may, when first perceivable, be as hard as cartilage, soft as brain, or fluid as cream; or they may become soft or fluid after having remained for a greater or less length of time in a state of hardness. This variety in the consistence of the carcinomatous formations depends on the following circumstances: —1st. the nature of the organ in which the carcinomatous deposit is contained; 2d. the elementary composition of the deposit; 3d. the subsequent changes occurring either in the deposit itself, or in the tissues with which it is in contact.

1st. The structure, situation, connection, and greater or less density of organs and tissues, greatly modify the consistence of the carcinomatous deposit, either in consequence of a difference between the quantity of this substance relative to that of the tissues in which it is contained, or of a difference in the degree of resistance opposed by the latter to its accumulation or development. Thus it is more consistent in the liver than in the lungs or brain; in the skin than in the cellular tissue or a mucous membrane; in a tumour situated beneath a dense covering than on a free surface.

2d. Modifications in the composition of the carcinomatous deposit exercise a considerable influence over the degree of consistence which it presents, for we often meet with it possessing various degrees of consistence, when examined at the same stage of its development, and in the same or in different organs. Examples of this kind, although common in almost every organ of the body, are best seen where the deposit is collected into isolated masses containing little or none of the natural tissues, and where consequently its consistence must depend on the nature of the elements of which it is composed. It is found in this state in cellular tissue and in serous membranes, and more especially on accidental surfaces, such as those of sores formed by the destruction of the protruded portion of tumours, or after the removal of an external organ affected with carcinoma. In these situations this substance may, at the same stage of its formation, present the opposite extremes of consistence, being in one case as hard as cartilage and more or less transparent, and in another as soft as brain, or quite fluid and opaque. But these opposite extremes of consistence are most strikingly manifested in those fungiform tumours which arise from the bottom of the orbit after the extirpation of the eye, or from the cicatrix of the integuments after the removal of the breast in consequence of carcinoma. In these two instances it is obvious that the stage of development of the tumours is the same in both; and that the difference of consistence which they present is no evidence of their being different in their nature, is equally obvious, inasmuch as the hardest of them often assume, after a certain length of time, the consistence of the softest, a part or the whole of the dense transparent substances of which they are composed being gradually transformed into a soft, brain-like, pulpy mass. This process of transformation is also most conspicuous in those tumours which constitute the *vascular* or *organized* sarcoma of Mr. Abernethy. They are at first more or less transparent, presenting the appearance of a solid mass of albumen, coagulable lymph, or fibrine, but become gradually opaque, soft, and pulpy, resembling fœtal brain, and are then not to be distinguished from those carcino-

matous tumours which, from their commencement possess the cerebriform character. These examples will suffice to show that the carcinomatous deposit, besides being modified in its consistence by the tissues in which it is contained, is equally so in consequence of a difference in its composition; that its consistence may or may not be the same when first formed; that it may be either hard or soft at this period; and, consequently, that the latter state is not necessarily preceded by the former, as was maintained by Laennec and the greater number of pathologists who have published on this subject since his time.

3d. The last modification of consistence of the carcinomatous formations is that to which the attention of pathologists has almost exclusively been directed. It depends on a series of changes taking place either in the carcinomatous matter itself, the tissues with which it is in contact, or in both at the same time. But in order that these changes may be more fully understood, we shall first describe the chemical and anatomical characters of carcinoma.

Chemical characters of Carcinoma. — In order to ascertain the chemical composition of the several varieties of scirrhoma and cephaloma, it would be necessary to procure a sufficient quantity of the carcinomatous matter isolated from the tissues with which it is so frequently more or less intimately united or combined. The difficulty, and in many cases the impossibility of obtaining it in several of these varieties in a separate state, has prevented the pathologist from determining accurately its chemical composition. Indeed, the results of the analyses that have been published may be regarded as indicating the chemical composition of particular organs and tissues affected with carcinoma, rather than of the carcinomatous matter itself. The most recent analysis of carcinoma in the scirrhomatous and cephalomatous states, is that published by Lobstein in his "Traité d'Anatomie Pathologique." Seventy-two grains of scirrhous breast were found to contain—

Albumen	2 grains
Gelatine	20
Fibrine	20
Fluid fatty matter	10
Water	20
	72

Seventy grains of the uterus in a state of scirrhus contained—

Gelatine	15 grains
Fibrine	10
Fatty matter	10
Water	35
	70

According to the same author, it would appear that the chemical composition of cephaloma is not the same at different periods of its development. Thus in the first stage of the disease, or that of *crudity*, it was found to contain a greater proportion of gelatine than of albumen; and in the second stage or that of softening, that is to say, when the carcinomatous matter is of the consistence of soft brain, the albumen is in much greater quantity than the gelatine.

[Other observers enumerate, also, gelatin among the constituents of encephaloid and scirrhous; in an analysis, however, by M. Foy, not a particle of that principle was detected in either. (Walshe, *Op. cit.*)]

For the reasons already stated, it must be obvious that no great importance can be attached to these results of the chemical analysis of the carcinomatous matter; and, independent of the difference of composition which it must present from its admixture, in various proportions, with the same or different tissues, it is highly probable that it is likewise modified, in this respect, by the physiological influence of the organ in which it is formed, and the constitution of the individual in whom it exists.

Anatomical characters of Carcinoma. — We have already pointed out the most important circumstances illustrative of the anatomical characters of carcinoma, when treating of the specific divisions of the disease, its varieties of form, bulk, and consistence; its seat and mode of formation. We shall, therefore, now examine more especially the structure or anatomical arrangement of the carcinomatous matter itself.

We formerly stated that the carcinomatous matter may exist in two states; that in the first state it has little or no tendency to become organized, its form and arrangement being determined chiefly by external circumstances; and that in the second it exhibits a greater or less tendency to become organized, possessing in itself properties by means of which its form, arrangement, and development are effected. The carcinomatous matter may, as we have seen, exist in three situations, viz. in the molecular structure of organs on free surfaces, and in the blood. It is, perhaps, only in the two latter situations that we can submit it to minute anatomical investigation. When, therefore, we examine anatomically a mass of carcinomatous matter contained in a large vein, or situated on the surface of a serous membrane, in loose cellular tissue, on the surface of a sore or cicatrix after the removal of an organ affected with carcinoma, we find it composed of the following elements in various proportions, viz. carcinomatous matter; cellular, fibrous, and serous tissues; and blood-vessels.

The *carcinomatous matter*, whatever may be its consistence, almost always forms by far the greater bulk of the disease. If, however, its consistence be considerable, it generally presents a uniform, granular, or radiated, and, when soft, a lobulated arrangement. These three varieties are sometimes met with in the same tumour, and indicate the progressive development of the disease, the radiated arrangement being seen at the basis, the uniform and the lobulated towards the circumference.

The *cellular tissue* is often small in quantity, and sometimes so fine and loose, as not to be perceptible till after the carcinomatous matter has been separated from it by pressure and maceration. It encloses that matter, separates it into granules, bundles, or lobules, intersects these in various directions, and serves to conduct the vessels which administer to the nutrition and growth of the disease.

The *fibrous tissue* is not often met with as an

anatomical element of carcinoma in the situations in which we are now considering this disease. The *serous tissue*, on the contrary, is frequently present, and may form either a capsule to the carcinomatous substance, which is then said to be *encysted*, or give rise to the formation of cysts of various sizes, containing gelatinous, albuminous, or other fluids.

When the carcinomatous matter is deposited in the molecular structure instead of on the surface of organs, as we have just been considering it, the quantity of the cellular and fibrous tissues which intersect it in various directions is sometimes very considerable. In carcinoma of dense organs, such as the breast, uterus, ovaries, liver, walls of the stomach, &c. these tissues are often very abundant. Indeed, in the early stage of carcinoma of these organs, a firm, pale, compact, cellulo-fibrous-looking tissue is not unfrequently the only anatomical element discoverable, and which on this account, and from the increase of bulk with which it is accompanied, has been described by Andral as *hypertrophy* of the cellular tissue, an appellation which does not appear to us to be warranted by analogy or by the changes which this tissue subsequently undergoes. For hypertrophiated cellular tissue, such as we find in *elephantiasis Arabum* or *Barbadoes leg*, has no tendency to terminate in carcinoma; nor does hypertrophy of the heart from disease, or of the muscles of voluntary motion from frequent exercise, ever present any other change than that implied by this term, except a certain increase of consistence, generally in proportion to the increase of bulk which has taken place. Besides, admitting that a certain degree of hypertrophy may precede the presence of carcinoma, the facts which we have already brought forward in illustration of the mode of formation of the disease, its seat and origin, clearly show that no such change is necessary, inasmuch as all the varieties of carcinoma may form in situations in which the cellular tissue is either extremely small in quantity or does not at all exist. What, therefore, appears to be hypertrophiated cellular tissue must be regarded a tissue *sui generis*, produced by the uniform distribution and molecular deposition of the carcinomatous matter, either in the cellular tissue of an organ, or in an accidental tissue of a similar kind, formed at the same time, and deposited along with the carcinomatous matter. Such is, in fact, the manner in which the cellular and fibrous tissues which enter into the composition of the carcinomatous matter are generally formed. These tissues are most conspicuous in the early stage of the disease, becoming gradually less apparent as it advances, and ultimately disappearing in consequence of their undergoing the carcinomatous transformation, or other changes which we shall afterwards describe.

The *blood-vessels* which enter into the composition of the carcinomatous matter vary greatly in number, and sometimes also in bulk. They are rarely perceptible in any of the varieties of scirrhoma; are generally few in number in the first and second varieties of cephaloma, or in the organized and mammary sarcoma of Abernethy; but in the last variety or medullary sarcoma, they are often so numerous as to form the greater portion of the brain-like tumour in which they ramify. When these vessels are examined in cephaloma, they are found to vary in diameter from the breadth of a hair to a line, and present that peculiarity of distribution, always more or less conspicuous in newly-formed blood-vessels; that is to say, the ramifications of which they are composed communicate with a common trunk at its opposite extremities in the same manner as the hepatic and abdominal divisions of the vena portæ do with this vessel. They are frequently varicose, their walls are remarkably delicate, and they have altogether much more a venous than arterial character. They appear to be formed apart from the vascular system of the surrounding tissues, as they can be seen forming from small specks of blood situated at the centre or at the circumference of the carcinomatous mass, in the form of striæ, or slender streaks of blood, and gradually assuming a cylindrical arrangement and ramiform distribution, and thereby constituting what may be called the *proper circulation* of cephaloma. The communication which exists between these vessels and those of the organ in which the carcinomatous substance is contained, is frequently very imperfect,—a circumstance which, together with the delicacy of their structure, renders them extremely liable to congestion and rupture. The most minute divisions of these vessels terminate by penicillated extremities in the carcinomatous matter, where they communicate with veins and arteries belonging to the affected organ. The latter vessels, which may be said to form the *collateral circulation* of cephaloma, are seldom so numerous as the former, but there are cases in which they appear to constitute the greater part of the vascular structure of the disease. They proceed in a radiating direction, from the pedunculated attachment of a tumour for example, or arise along its circumference in the cellular tissue which separates it from the neighbouring parts. It is by means of these vessels that the materials required for the nutrition and growth of such tumours are supplied; and, as we shall afterwards see, the partial or even complete destruction of these and other tumours similarly situated, is occasioned by causes which interrupt this their collateral circulation.

The blood-vessels which are seen in scirrhoma appear to be no other than branches of those which belong to the neighbouring tissues, and which have become inclosed within the substance of which its several varieties are composed.

Physiological characters of Carcinoma.—The anatomical characters just described are the most unequivocal circumstances by means of which we are enabled to perceive the existence and estimate the degree of those properties termed vital or physiological which manifest themselves during the developement of carcinoma. But it is more especially the formation of cellular tissue and blood-vessels in the carcinomatous matter which shows it to be in possession of these properties. We have already seen that the functions of circulation and nutrition are actively carried on in the carcinomatous matter. Of these functions, that of circulation is far the most important, inasmuch as many of the more remarkable phenomena which present themselves during the progress of carcinomatous formations depend on changes

which take place either in the proper or collateral circulation which we have described. Thus, the quantity of blood contained in a carcinomatous tumour, and consequently various shades of colour of the substance of which it is composed, will depend much on the degree of facility with which the circulation is performed in either or both systems of vessels. An imperfect communication between these vessels, owing to the manner in which they are connected, or the presence of a mechanical obstacle in the situation of the collateral veins preventing the return of the venous blood, frequently gives rise to congestion of the whole or a portion of a carcinomatous tumour, the colour of which becomes more or less red, purple, brown, or black. The congestion thus produced may be such as to give rise to rupture of the vessels, and internal or external hemorrhage. In the former case the carcinomatous substance, when situated externally in the form of a tumour, is seen to acquire a rapid increase of bulk, proportioned to the extent of the effusion, and, when examined afterwards, is found to be infiltrated with blood, or broken down and mixed with clots of this fluid, and irregular masses or layers of fibrine, thereby producing, when the tumour possesses the cerebriform character, appearances very similar to those observed in cerebral apoplexy from sanguineous effusion. If the obstacle interrupt entirely the circulation in the tumour, nutrition ceases, and death ensues in all those parts of it from which the obstructed vessels proceeded. The termination of carcinoma in mortification from obliteration of veins is far from being a rare occurrence. It sometimes occurs in whole tumours, but is most frequently observed in portions of them, or in some of the small tumours of which larger ones are frequently composed, that are attached by narrow pedunculated extremities. The unequal development of one of these small tumours may give rise to compression of a neighbouring one; or the tissue to which they are attached may, from its unyielding nature, act as a ligature on their pedunculated extremities, and intercept the return of the venous blood through them. The same thing sometimes happens to tumours that have perforated fasciæ or even the skin. The protruding portion, now relieved from the pressure to which it was before subjected, increases rapidly in bulk; but the dimensions of the opening remaining the same, very soon exercise a degree of constriction which arrests the circulation through the vessels of the neck of the tumour, and it dies and sloughs.

Changes of a similar kind result likewise from the presence of the carcinomatous matter acting as a stimulus, and exciting various degrees of congestion. In consequence of the congestion thus produced, and the modification of nutrition which necessarily follows, softening takes place, not only of the carcinomatous substance, but likewise of the tissues which enter into its composition. Softening of this kind is sometimes effected with great rapidity, and tumours which before felt firm or even hard, acquire a soft, pulpy feel, and, when laid open, are found to contain a fluid of the consistence of cream intermixed with shreds of cellular tissue, detached blood-vessels, blood, and sometimes pus. This process of softening is frequently seen taking place in carcinomatous tumours that have perforated the skin, and when considered in connection with the state of the circulation which has given rise to it, enables us to explain the peculiar appearance of those frightful solutions of continuity by which it is followed, such as their projecting everted edges, and rugged central excavation. It is well known that it is the most projecting part of a tumour situated beneath the skin in which a solution of continuity commences, and the reason of this is, that it is here the circulation is first arrested from the greater degree of compression to which the blood-vessels are subjected, together with the increased influx of blood caused by a greater degree of excitement. The most elevated portion of the skin becomes atrophiated during the first stage of compression and irritation, that is, when the circulation of the blood through it is only impeded; but so soon as this all-important function has ceased, which is announced by a change of colour from bright to dark-red, purple or black, and a diminution of sensibility and temperature, it begins to soften, soon sloughs, and exposes the subjacent portion of the tumour whose circulation had been similarly modified, softened, and deprived of its vitality, to a greater or less depth. The edges of the solution of continuity of the skin when first formed are sharp and irregular; they are not *everted;* they are, on the contrary, sometimes *inverted;* and their thickness is in proportion to the depth of the slough. The peculiarity of form assigned to them is produced by the subsequent development of the carcinomatous substance situated beneath them, which, being entirely freed from pressure all round their internal margin, necessarily projects forward, as it grows, towards the centre of the tumour hollowed out by the softening and sloughing process, and, consequently, carries them gradually upwards and backwards. They acquire at the same time a great accession of bulk, and form a rounded undulating border, beneath which the skin is found doubled upon itself, encircling the carcinomatous excavation.

All these changes, viz. congestion, hemorrhage, softening and sloughing, which we have described, take place in both species of carcinoma. In scirrhoma, however, they originate in the vascular system of the tissues included within the carcinomatous substance, but are not on that account less frequent and destructive than those which arise in the proper and collateral circulation in cephaloma. In general the softening is less complete, the hemorrhage not so considerable, and the sloughing more extensive in the former than in the latter.

Softening may take place in any portion of a carcinomatous tumour, although it has been maintained that the central portion is the primary seat of this change. Instead of being softer, the centre of the tumour is often much harder than any other portion of it. In such cases it consists of a nucleus of firm, grey, semi-transparent substance and obliterated blood-vessels, forming a central depression, around which the rest of the tumour presents a radiating structure. The depression is not observed unless when the tumour is divided, or is situated on the surface of an organ, as the liver, where tumours of this kind are generally

met with. In the former case the depression arises in consequence of the softer substance, after the division of the tumour, raising itself by its elasticity above the unyielding nucleus; in the latter it is produced by the peritoneum adhering to the surface of the tumour when small, and preventing its development in that direction. If the tumour does not come in contact with the peritoneum until it has acquired a considerable size, it presents no such depression, or only a very small one. Hence the reason why, in carcinoma of the liver, we meet with some tumours having a smooth globular surface, and others with a central depression of greater or less extent.

Nerves have never been detected in any of the varieties of carcinoma as a *new formation*. They are sometimes included within agglomerated tumours, or even in a single tumour that has happened to form in a situation through which they pass. It is on this account that some pathologists have supposed the carcinomatous matter to be supplied with nerves: and M. Maunoir of Geneva (Loc. cit.) hazarded the opinion that cephaloma, no doubt from its frequently resembling the substance of the brain, is in reality this substance effused by the nerves when under the influence of some peculiar morbid state; an opinion to the accuracy of which the facts related in the preceding pages do not leave even the semblance of probability.

The last circumstance connected with the pathological anatomy of carcinoma to which we shall allude, is the development of the subcutaneous venous system sometimes so conspicuous when the disease affects the breast in the form of a tumour, or any other external part where the skin is capable of considerable extension. The dilated and varicose state of these veins is simply the consequence of the mechanical obstacle occasioned by the tumour to the venous circulation in its vicinity, and not the result of any special influence exercised by the disease. It is produced by tumours of every description, similarly situated, —fatty tumours and even cysts, and cannot therefore be considered as furnishing any evidence of the existence of carcinoma in particular.

The great difficulty generally experienced by physicians in distinguishing carcinoma under the various forms which it presents in the different stages of its development, and in different organs of the body, will, we trust, furnish a sufficient excuse for our having given such a lengthened description of what strictly relates to the anatomy of the disease. If we have not succeeded in conveying a clear impression of this part of our subject, much assistance may be derived by consulting the coloured plates of the second and third fasciculi of the author's work on the Elementary Forms of Disease.

[In a recent work, already referred to, Dr. Walshe has thus classified the genus cancer or carcinoma:

GENUS CANCER OR CARCINOMA.

Species.	*Varieties.*	*Synonyms of the Species.*
Encephaloid	Common vascular sarcoma. } Abernethy. Mammary sarcoma? } Solanoid. Recamier. Zang. Nephroid. *Idem.* Napiform. *Idem.* Carcinoma fasciculatum vel hyalinum. Mueller. Fungus hæmatodes. Hey. Hematode cancer. Auct. Gall.	Spongy or ossivorous tumour. Ruysch. Palletta. Struma fungosa (testis). Callisen. Spongoid inflammation. Burns. Milt-like tumour. Munro. Medullary sarcoma. Abernethy. Cerebriform disease or cancer. Laennec. Pulpy testicle. Baillie. Carcinus spongiosus. Good. Carcinoma spongiosum. Young. Fungoid disease. A. Cooper. Hodgkin. Medullary fungus. Maunoir. Chelius. Acute fungous tumour. C. Bell. Medullary cancer. Travers. Cephaloma. Hooper. Carswell. Carcinoma medullare. Mueller. Soft cancer. Auct. Var.
Scirrhus	Pancreatic sarcoma? Abernethy. Napiform. } Recamier. Chondroid. } Lardaceous tissue. Auct. Gall. Carcinoma reticulare. Mueller.	Carcinomatous sarcoma. Abernethy. Carcinoma scirrhosum. Young. Scirrhus cancer. Travers. Scirrhoma. Carswell. Carcinoma simplex fibrosum. Mueller. Stone cancer. Auct. Var.
Colloid	Pultaceous cancer. } Cruveilhier. Pearly alveolar ditto. }	Areolar gelatiniform cancer. Cruveilhier. Carcinoma alveolare. Mueller. Gum cancer. Hodgkin.

These three species of carcinoma are thus described in a tabular manner by Dr. Walshe:

Encephaloid.	*Scirrhus.*	*Colloid.*
Resembles lobulated cerebral matter.	Resembles rind of bacon traversed by cellulo-fibrous septa.	Has the appearance of particles of jelly inlaid in a regular alveolar bed.
Is commonly opaque from its earliest formation.	Has a a semitransparent glossiness.	The contained matter is strikingly transparent.
Is of dead white colour.	Has a clear whitish or bluish yellow tint.	Greenish yellow is its predominant hue.
Contains a multitude of minute vessels.	Is comparatively ill-supplied with vessels.	(Its vessels have not been sufficiently examined as yet.)
Is less hard and dense than scirrhus.	Is exceedingly firm and dense.	The jelly-like *matter* is exceedingly soft; a colloid *mass* is, however, firm and resisting.
Is frequently found in the veins issuing from the diseased mass.	Has not been distinctly detected in this situation.	The pultaceous variety has been detected in the veins.
The predominant microscopical elements are globular, not always distinctly cellular, and caudate corpuscula.	The main microscopical constituents are juxtaposed nuclear cells; caudate corpuscula do not exist in it.	Is composed of cells in a state of *emboitement*.

Encephaloid.	*Scirrhus.*	*Colloid.*
Occasionally attains an enormous bulk.	Rarely acquires larger dimensions than an orange.	Observes a mean in this respect.
Has been observed in almost every tissue of the body.	Its seat, as ascertained by observation, is somewhat more limited.	Has so far been seen in a limited number of parts only.
Very commonly coexists in several parts or organs of the same subject.	Is not unusually solitary.	Has rarely been met with in more than one organ.
Is remarkable for its occasional vast rapidity of growth.	Ordinarily grows slowly.	Grows with a medium degree of rapidity.
Is frequently the seat of interstitial hemorrhage and deposition of black or bistre-coloured matter.	Is comparatively rarely the seat of these changes.	
When softened into a pulp, appears as a dead white or pink opaque matter of creamy consistence.	Resembles, when softened, a yellowish brown semitransparent gelatinous matter.	Undergoes no visible change of kind.
Subcutaneous tumours are slow to contract adhesion with the skin.	Scirrhus thus situate usually becomes adherent.	
Ulcerated encephaloid is frequently the seat of hemorrhage, followed by rapid fungous development.	Scirrhous ulcers much less frequently give rise to hemorrhage, and fungous growths (provided they retain the scirrhous character) are now more slowly and less abundantly developed.	
The progress of the disease after ulceration is commonly very rapid.	There is not such a remarkable change in the rate of progress of the disease after ulceration has set in.	
Is the most common form under which secondary cancer exhibits itself.		
Is the species of cancer most frequently observed in young subjects.	Is much less common before puberty.	Has so far been observed in adults only.]

Local and other relations of Carcinoma.—There are *no organs*, and *few tissues*, which may not become affected with carcinoma. Among the former, the stomach, liver, uterus, breast, and testes, are *much more frequently* the seat of the disease than any of the other organs of the body. It is also worthy of remark that it is met with more frequently in certain portions of organs and systems than in others. Thus, when it affects the uterus, it is almost always the os tincæ in which it commences; in the stomach it is much more frequently the pyloric than the cardiac orifice; it much more often affects the stomach than the œsophagus or intestines; the large than the small intestines. In the latter, it is rarely met with, and perhaps only in the duodenum and commencement of the jejunum; and in the former it is exclusively confined to the rectum, sigmoid flexure of the colon and ileo-cæcal valve, unless when propagated from a neighbouring organ by contiguity of tissue.

If we pass in review the several tissues subject to carcinoma, we find that the cellular is infinitely more so than any of the other tissues in which the disease occurs, although we have proved that it is far from being so frequently the seat of the disease as was, and still is, generally believed. The mucous and cutaneous tissues are the next in the order of frequency, and lastly the osseous, venous, and arterial. We have never observed the disease in cartilage, tendon, or ligament; but we have shown, when treating of the mode of its formation in the stomach, that, contrary to the general opinion, the muscular tissue of this organ is frequently the seat of it.

The number of organs that may become affected with carcinoma in the same individual varies considerably. In some cases there may be only one organ or tissue affected with the disease, as the stomach, intestines, œsophagus, liver, lungs, kidney, uterus, testis, breast, brain, eye, tongue, chin, cellular tissue, lymphatic glands, bone, capillaries, and veins. In other cases it may be found in a great many organs and tissues in various stages of its progress. It is seldom that double organs, such as both eyes, the mammæ, testes, or kidneys, are affected at the same time. We have never met with carcinoma of the pancreas, muscular, venous, and arterial tissues, serous, mucous, and fibrous membranes, without the disease being present in a neighbouring organ or tissue, and from which it was communicated to the former.

The greater liability of some organs and tissues than others to become affected with carcinoma is a circumstance of considerable practical importance. So, likewise, is its occurrence as a primary and secondary affection. In this latter respect the disease may be *secondary* only as regards the *order of its appearance*, the same morbid condition of the economy which gave rise to it in one organ giving rise to it in the others, which become successively affected; or it may be secondary in one organ in consequence of the *intimate physiological connection* existing between it and another previously affected; and, lastly, it may be secondary from *mere contiguity* of tissue.

In the first case the secondary appearance of the disease is recognised partly by the extent which it occupies, and partly by the physical and anatomical characters which it presents in the different organs in which it is present. By the same means, and more especially in consequence of two or more organs being found to be much more frequently than others affected with the disease, we infer that its propagation in the former is influenced by the intimate physiological connection which is known to exist between them, as is exemplified in carcinoma of the uterus and mammæ, and of the liver and stomach succeeding to each other. The secondary production of carcinoma from contiguity of tissue, whether of a similar or dissimilar kind, is frequently observed; such as the gradual extension of the disease from the walls of the stomach to those of the intestines, and from the latter to the parietes of the abdomen; from the stomach to the liver; from the uterus to the bladder or rectum, and *vice versâ*. But in all these cases the contiguous tissues and organs become united or continuous before the disease passes from the one to the other, which is then

propagated by the gradual molecular deposition of the carcinomatous matter, in the same manner as we see it accomplished in the skin during the ulcerative stage of the disease.

An opinion very different from that we have now given respecting the secondary production of carcinoma has long been entertained, chiefly by surgeons. Finding, as they frequently must have done, cancer in an internal organ which had given no signs of its presence until after it had existed for a greater or less length of time in some external part, they considered the production of the disease in the former situation to be subsequent to that in the latter, and to arise in consequence of the absorption of a specific virus from the supposed primary disease, and its transmission into the system. This opinion was strengthened by the fact that symptoms of cancer of an internal organ frequently make their appearance soon after the breast, testicle, or other external part has been removed by a surgical operation, and was considered as fully confirmed by another fact, viz. that the lymphatic glands situated in the vicinity of a cancerous tumour or ulcer are seen to become affected during the progress of the primary disease. We shall only remark with regard to this view of the secondary production of carcinoma, that the facts adduced are far from justifying the application which has been made of them; for they furnish no proof that the occurrence of the disease internally, at any period subsequent to its existence externally, may not depend on the same morbid condition of the economy producing its effects successively or simultaneously, in a greater or less number of organs, inasmuch as we know that carcinomatous tumours may exist for a considerable period, even in the most important of the internal organs, without giving rise to any appreciable modification of function calculated to lead to their detection. Hence, under whatever circumstances the signs of carcinoma may present themselves for the first time in an internal organ, we cannot determine either the length of time it may have existed, or the relative order of its succession. Besides, the extension, as it is called, of carcinoma from the breast or testis, for example, to the neighbouring lymphatic glands, affords no proof that it takes place through the medium of absorption; for we have found these glands in the axilla, and in the lumbar region, extensively diseased in carcinoma of the breast and testis, without any of the carcinomatous matter of which all these were composed being visible in the lymphatic vessels passing from the one to the other. The more natural explanation of the occurrence of the disease in these glands in such cases is, that, being subjected to the irritation which accompanies the latter stage of the disease, (the period at which the lymphatic glands are generally observed to become affected,) they become the seat of congestion, and, as we have already endeavoured to show, the material element of carcinoma being contained in the blood, it is separated from this fluid and deposited in their substance.

We are, however, well aware that there are cases in which this matter is absorbed and accumulates in the lymphatic glands; but from the circumstance just stated, and from the fact already noticed that these glands may be the only organs in the body in which, after the most careful examination, the disease is found to exist, we are surely not entitled to say that they are always secondarily affected, whatever signification we may attach to this term. We have seen several instances of cephalomatous tumours formed exclusively in the mesenteric glands and abdominal lymphatic glands; and in one case the latter glands of the principal regions of the body, on both sides of the neck and under the jaws, in the axillæ and groins, in the chest and abdomen, were extensively affected with the disease, and forming tumours varying from the size of a cherry to that of an egg. The spleen was the only other organ which presented any trace of the disease.

Carcinoma is a disease which is far from being equally frequent at the *different periods of life*. It is observed to make its appearance most frequently in the male from between thirty to forty or fifty years of age, and in the female after the cessation of the menstrual discharge, than at any other period of life. It is also on account of the more complicated nature of the organs of reproduction in females that they are more subject to the disease, generally considered, than males; for the uterus and mammæ are the organs which, in the former, are most frequently the seat of the disease. In the latter it rarely makes its appearance in the breast, and not so frequently in the testes as in the uterus. The stomach and liver are, according to our own observations, the most frequent seat of the disease in males, although these organs are, perhaps, equally so in females. The tongue, and especially the lips, are often affected in the former, and rarely in the latter. It is also worthy of remark that from childhood up to the age of puberty, and even to twenty or twenty-five years of age, we seldom meet carcinoma unless in particular organs or regions of the body. Thus it is chiefly the lymphatic and mesenteric glands, the great joints, as the elbow and knee joints, the brain, and cellular tissue, where it is considerable in quantity; whereas the stomach, intestines, uterus, and mammæ are almost exempt from the disease till a later period of life. And it is interesting to observe that the exceptions to its non-occurrence in these latter organs within the period alluded to are met with in such of them only the exercise of whose functions are susceptible of being prematurely and preternaturally excited, particularly the testes and ovaries.

These remarks on the relative frequency of carcinoma under the circumstances of age and sex apply to the disease generally, and not to both species and their varieties; for while scirrhoma is rarely met with within the period which we have specified, cephaloma is of frequent occurrence, and seldom proceeds to such an extent or with such rapidity in advanced as in early life; a circumstance which may probably depend on the greater activity of nutrition and the more plastic quality of the blood in the latter than in the former condition of life; and thus also a corresponding character may be given to the morbid products which manifest themselves in each.

The frequency of carcinoma is said to be considerably influenced by *temperament*. Thus out of forty-four cases of the disease in which the origi-

nal temperament was sufficiently characterized, Breschet and Ferrus found the lymphatic to prevail twenty times, the sanguineous twelve, the bilious eight, and the nervous two; and in almost all the patients submitted to their observations, the lymphatic temperament had acquired a marked predominance during the progress of the disease. (Dict. de Méd. t. iv. art. *Cancer*.)

The observation of carcinoma in individuals of different *habits* and *modes* of life submitted to the influence of various external agents arising out of locality, profession, or climate; in the married and unmarried; in women who have or who have not had children; in the poor and wealthy; in the temperate and debauched, &c. &c. has not led to very satisfactory results regarding the relative frequency of the disease. It is, however, said that it is as rare in peasants and country-people in general, as it is common among the inhabitants of large cities; and that it is more frequent in the lower and higher than in the middle classes of society.

Causes and nature of Carcinoma.—The observations which we have made on the relative frequency of carcinoma as to age, sex, temperament, and condition of life, contain the greatest part of what we have to say on the *predisposing* causes of the disease. Among these have long been enumerated the frequent and direct operation of irritating substances; external injuries, especially blows; the abuse of stimulating potions; immoderate indulgence in venery; the depressing influence of moral afflictions; bad food, conjoined with the debilitating effects of cold and otherwise unhealthy habitations; the injurious influence of one or more of these predisposing causes on particular organs being determined or modified by the individual or accidental circumstances of the case. The frequent occurrence, however, of carcinoma in individuals in whom none of these predisposing causes seem to have co-operated in the production of the disease, as well as its non-occurrence in many who have been subjected to the influence of these causes, has led many pathologists to consider it as having an hereditary origin. They believe that the *germ* of the malady, or *cancerous virus*, is transmitted from the parent to his offspring, and cite, in favour of their opinion, the occurrence of the disease in several members of the same family. This opinion, however, has few advocates, particularly since Alibert, (Description des Maladies de la Peau, p. 118,) Biett, and Dupuytren (Dict. des Sciences Médicales, t. iii. p. 677,) have shown that the carcinomatous matter may be introduced in the form of inoculation into the digestive organs, the serous cavities or veins, without giving rise to the disease; experiments, it may be remarked *en passant*, to which no more importance can be attached than to the fact that the disease may occur in several individuals of the same family. A more generally received opinion, and one much more in accordance with the results of accurate observation, is, that the manifestation of the disease is at all times, and under all circumstances, dependent on the previous existence of a peculiar state of the constitution, either congenital or acquired, termed *diathesis*. The evidence on which this opinion rests we have in great part already exposed when treating of the seat, local origin, and mode of formation of carcinoma. We have shown that the material element of the disease — without which it can have no existence—is contained in the blood, is separated from this fluid after the manner of nutrition or secretion, either in the molecular structure, or on the free surface, of organs; and that, while the formation of the disease is thus going on, there may be no appreciable physical or physiological modification of the part in which it is observed. It is thus that we meet with carcinomatous tumours in the brain, which, from their bulk and other characters, must have existed long before the functional disturbance of the organ gave signs of their presence; and we have an equally striking example of the silent development of these tumours in the eye, until, acting simply as a foreign body, they obstruct the rays of light, and render vision more or less imperfect. In persons, too, apparently in the enjoyment of the most perfect health, we often see the disease making its appearance in the form of a small pimple, proceeding more or less rapidly in its course, extending in breadth and in depth, and terminating ultimately in death, in spite of all the means which art has devised. In others, a similar pimple arises under similar, or even unfavourable, circumstances, proceeds like the former to ulceration; and although it may have been neglected, irritated, and excited from time to time, and maltreated in every possible way, disappears, and leaves the patient in perfect health. There is, indeed, no form of inflammation which may not exist for any definite length of time, and in every organ of the body, without being followed by carcinoma. Of the truth of this position every candid inquirer must be fully aware, although it is still attempted to support the unphilosophical theory which maintains that this disease is always preceded by chronic inflammation. It would, however, be a great practical error were we to overlook the influence of this pathological state on a constitution predisposed to carcinoma; for this disease does make its appearance in organs which we have every reason to believe would not have become affected with it, had they not been previously modified by the former. We must, therefore, conclude that, if carcinoma makes its appearance in individuals, however they may have been placed in regard to the operation of what are called predisposing and exciting causes, there must be present in such individuals a peculiar condition or disposition of body, previous to the manifestation of the disease. In what this disposition consists, we are entirely ignorant. Its very existence is made known to us only by means of the peculiar characters of the products to which it gives rise. We have certainly seen that the great function of nutrition is that which is more especially affected, and that, as the material element of carcinoma is contained in the blood, it is highly probable that a modification of this fluid constitutes the primary if not the essential condition of the formation of the disease. But, unacquainted as we are with the nature of nutrition as a physiological function, we can offer no explanation of the nature of the change effected in the blood, nor, consequently, of the nature of carcinoma. It is, however, an interest-

ing fact,—the result of our anatomical researches in particular,—that, as carcinomatous formations derive the materials of which they are composed from the blood, instead of their being local *transformations* or *degenerations* of pre-existing tissues, they do not, in this point of view, form an exception to the law, viz. that the natural and healthy solids, as well as the fluids of secretion, derive also their respective materials from the same source; and, therefore, we are led to hope that a more intimate knowledge of the manner in which these two functions are performed will enable us, at some future period, to determine the nature of a disease which hitherto has only been rendered more obscure by the attempts which have been made to explain it.

[For some excellent observations on the etiology of Cancer, see the work of Walshe, already cited.]

Symptoms of Carcinoma. — Considered in a general point of view, the symptoms of carcinoma refer to changes taking place during the progress of the disease, as they occur in the carcinomatous substance itself, in the organs in which it is contained, and in remote organs or the constitution generally. The symptoms are therefore local or general. The former are referable to changes in the bulk, consistence, form, colour, temperature, sensibility, circulation, nutrition, and special functions of the organ affected; the latter to changes in the functions of circulation, nutrition, and innervation in general. Both series of phenomena are greatly modified by the seat, stage, or period of the disease. They present also marked differences in the two species of carcinoma, those observed in the first species being often absent in the second; or, being present in the former from the commencement, either do not occur in the latter at all, or only towards its termination. We shall pass in review the *local* and *general* phenomena which accompany the presence of carcinoma in those organs the disease of which belong more especially to the province of medicine.

Local symptoms. — Few of the changes to which we have referred the *local* symptoms of carcinoma are discoverable in internal organs, and all of them may be absent in the early stage of the disease. Changes in the *colour*, *temperature*, *circulation*, and *nutrition* of the affected organ, cannot be detected by direct observation; and those of *bulk*, *consistence*, and *form*, can be determined only in certain organs, and at a more or less advanced period of the disease, such as the stomach and intestines, liver, spleen, kidneys, ovaries and uterus, lungs, and mesenteric glands; in all of which organs these changes may be recognised either by the touch, percussion, or auscultation. But it is more particularly the change of bulk which is detected by these means, and which, as a local symptom of the presence of carcinoma, is that to which the greatest importance is to be attached. The increase of bulk which accompanies the presence of carcinomina is not perceptible till the disease has made some progress. It is most considerable in solid organs, such as the liver, kidney, ovary, &c., and is seldom very marked in hollow organs, such as the stomach or intestines. Considerable increase of bulk may, however, have taken place in the walls of the stomach and intestines, without our being able to detect its presence, which happens when the carcinomatous matter accumulates in the direction of the internal surface of these organs. In such cases an increase of bulk of a different kind is produced, viz. dilatation, in consequence of the obstacle presented by the carcinomatous matter to the passage of the food or fæces. When dilatation of the stomach is thus produced, the obstacle is situated at the pylorus; when of the small intestines, it is, in the great majority of cases, situated at the termination of the duodenum or commencement of the jejunum, and caput cæcum coli; and at the sigmoid flexure of the colon and rectum, when the dilatation occupies the large intestines. The increase of bulk which the stomach and intestines acquire in consequence of an obstacle of this kind is sometimes very great. In some cases of scirrhus pylorus, the stomach has been found to occupy the greater part of the abdominal cavity, stretching down to the symphysis of the pubis, and from one lumbar region to the other; and the large intestines sometimes measure from four to six inches in diameter, when similarly affected. We have seen the small intestines equal in size to the ordinary dimensions of the stomach. It is important to know that the extent of the dilatation is not to be taken as the measure of the extent of the disease. The greater the dilatation the greater we may infer is the obstacle by which it is occasioned; but this obstacle may consist in a slight scirrhous enlargement, which prevents the passage of the food or fæces as effectually as when it is occasioned by one or more tumours of considerable size, or great thickening occupying several inches in length of the whole circumference of the walls of the stomach and intestines.

There are two circumstances connected with the dilatation of these organs from carcinoma which merit particular notice. The first is the *disappearance* of the dilatation at a particular period of the disease. This may happen a considerable time after the dilatation was first perceived, and is the consequence of the destruction of the carcinomatous substance from softening, ulceration, or sloughing. The obstacle being thus removed, a free passage is opened to the accumulated contents of the stomach and intestines, and the dilated walls of these organs are allowed to contract, and in some instances regain their natural dimensions. The second circumstance is the *re-occurrence* of the dilatation, which we have observed to take place only in the intestines. It does not occur, unless the mucous and muscular coats have been destroyed by ulceration, after the destruction of the carcinomatous substance, and not until cicatrization has commenced. The cicatrix being formed of cellulo-fibrous tissue, contracts and produces stricture of the intestine. The passage of the fæces is again obstructed, and the intestine acquires an increase of bulk much greater than before the destruction and removal of the carcinomatous substance. We shall again allude to these changes in bulk when speaking of the modifications of function, and the diagnosis of carcinoma in the digestive organs.

The increase of bulk which accompanies carcinoma of the liver is often very considerable. Cases have been met with in which the left lobe

of the liver extended into the left hypochondrium, and the right down to the iliac fossa on the same side. It is always produced in this organ by the accumulation of the carcinomatous matter in the form of tumours, which may often be felt projecting above its surface. It is chiefly from this latter circumstance that we are enabled to detect carcinoma of the liver. It is, however, necessary that the tumours should occupy the convex surface of the liver, and that this organ should project beyond the false ribs.

In one instance only have we found the spleen, when affected with carcinoma, much increased in size; it was nearly six times larger than natural. We have also found the kidney enlarged to the same extent in a young person, but it is seldom more than twice its natural size in this disease. Carcinoma of the uterus is not accompanied by any perceptible increase of bulk, unless examined *per vaginam*, when, in the early stage of the disease, the os uteri is found enlarged and projecting into the vagina. The ovaries acquire the size of the fist or even of the head of a child, but never become so large as when they are the seat of dropsy, or contain fibrous tumours. We have never seen the bulk of the lungs so increased by the presence of the carcinomatous deposit as to give rise to dilatation of the walls of the chest. We have already noticed the great increase of bulk which accompanies carcinoma of the mesenteric and lymphatic glands.

The only modification of the *sensibility* which, as a local symptom, accompanies carcinoma, is that of pain. There is, however, no symptom of carcinoma more deceptive than pain. The importance attached to it, more particularly when it possesses a *lancinating* character, must have originated in the study of the disease in external parts of the body, as the face, breast, or the skin and subjacent tissues in general; for there are several organs in which the pain is either very slight or seldom acquires the lancinating character ascribed to it: such is the case in carcinoma of the liver, spleen, kidneys, ovaries, stomach and intestines, (with the exception of the rectum,) the mesenteric glands, and even the brain. It is also to be remembered that pains, described by patients as lascinating, may occur without any trace of carcinoma being found in the organs to which they are referred.

Of all the varieties of carcinoma, it is that of scirrhus which is most frequently accompanied with pain; and it is also in this variety that the pain is most severe, acute, and lancinating. In medullary sarcoma this symptom is less frequent and severe than in any of the other varieties. But it is not according to the several varieties of carcinoma that we are to form an estimate either of the frequency or severity of the pain. For this symptom may, in both these respects, be said to vary with the degree of induration of the carcinomatous substance; of the distension or compression, and of irritation to which this substance gives rise in the neighbouring tissues. Under the influence of the two former of these conditions, pain would seem to result from compression of the nerves which happen to be included within the dense carcinomatous substance, or that are distributed in its immediate vicinity. Pain from irritation may also be produced under similar circumstances, but it is much more frequently when softening and sloughing of the carcinomatous substance, and ulceration of the neighbouring tissues, have taken place, that pain from this cause makes its appearance, and acquires a degree of severity which gives rise to the most intolerable suffering. It is in this stage of the disease that pain occurs in internal organs, in consequence of the extension of the irritation to the nerves of sensation.

The pain may be intermittent, remittent, and continued, whatever may be the organ affected with carcinoma. The intermittent character is most frequently observed during the early stage of the disease; and the remittent and continued during the progress of softening, sloughing, and ulceration. Numerous circumstances concur to produce these varieties in the duration of the pain in carcinoma; but in the great majority of cases they appear to depend on varying and opposite states of the sensibility and circulation of the affected organs. For we know that the direct application of those means which increase the sensibility and circulation excite, in an organ affected with carcinoma, pain when absent, and increase it when present; whilst those remedies which are known to diminish the sensibility and the action of the vascular system, effect also a diminution or an entire cessation of the pain in this disease.

The symptoms which depend on the *modifications of the functions of organs* affected with carcinoma, are far from being so conspicuous as the fatal character of the disease would lead us to suppose. We allude to the *special* modifications of function observed in carcinoma of internal organs. Before taking a general view of these modifications of function, we may remark that there is not one of them which may not be found to accompany other diseases than carcinoma. They nevertheless require to be studied with great care, because of the effects to which they give rise being sometimes more intolerable than the disease itself, and requiring a separate mode of treatment.

The modifications which are observed to occur in the special functions of organs, present great variety not only in different organs, but also in the same organ, according to the stage, extent, and situation of the disease. Thus the function of digestion is not so frequently disturbed in the early as in a more advanced stage of the disease, nor is the disturbance so great in the former as in the latter case. This difference in the effects of carcinoma on the function of digestion may be explained on the following principles, viz. that the carcinomatous substance, when first deposited, acts merely mechanically, and therefore does not interfere with the function of digestion, unless it occupies a great extent of the walls of the stomach, or prevents the egress of the digested food; whereas during its subsequent development, this substance undergoes those changes which we have already described, viz. softening, sloughing, and ulceration. The absence of irritation in the former case, and its presence in the latter, furnish an obvious reason why digestion is seldom disturbed in the one case, and more frequently and

to a greater degree in the other. The influence of carcinoma as to extent and situation, over the function of digestion, is very great. A carcinomatous tumour of from three to four inches in diameter, and projecting from one to two inches above the mucous membrane of the stomach, if situated at the small or large curvature, may be accompanied by but a very slight derangement of the function of digestion; whereas a tumour not larger than a filbert, situated at the pyloric orifice, may disturb this function to an extreme degree. It is, indeed, very often in consequence of the mechanical operation of carcinoma preventing the egress of the food or chyme, that we are first led to detect disorder of the function of digestion, and to suspect the nature of the disease on which it depends. In such cases more or less of the digested food is retained; the succeeding meal is partially or imperfectly digested; the stomach becomes distended, and being irritated by the continual contact of its contents, rendered more stimulating by decomposition or fermentation, contracts forcibly, and they are rejected by vomiting. Vomiting is an invariable consequence of carcinoma of the pylorus, accompanied with a diminution of bulk of the orifice of this part sufficient to interrupt or impede the exit of the chyme or indigested food. Perhaps the most frequent cause of vomiting is the mechanical obstacle occasioned by the carcinomatous substance in the pyloric portion of the stomach. This modification of the function of the stomach as a mechanical effect, we have never observed in carcinoma of any other portion of this organ. Vomiting, however, frequently occurs, whatever may be the situation of the disease, in consequence of the irritation which accompanies the softening process, and the ulceration by which it is followed. Vomiting from irritation may, in general, be distinguished from that occasioned by a mechanical obstacle situated at the pylorus. The former takes place however small the quantity of fluid taken into the stomach; the latter, only when the quantity is considerable. Vomiting from irritation is sudden, and accompanied by a disagreeable or painful effort; that from a mechanical obstacle gradual, and instead of being accompanied by pain, frequently affords relief from this state or a considerable degree of uneasiness. It is in this case a kind of passive act, the consequence of the great dilatation of the stomach, and sometimes of the inferior portion of the œsophagus also. The presence of dilatation of the stomach, which is easily detected by percussion, will enable us to distinguish vomiting from a mechanical obstacle from that occasioned by irritation.

The periodical character of vomiting is, in the great majority of cases of carcinoma of the stomach, to be attributed to the presence of a mechanical obstacle at the pylorus. The vomiting occurs at certain intervals, which vary with the extent of the obstacle, the quantity and kind of food taken, and other necessary and accidental circumstances, as the susceptibility of the patient and the state of those organs which exercise a sympathetic influence on the function of digestion. In some cases of this kind, the vomiting, after having continued for several weeks or months, disappears for a considerable time before it recommences, and in other cases ceases entirely. We have met with examples in both cases, referable to opposite physical conditions of the pyloric orifice. In both cases the vomiting depended on the pyloric orifice being obstructed by thickening of its walls, or the presence of projecting or pendulous tumours; and the partial or permanent cessation of this symptom, to the patency of this orifice being restored, in consequence of the destruction of the carcinomatous substance. The return of the vomiting in the former case was owing to the return of the disease in such a form as to obstruct anew the exit of the contents of the stomach; and in the latter, the entire cessation of this symptom was to be attributed to the progressive extension of the ulcerative and sloughing processes, and, consequently, the complete removal of the obstructing cause.

The *quantity* and *quality* of the matters vomited are variable. Both will be modified by the quantity and quality of the food and drink; the former by the capacity of the stomach, and the absence or presence of irritation; the latter by the nature of the ingesta, the state of digestion, and the stage and variety of the disease. It is only at the early stage of carcinoma, or at least before softening and ulceration have taken place, that the vomiting consists of a watery or mucous secretion. At a more advanced stage, the rejected food is less altered by the digestive process than before, and is often accompanied by a quantity of gas of a disagreeable odour. In the great majority of cases, and always towards the termination of the disease, the contents of the stomach rejected by vomiting contain a substance resembling the lees of wine, a mixture of chocolate, or soot and water. This substance may appear in the form of little particles, patches, or streaks, among the other matters vomited, or it may be in such quantities as to give to the whole contents of the stomach a deep brown or black colour. Its appearance always indicates the effusion of blood into the cavity of the stomach from hemorrhage, either in consequence of the softening of the carcinomatous substance, or the sloughing of this substance and of the contiguous parts. It is on this account regarded as a fatal symptom, and as indicating the speedy termination of the disease. (The cause of the black colour of the effused blood we have already explained in the articles Mortification and Perforation.) It is also at this period that the odour of the breath and the rejected matter is most offensive; and that the appetite, if not previously much affected, is entirely lost, perverted, or replaced by a morbid craving for peculiar kinds of food. There is only one other circumstance connected with vomiting to which we shall allude, viz. the rejection of the food taken the previous day or even at a later period, whilst the last meal is retained. This kind of choice, as it would seem, of the stomach between fresh and digested food, is not frequently observed. We do not recollect to have observed it except in cases of carcinoma of the pyloric portion of the stomach.

The modifications of the special functions of the intestines produced by carcinoma are in many respects very similar to those which we have described as occurring in the stomach. We have already noticed the mechanical influence of the disease in

preventing the passage of the food and fæces, the accumulation of the latter, and the subsequent dilatation of the intestine. In no other respect does carcinoma interfere with functions of the intestines, except when it gives rise to great irritation or inflammation of the mucous membrane and subjacent tissues, or when it terminates in sloughing and ulceration. Diarrhœa is the consequence of the former, and hemorrhage a frequent attendant on the latter of these morbid conditions. The rejection of fæcal matter by vomiting is not often observed in carcinoma of the intestines. The stools sometimes present the same melanotic character as the matters rejected by vomiting in the last stage of carcinoma of the stomach. They also indicate the last stage of the disease in the intestines, coincide with the appearance of the hemorrhage, and depend on the subsequent discoloration of the effused blood.

Carcinoma of the liver may occur without any appreciable derangement of the special function of the organ being observed. We are disposed to believe that a suspension of the secretion of the bile very seldom occurs in the disease. In the great majority of the cases of jaundice which we have seen to accompany carcinoma of the liver, we have found the ductus communis choledochus, the hepatic duct or its principal branches, much compressed or obliterated by the carcinomatous substance in the form of large tumours. The same mechanical operation of these tumours on the trunk of the vena portæ or its larger divisions in the liver, prevents the return of the blood of the chylopoietic viscera to this organ ; hence that form of ascites which always accompanies this state of the portal vessels.

There is often no apparent alteration in the quantity or quality of the bile, even in the most extensive forms of carcinoma of the liver. This fact is determined not only by the colour of the fæces during life, but by the examination of the organ after death; the substance of the liver presenting no unusual colour, and the gall-bladder being filled with bile of the natural consistence and colour.

There is no apparent modification of the secretion of the urine in carcinoma of one of the kidneys, although the disease may be so extensive as to leave no trace of the natural structure of the organ. We have never found both kidneys affected. On the contrary, the sound one is generally larger than natural, and appears to supply by its increase of bulk or energy the place of the other, as the quantity of urine voided in a given time is not sensibly diminished.

The much more frequent occurrence of carcinoma after than before the cessation of the menstrual discharge, prevents us from estimating accurately the influence which this disease exercises on the special function of the uterus and ovaries. Impregnation, however, has been known to take place in carcinoma of the os uteri, and of one of the ovaries. For farther information on carcinoma of the female organs of generation, see Uterus, Diseases of.

Only a few remarks are necessary on the modifications of function which accompany carcinoma of the spleen, pancreas, mesenteric and lymphatic glands, epiploon, and serous membranes in general. With regard to the spleen, we have only to remark that its cellular organization may be completely effaced by the presence of the carcinomatous matter, and consequently it is rendered incapable of receiving more blood than is necessary for the nutrition of its solid parts, and the growth of the disease. Carcinoma of the duodenal extremity of the pancreas, in consequence of the compression of the duct which passes in this direction, gives rise to an accumulation of the secretion of this organ, and great dilatation of the duct throughout its whole extent. It is in consequence of the increase of bulk of the pancreas which accompanies such cases, that we are sometimes led to suspect retention of the secretion of this organ. Diminished or suspended absorption are the occasional consequences of carcinoma of the mesenteric and lymphatic glands. Emaciation, when attributable to no other cause, may be regarded as indicating the modifications of function alluded to, of the former glands, and œdema of some external part, of the latter, both of which are rare occurrences, particularly œdema. An accumulation of the secretion of serous membranes, and a greater or less degree of obstruction to the motions of the contained organs, are the functional derangements which accompany carcinoma of these membranes and of the epiploon. The latter, when affected with carcinoma, is generally drawn up in the form of a thick irregular mass, and fixed to the stomach along its great curvature; or it is sometimes split into several portions attached above to the stomach, and below to the uterus, ovaries, or walls of the abdomen, forming so many thick bridles, which not only interrupt the motions of the intestines, but sometimes pull the stomach downwards, giving rise to an uneasy dragging sensation in the latter organ, and a sense of tightness or constriction in the former.

The function of respiration may be interrupted to such a degree by the mechanical presence of the carcinomatous matter, as to terminate in fatal asphyxia. We remember one case in particular of this kind. It occurred in a young man about twenty-five years of age, who, six weeks previous to his admission into hospital, performed the active duties of a soldier. He complained only of difficulty of breathing; he had a slight cough, followed occasionally by the expectoration of a small quantity of mucus. The difficulty of the respiration rapidly increased, and terminated in asphyxia, without the occurrence of fever or emaciation. Both lungs were nearly filled with large masses of the medullary sarcoma. The remaining pulmonary tissue was compressed, but not otherwise altered. This case affords a striking example of the mechanical effects of carcinoma, and the rapid and extensive development of the medullary variety of the disease. Carcinoma of the heart has been seldom met with to any great extent, and so far as we know, no particular modification of function has been observed to accompany its presence. We have already minutely detailed the changes effected by this disease in the capillary and venous circulation.

The functional lesions which accompany carcinoma of the brain, cerebellum, and spinal cord, vary considerably with the seat of the disease re-

lative to these organs individually, as well as to particular portions of them. But in neither of these respects does it give rise to any symptom which can be regarded as pathognomonic of its presence. As a foreign body, it gives rise sometimes to a degree of compression sufficient to produce partial or complete paralysis; loss of memory, or difficulty of speech; and derangement of the intellectual faculties. But these latter changes depend principally on the irritation and softening of the substance of the brain in contact with the carcinomatous mass. Even paralysis is more frequently produced by these subsequent changes than by compression. We have met with two cases of medullary sarcoma of the cerebellum, characterized by a remarkable development of the function ascribed to this organ by Gall. Both patients, young men, were between 18 and 19 years of age. The left lobe of the cerebellum in one of them contained a carcinomatous tumour, of the variety mentioned above, as large as a hen's egg; in the other the tumour was less, and projected from the centre of the cerebellum into the fourth ventricle. We could not ascertain how long they had practised the act of pollution, but both were emaciated and weak when admitted into hospital. One of these patients was left to himself, and died about two months after his admission, in a state of extreme debility. The other lived nearly three weeks. When warned of the fatal consequences which must soon follow the practice which had already reduced him to a state of great misery, he declared that although he was conscious of the nature of his situation, it was not in his power to resist the influence under which he felt himself compelled to act. His hands were secured, but without the desired effect. As a last resource, the whole of the prepuce was removed, yet in this mutilated state he attempted to gratify the fatal propensity. He died a few days afterward, having had several severe convulsive attacks.

Paralysis of the superior and inferior extremities, of the muscles of respiration, of the bladder and rectum, have been observed in carcinoma of the spinal cord. It is hardly necessary to observe that the seat and extent of the paralysis depend on the portion of the spinal cord occupied by the disease.

General Symptoms.—The general symptoms of carcinoma do not make their appearance before the last stage of the disease. Their severity depends much on the nature of the organ, and the extent to which it is affected; but it is principally the irritation produced by the presence of the carcinomatous substance during the period of softening, sloughing, and ulceration, that determines the gravity of these symptoms. It is in this, the last stage of the disease, that the circulation and innervation become deranged, and that fever and a diminution of the nutritive function are first observed. It is likewise at this period, but more frequently a few days or weeks before death, that the skin assumes a pale earthy, or dull ochry tint; that debility and emaciation make rapid progress; and all the functions of the economy become implicated in the deteriorating influence of the disease. It is this group of the general symptoms which constitute what is called the *cancerous cachexia*. The febrile symptoms, as well as the diminution of nutrition, in general are greatest when the seat of carcinoma is the uterus or stomach; and least in those organs, as the brain and lungs, in the former of which softening, and in the latter compression, may terminate in death, before either of these symptoms has become conspicuous. General dropsy does not often occur, and is never great. Ascites frequently accompanies carcinoma of the liver, for the reasons which we have already stated. Dropsy of the inferior extremities occurs more frequently in carcinoma of the ovaries and uterus than of any other organ. It is the consequence of compression of the iliac veins, but it may also be occasioned by the extension of the inflammation which accompanies the ulcerative stage of the disease to these vessels. Compression of the vena cava by tumours in the liver, or by the enlarged mesenteric glands, may also give rise to the same state of the inferior extremities.

Diagnosis.—It is not until carcinoma has made considerable progress, that we are sometimes able to recognise its presence in internal organs, by means of a careful consideration of the local and general symptoms which we have enumerated. We have had frequent occasion to remark how little importance is in general to be attached to any one of these symptoms taken individually. But when the local signs, viz. the changes in the bulk, form, and situation of organs, occasioned by the disease; its relative frequency in different organs and in particular portions of the same organ, are taken in connection with the special and general modification of function which may be present in individual cases, the greatest possible assistance is afforded us in establishing the diagnosis. The degree of facility with which this important object may be accomplished, will depend on the number of the signs and symptoms present, and the possibility of detecting them by the means of investigation in our possession. Thus it is more easy to detect carcinoma of the stomach than of the lungs, of the latter than of the brain; because of our being able to ascertain the presence of the greater number of the local signs of the disease in the first case, only a few of them in the second, and none at all in the third. And when the sense of sight can be applied with that of touch and hearing, the diagnosis seldom presents much difficulty, as in the case of carcinoma of the os uteri and rectum.

It is necessary to observe that too much reliance is not to be placed on the presence of those general symptoms which constitute the cancerous cachexia; for there are morbid conditions of the stomach and duodenum, associated with derangement of the biliary secretion, which give rise to a state of debility and emaciation, accompanied with discoloration of the skin, which so closely resembles the cancerous cachexia, that the one is not to be distinguished from the other. The difficulty of establishing the diagnosis in such cases is likewise increased by the circumstance that the same chronic character prevails in both. There is, therefore, no possibility of distinguishing between carcinoma of the stomach and such morbid conditions of the same organ, unless the local phenomena of the former be very conspicuous.

It is hardly necessary to remark that the presence of carcinoma in an external part of the body is to be regarded as a diagnostic sign of great importance, in all cases of a doubtful character in which functional derangement of an internal organ has existed for some time. In such a case we should regard the frequent occurrence of vomiting after meals as indicating the existence of carcinoma of the pylorus, even should no tumour be felt in this situation, or dilatation of the stomach. If the presence of a tumour were detected in any part of the abdominal cavity, we should not hesitate to say that it was of the same nature as the external affection; and the occurrence of paralysis, under the same circumstances, would justify us in attributing it to carcinoma of the brain or spinal cord.

We shall not, in this general article, attempt to determine how far it may be possible to distinguish carcinoma from other diseases to which internal organs, considered individually, are subject. Besides, in the description which we have given of the signs and symptoms of carcinoma, we have already endeavoured to point out those which more especially characterize the presence of this disease in individual organs.

Prognosis.—In no disease is a fatal termination so universally admitted as in carcinoma. The possibility of the cure of carcinoma of internal organs has never been supported by substantial evidence; and the examples are few indeed in which we are disposed to believe that the disease has been removed from an external part by surgical or other means, without its recurrence in the same or some other part of the body at some other future period.

Treatment.—A host of remedies have been proposed for the cure of carcinoma; the greater number of them have been tried in almost every form of the disease, but they have nearly all failed to justify the high praises formerly bestowed on their curative virtues. Some of them, however, have been found to retard, if not to arrest the progress of the disease; and, what is of great importance, to alleviate the sufferings and prolong the life of the patient. We shall notice those remedies only, the successful administration of which has been rendered evident in carcinoma of external organs, as under such circumstances the nature of the disease is less likely to have been mistaken. We shall speak first of those remedies which effect a salutary change in the nutritive function of the affected organ, and thereby retard or arrest the progress of the disease; secondly, of those best calculated to prevent, remove, or mitigate the local and general effects to which it gives rise.

1. The remedies which retard or arrest the progress of carcinoma consist of those which exercise a direct or indirect influence on the nutritive function of the affected organ. Among the former, or those which operate directly, the local abstraction of blood by means of leeches, and compression, hold the first rank. The first of these means should be employed for a considerable length of time, at intervals of one, two, or three days, and the quantity of blood taken should be regulated chiefly by the strength of the patient. The diminution of bulk of the original tumour which follows this mode of treatment, is sometimes very considerable. In the great majority of cases the tumour is not entirely removed. It may be reduced from the size of a hen's egg to that of a nut, and in this state remain stationary for years without giving rise to pain or any inconvenience whatever. The alternate use of local bleeding and compression effect more rapidly the reduction of bulk just noticed than when either is employed separately; but the former should, as a general rule, be always employed so as to produce a certain degree of indolency in the tumour, before the latter is had recourse to.

The beneficial effect of pressure, first employed by Mr. Young, (Cases of Cancer, &c. London, 1816,) has been satisfactorily determined by M. Recamier, one of the physicians of the Hôtel Dieu of Paris. The following are general results obtained by this physician:—

1st. Of one hundred patients treated by M. Recamier for carcinomatous affections, sixteen appeared to be incurable, and underwent only a palliative treatment. Thirty were completely cured by compression alone; and twenty-one, submitted to the same means, derived considerable benefit from it. Fifteen got rid of the affection radically, by means of ablation alone, or chiefly by ablation combined with pressure; and six by means of compression and cauterization. In the twelve remaining patients, the disease resisted all the means employed.

2d. Tumours similar, or at least analogous to those which degenerate into incurable cancer, are cured by methodical compression, and some other internal and external remedies.

3d. When a tendency towards resolution of a swelling of the mammary gland, which has not yet degenerated, has been produced for a considerable length of time by means of compression, the resolution of the swelling continues even after the compression is no longer employed: but if the swelling has degenerated, and, after having obtained a great diminution of its bulk, compression be laid aside, the swelling may resume its former bulk, and its degeneration proceed with greater rapidity than before.

4th. Compression may assist in preventing the return of cancer after ablation.

5th. The resolution of chronic inflammation is greatly favoured by compression alone, or combined with local bleeding, &c.

6th. Various tumefactions of the neck of the uterus are resolved by compressing this part by means of a pessary in the form of a hollow cone terminating in an open olive-shaped extremity.

7th. It is reasonable to hope, that if compression were employed at an early period, that is to say, before the degeneration of those tumours susceptible of this mode of treatment, the resolution of a greater number of them would be obtained, and the necessity of the ablation of cancer of the breast, so frequently followed by a return of the disease, when not encysted, be greatly diminished. (Recherches sur le Traitement de Cancer, par M. Recamier, t. i. p. 474.)

Although compression and local bleeding cannot be employed in the treatment of carcinoma of internal organs, properly so called, we have thought it proper to notice the results which M. Recamier states he has obtained by their external applica-

tion, as encouraging to the physician, and as affording a strong presumption that the cure of this disease, even in internal organs, is not altogether beyond the resources of his art.

It is also in consequence of a modification of nutrition in general, and consequently of that of the affected organ, that the beneficial effects of some general remedies, in carcinoma of external organs, are chiefly to be attributed. Some of these remedies appear to modify nutrition by effecting some unknown change in the composition of the blood, as aconitum, conium, and arsenic; others, by acting on the capillary circulation and absorption, as mercury, in alterative doses, and various preparations of iodine.

The beneficial effects of tonics, as preparations of iron, the fixed and volatile alkalies, mineral waters, such as those of Plombières, Barèges, and Vichy, and all other remedies which increase the vital energies, invigorate digestion, and promote absorption and secretion, may also be referred to a favourable change induced in the nutritive function of the affected organ, by the introduction of these remedies into the circulating system.

The salutary operation of these local and general remedies is much increased by a judicious combination of both, regulated according to the circumstances of individual cases. But while employing any of these remedies, it is of the utmost importance to regulate the diet and regimen of the patient in such a manner that neither of them may interfere with the operation of the remedy employed. M. Recamier, in the work already referred to, has shown that the curative virtues of conium, for example, depend greatly on the quantity of food consumed by the patient; that is to say, the operation of this remedy was more or less powerful when only a small quantity of food was allowed, and hardly perceptible when the quantity was considerable. While using the conium, he therefore restricts the patient to a severe diet; and in this way he says he has succeeded in curing several cases of carcinoma of the uterus, liver, spleen, mammæ, testes, and of the extremities. The following are the principles of the treatment:—

1st. The patient takes a dose of the extract of conium, evening and morning, two hours before the first and two hours before the last meal. The amount of the first dose is half a grain, which is gradually increased to six grains each time. This dose is continued for a fortnight in order that the organs may become habituated to its operation, and is afterwards increased to twelve grains each time, beyond which it is not necessary to carry the remedy because of its influence being sufficient. The twelve-grain dose is continued for from two to three or four weeks.

2d. After each dose of the conium, as well as at meals, the patient uses a decoction of sarsaparilla, (composed of two ounces of the root to two pounds of water,) instead of water.

3d. Only the third of the ordinary quantity of food is allowed, which ought to be very simple, and divided into three small meals.

4th. If the conium disagree in one form, it should be given in another, or the aconitum may be used instead, but in lesser quantity than the conium. Towards the end of the treatment the dose of the conium is gradually diminished, and the diet gradually increased.

M. Recamier ascribes the success he has obtained in the use of the conium not only to the strict observance of these dietetic rules, but also to the method he has employed in the preparation of the extract. The plant is submitted to the action of the vapour of vinegar or alcohol, before the juice is expressed from it; the juice is afterwards exposed to the heat of a sand-bath, and evaporated to the consistence of an extract. The extract thus obtained has not the nauseous odour of that usually employed, while it possesses all the deobstruent virtues, and sits better on the stomach than the latter.

[The only class of remedies, that can be expected to afford any essential benefit, are those that are capable of inducing a new condition in the system, by modifying the function of nutrition; such as the various preparations of iodine, combined with a thorough change of every thing surrounding the individual. The cachexia is the real morbid condition, and the cancerous affections in particular organs are but so many evidences of it, as tubercles in the lungs are mere expressions or indications of another form of cachexia, equally possessing the whole system. Hence it is, that cancerous tumours on the external parts of the body are so apt to recur after they have been removed by the surgeon. Still it must be admitted, that in cases of scirrhous tumours, when they have been removed early, there has very frequently been no return of the disease. In such cases the cachexia has been less strongly marked, and time, apparently, has not been permitted for the local mischief to increase the morbid disposition. It would seem, too, that the particular species of cancer influences the probability of recovery. There are few examples of permanent recovery after the removal of encephaloid tumours.

Recent statistical inquiries by M. Leroy d'Etiolles, offer no great encouragement to the surgeon to attempt to remove by the knife the local evidences of systemic mischief. Of 2781 cases occurring in the practice of 174 surgeons, 1227 happened in persons above 60 years of age. The cases of cancer of the uterus were about 30 per cent., those of the heart 24 per cent. Cancer of the mouth was in women only as 1 to 1½ per cent.; whilst in men, probably—he suggests—from the use of the tobacco-pipe, it was as much as 20 per cent. Of 1172 patients not operated on, 18 lived more than thirty years after the first appearance of the disease; whilst of 801 operated on by excision or caustic, the existence of only 4 was prolonged for a similar time. 14 patients operated on, and 34 not operated on, lived from twenty to thirty years; and 88 in the first category, and 228 in the second, lived from six to twenty years after the first appearance of the disease. The ordinary duration of life after this period, amongst persons not operated on, is said to be five years for men, and five and a half for women; whilst among those operated on, it is no more than five years and two months for men, and six years for women. Hence it would seem, that setting aside the immediate danger from the operation, the removal of cancerous disease by the knife had but little influence in prolonging life. Further observa-

tions are necessary, however, before these influences can be regarded as generally applicable. (See on the whole subject of cancer the excellent Essay by Dr. Walshe, especially the Amer. edit. by Dr. J. M. Warren.)]

II. The remedies best calculated to prevent, remove, or mitigate the local and general effects of carcinoma of internal organs, vary with the nature of these effects and the seat of the disease. The state of irritation and fever, and pain, at whatever period of the disease they may occur, may be greatly moderated by the use of the conium, aconitum, opium, hyoscyamus, the acetate or muriate of morphia; whilst at the same time the use of all kinds of stimuli is to be avoided, particularly if the digestive organs be the seat of the disease; and the patient himself kept as much as possible in a state of quiet of body and mind. If the os uteri be the seat of the disease, additional benefit may be derived from the use of leeches applied to this part, and also sedative injections. It is only in this latter situation that sloughing and ulceration can be detected, and local remedies applied to remove some of the disagreeable effects of the one, or retard the progress of the other. The chlorurets of lime and soda are, perhaps, the best remedies we can employ in this case, as they not only destroy the disgusting odour which accompanies this stage of the disease, but remove the putrid and irritating fluids which are then discharged. The retention of the contents of hollow organs, from compression or obstruction, is an occurrence which ought to be guarded against by regulating the quantity and quality of the food, for negligence in this respect may be followed by fatal consequences, if the obstacle be situated in the intestines.

It is not in our power to prevent the occurrence of ascites from compression of the vena portæ, nor of œdema of the inferior extremities from compression of the cava in carcinoma of the mesenteric glands, or of the iliac veins when the ovaries or uterus are affected with this disease. But the quantity of the effused fluid may be prevented from becoming so great as to affect the respiration, or give rise to painful distension of the integuments, by the use of those remedies usually employed in dropsy from obstruction to the return of the venous blood. (See Dropsy.)

When carcinoma has arrived at that period when the cancerous cachexia announces the extension and fatal termination of the disease, the efforts of the physician must be directed solely to the mitigation of the sufferings of the patient. It would indeed be a valuable discovery — a remedy capable of removing pain without producing any injurious effects on the economy; for if this symptom were removed, there are many cases in which carcinoma would run a much longer course, and give rise to comparatively little functional derangement.

We have not in the course of this article alluded to the perforation of hollow organs from carcinoma. With regard to this termination of carcinoma, we shall only remark that it most frequently takes place in the uterus and stomach, the rectum and urinary bladder, the transverse arch of the colon and jejunum, and the peritoneum. The perforation of the rectum, bladder, and peritoneum, is the consequence of the extension of the disease from the uterus; that of the transverse arch of the colon, the consequence of its extension from the stomach. (See Perforation, Peritonitis, Stomach and Uterus, Diseases of.)

Robert Carswell.

SCORBUTUS. — This is the general appellation of nosologists for the disease long known in our own country by the name of *scurvy*. The latter term, however, in professional as well as in popular use, has had an extended and very vague signification, embracing various morbid conditions of the skin which differ often essentially from each other, and are unallied to the subject of the present article. Illustrations of this remark might be adduced from various sources. As an instance, in the English translation of the Pentateuch the word scurvy is twice used synonymously with scabies in the Latin. (Lev. xxi. 20, xxii. 22.) This and similar applications of it we think may be traced to its early use in an adjective sense; the substantive scurf having its literal prototype in the Saxon language, and referring, as is well known, to exfoliations of small particles of the cuticle; an occurrence not uncommon in the disease now called scurvy, but which has no title to a characteristic symptom.

The word *scorbutus*, as Good observes, is neither Greek nor Latin, nor belongs to any language whatever, but is an intolerable barbarism, deduced probably from the Sclavonic word 'scorb,' the identical disease of which we have to treat having been frequently endemic in Russia and other northern countries: it has gratuitously received a sort of Latin termination. It has also been referred to 'schorbert' in the Danish language, and 'scorbeck,' *i. e.* sore mouth or 'scheurbuych' in the Dutch. Most authors, says Lind, have traced it to 'schorbock,' a griping or teazing of the belly, by no means a usual symptom, but so stated by a mistake in the etymology of the word. Scorbutus has also been called gingibrachium and gingipedum, from its affecting the gums, arms, and legs. It is probable also that the word 'stomacace,' (from στοματος and κακος, disease of the mouth) and 'sceletyrbe' (from σκελος, the leg, and τυρβη, disorder) have by the ancient writers been employed to designate this affection. It may be well also to mention here that 'scorbutus' has two derivatives, which have had the same extensive and corresponding misapplication as the original, viz. the terms scorbutic and antiscorbutic, the former referring to a peculiar virus supposed to be the common root of a large class of diseases, the latter to the substances employed for their removal, constituting a very formidable and extraordinary catalogue.

To prevent misconception, it seems necessary for us to premise that the following discussion relates to a peculiar disease, distinct, so far as we know, from the papular, pustular, squamous, and other diseases of the skin which have been unfortunately confounded with it; a confusion which has given rise to evils of the greatest magnitude, as exemplified not only in the errors of the careless and illiterate, but in their endless dissemination with all the force of authority from the written doctrines of the respected and erudite. It may not be without its use to mention, that from the

confusion of terms above adverted to, the best medicine for the prevention and cure of scorbutus was for a very long period overlooked and neglected, to the immense sacrifice of human life; and from the same cause it is stated that on the recommendation of Böerhaave, mercury was employed by the medical officers of the imperial army of Hungary in 1720, in the treatment of four hundred soldiers suffering from real scorbutus; every one of whom having been subjected to a course of this medicine died in consequence. (Elements of Medical Logic, by Sir Gilbert Blane, M. D. p. 217.)

Scorbutus, or true scurvy, is a disease which pervades the whole of the human frame, and is characterized by general debility, fœtor of the breath, sponginess and turgidity of the gums, livid subcutaneous spots, particularly at the roots of the hairs, ecchymoses, spontaneous hemorrhages, and frequently contraction of the limbs. Cullen has placed it in the class *Cachexiæ* and order *Impetigines*, and has thus defined it: "In regione frigida post victum putrescentem, salitum, ex animalibus confectum, deficiente simul materia vegetabili; asthenia, stomacace, in cute maculæ diversi coloris, plerumque livescentes, præsertim ad pilorum radices." Mason Good has arranged it in his class *Hæmatica* and order *Dysthetica*, as one of three species under the generic name *Porphyra;* including under it every variety of petechial eruption not depending on fever. The first species, viz. "P. simplex—petechial scurvy," he has defined "spots numerous but small and flea-bite shaped, chiefly in the breast, arms, and legs, paleness of visage." The second "P. hæmorrhagica—land scurvy," in which the spots are circular, of different sizes, often in stripes or patches irregularly scattered over the thighs, arms, and trunk; occasional hemorrhage from the mouth, nostrils, or viscera; great debility and depression of spirits. In the third species, viz.: "P. nautica —sea scurvy," the spots are of different hues intermixed with some which are livid, principally at the roots of the hairs, teeth loose, gums spongy, and bleeding, breath fetid, debility universal and extreme. The first and second species having been particularly discussed in the article Purpura, in conformity with the usage of modern writers, require no further comment in this place, than that they have been so distinguished from the circumstance of their having frequently occurred in young persons living in the interior of the country, and previously enjoying good health with all the necessaries and comforts of life, but who, nevertheless, having failed to derive benefit from the diet and regimen usually found adequate to the cure of sea-scurvy, have not unfrequently been recovered by opposite means; circumstances which appear to indicate some essential differences in the pathological conditions under which they occur. This opinion has been further strengthened by the blood drawn from the veins being also dissimilar; under the former circumstances being livid and very loosely coagulable, and under the latter having the usual appearances characteristic of an inflammatory disease. It is to be remarked, however, that the scurvy as it is developed at sea is a form of disease in its characters precisely similar to that which was commonly termed land-scurvy long prior to the distinction of Mason Good above adverted to; the only difference being that of the situation of its occurrence and the class of persons (mariners) who have been most frequently its victims. In our own country, though now happily a rare disease, it was formerly, even in the inland parts, of great frequency; and in other northern states, particularly on the shores of the Baltic, where the products of vegetation, at least in their fresh state, have formed a very insignificant portion in the diet of its inhabitants, it is now even occasionally endemic. Its former frequent occurrence in besieged towns and garrisons, under the combined circumstances of defect in the quantity and quality of food, fatigue, anxiety, disappointment, and exposure to the united influence of a cold and damp atmosphere, further prove that any particular influence from the sea is not essential to its generation. A memorable instance in point presents itself in the account of the siege of Thorn; where we find that between five and six thousand of the garrison, besides a great number of the inhabitants of the town, were cut off by the disease, when the Swedes, who were the besiegers, were altogether exempted from it; and it is further remarkable that no sooner were fresh vegetables admitted to their use than the mortality subsided, and the disease disappeared. (Lind on Scurvy, Part III. ch. ii. p. 395.)

Considerable discrepancy of opinion has prevailed as to the origin of scorbutus; whether it be of recent date, or referred to in the earliest productions of medical literature. It has been contended, chiefly by the continental writers, though some of high estimation in our own country have coincided in the opinion, that the ancient physicians were acquainted with it, although it has not been accurately described by them. On the other hand, there are authors of great celebrity, amongst whom are to be found Friend, Lind, and Trotter, who have maintained that the Greeks, Romans, and Arabians never could have witnessed it; considering it indigenous to the colder regions of the globe, and chiefly incidental to the privations consequent to long voyages, which from their ignorance of the compass and the science of navigation generally, they never undertook. Sieges, however, and seasons of dearth have been common to every period and country, the former of much longer duration in ancient than in recent times; and though experience has determined that the climates, or at least the vegetable productions of tropical latitudes, and their consequent use in the diet of the inhabitants, would in general insure its prevention, we have abundant proof that its existence is not incompatible with high temperatures. The ancient physicians, too, it is contended, have left us details more closely corresponding to the symptoms of scorbutus in our present acceptation of the word than any other disease with which we are acquainted. Thus Hippocrates, in his description of disorders of the spleen, has noted the occurrence of the following assemblage of symptoms. "The abdomen is distended, and subsequently the spleen is enlarged, becomes hard, and the seat of acute pain; the complexion is changed and has a dusky (μελας) pallid appearance, like the colour of a pomegra-

nate; a disagreeable odour is exhaled from the ears and gums; the latter recede from the teeth, and ulcers break out on the tibiæ like nocturnal pustules or blotches, (οκοια περ επινυκτιδες;) the limbs are attenuated and the bowels costive." Again, in his second book of Prognostics, he observes that in those who have tumid spleens, the gums are diseased and the mouth emits a fetid odour, but those whose spleens are enlarged without any consequent hemorrhages are attacked with ill-conditioned ulcers in the legs and black scars. His description of the convolvulus sanguineus (Ειλεος αιματιτης) more nearly represents the scurvy than that of the σπλην μεγας. "A bad odour is emitted from the mouth, the gums recede from the teeth, and blood is effused from the nostrils: but sometimes ulcers break out on the legs, and while some are healing others break out afresh, the skin about them is of a dark colour, thin and tender, and the patient is not disposed to walk or use any exertion." In the original the affirmative is asserted, that the patient is disposed to exertion, a circumstance so inconsistent with ulcerations of the legs, hemorrhages, and other symptoms, that commentators agree that the negative particle (ου) must have been omitted: this derives further confirmation from some additional remarks of the same writer, referring to a former description of another kind of convolvulus for the remaining symptoms, in which it is said that the patient's legs are wearied, and if he walk they tremble, and if he should ascend an acclivity that he breathes with difficulty, the elbows being raised as if they were suspended, &c.; the causes of which, he states, are heating food taken by persons using little or no exercise, and who, thus weakened, were suddenly forced to take long and fatiguing journeys in very cold weather; the ειλεος, it must be remembered, being a term not confined by the ancients to express affections of the smaller intestines, but applied to denote also pains in the other parts of the abdomen. (Enquiry on Scurvy by Francis Milman, M. D. Lond. 1782, p. 179.) Celsus has given a similar character of the ulcerations attending scurvy to that of Hippocrates: "Ulcera autem omnino non sanescunt, aut certe cicatricem vix recipient;" and in another part seems to have translated the observations of Hippocrates: "At quibus magni lienes sunt, his, gingivæ malæ sunt, et os olet, aut sanguis aliqua parte prorumpit; quorum si nihil evenit, necesse est in cruribus mala ulcera et ex his nigræ cicatrices fiant:" (Lib. ii. c. vii.), and in another passage, on tumefactions of the spleen, he has almost confirmed the conjecture above mentioned, expressly observing, "in intenta ambulatione cursuque dolor et quædem difficultas est;" and he thus proceeds: "hoc vitium quies auget, itaque exertione et labore opus est, habitâ tamen ratione, ne febrem ista, si nimium processerint, excitent." (Liv. iv. c. ix.) Aretæus, (lib. i. c. 14,) Paul of Ægina, (lib. iii. c. 49,) and Avicenna, (lib. iii. c. 2,) as well as other Greek and Arabian physicians, have described the same chain of symptoms.

It seems highly probable also that the true scurvy has been referred to both by Strabo and Pliny; by the former of whom we are told that the Roman army, sent into Arabia under Ælius Gallas in the reign of Augustus, underwent great hardships and fatigue from difficult marches, sometimes in a marshy unhealthy country, and at others from long and troublesome navigations, which Syllæus purposely protracted. "Proinde," says he, "ad Album Pagum pervenit, jam exercitu oris et crurum vitiis (qui morbi sunt ei regioni peculiares) tacto stomacacen et sceletyrben dicunt; quorum illa circa os, et circa crura resolutio quædam est ex aquis et herbis proveniens." (Strabonis Geograph. lib. xvi.) Pliny has left an observation which seems to bear on the same point. He states that the Roman army under the command of Cæsar Germanicus, having encamped in Germany beyond the Rhine, near the sea-coast, met with a fountain of sweet water, by the drinking of which in the space of two years the teeth drop out, and the joints of the knees became paralytic (compages genubus solverentur). The physicians, he adds, called the disease stomacace and scelotyrbe, and discovered a remedy for it, viz. herba Brittanica, "a salutary medicine not only in disorders of the mouth and nerves, but for the quinsy, bite of serpents," &c. (Plinii Histor. Naturalis, lib. xxv. c. iii.)

It has been denied, however, that the scelotyrbe was an indication of scurvy, because Galen has spoken of it as a kind of paralysis,* by which the patient is disabled from walking straight; but such an effect does not seem at all inconsistent with the detail of the symptoms. It has been argued, also, that the stomacace may have stood for aphthous and similar disorders of the mouth; and that other concomitant symptoms equally constant and remarkable, particularly the petechiæ and ecchymoses, could not have failed to elicit the notice of the early writers, if the disease they described had been scurvy. On the other hand, from the comparative rarity of the occurrence of scurvy in the southern climates, it is not to be presumed that the attention of the ancient physicians should have been very particularly directed to it. There is, besides, a peculiarity in the combination of the symptoms, a difficulty in referring them to any other known disease, and an apparent identity of circumstances under which they had been induced. It is likewise an established fact that in many instances the presence of scurvy has been acknowledged, and it has been expressly noticed, without the appearances which have been supposed to constitute the deficiency in the description of the ancient writers. Thus Sennertus observes, "In aliquibus nullæ erumpunt maculæ; aliis tota crura violaceo pinguntur ut tibialia ejus coloris superinducta jurares." To cite another authority, Nitzeh, who had very extensive experience of the disease as physician in the imperial Russian armies, and published an elaborate account of it in the year 1747, has noticed the occasional appearance of the other symptoms of scorbutus without the petechiæ which usually accompany it. (See Lind on Scurvy, p. 423.)

From a consideration of all the circumstances of the question at issue, it appears a reasonable conclusion that the conjecture of the antiquity of the disease is well founded, and that the slight diversity of the effects, if any, by which it has

* Mason Good imagines that Galen referred to chorea, under the name scelotyrbe. — Study of Med. vol. iii. p. 432. First Edition.

been manifested at different periods, is to be accounted for by the infinity of varying circumstances which exert their modifying influences on disease, rather than by any essential differences in the actual morbid condition under which it has been induced. It will be sufficient to mention the diversity of periods, of seasons, of climates, of localities, of occupations, of diet, besides numberless others of a moral nature. It is further corroborative of the antiquity of scorbutus, though we mention it in continuation of its history, rather than with the view of dwelling on incidents from which no deductions of practical value are to be drawn, that with the revival of literature after the siege of Constantinople, we find an undoubted record of its occurrence. It is characterized in the most particular manner by the Sieur Joinville, from the appearances it presented in the Christian army under St. Louis IX. in Egypt, about the year 1260. They had only one sort of fish, viz. the bombette, and their religion would not suffer them to eat meat during Lent; circumstances which, together with bad air and great scarcity of water, were supposed to have induced the disease. (Histoire de Louis IX. par le Sieur Joinville.—Milman on Scurvy. Lond. 1782. p. 184.) In the year 1486, it is stated by Fabricius in his account of the antiquities of his own country, (Misnia,) to have been a new and unheard-of disease, spreading as supposed by contagion, and proving extremely dangerous. (Op. supra cit. p. 186.) In 1497 it was the acknowledged occasion of dreadful havoc in the crew of Vasco de Gama in his passage of discovery by the Cape of Good Hope, (Hackluyt's Collection of Voyages, vol. iii. p. 225); and its destructive ravages have since been awfully pourtrayed in the narratives of the early English navigators, particularly in those of Cartier, Sir Francis Drake, Davis, Cavendish, and Dampier. Sir Richard Hawkins mentions that within his naval experience, he had known of 10,000 men having perished by the scurvy;* and from the same cause Commodore Anson, in the course of his voyage round the world, lost more than four-fifths of his men.

Until the year 1796, scorbutus may be said to have been the universal scourge of our maritime connections; and it is supposed to have destroyed more sailors than the various accidents incidental to a sea life, united with the terrific consequences of naval warfare. Happily, however, since the above-mentioned period it has been of very rare occurrence in our ships of war and naval hospitals; so rarely, that on the high authority of Sir Gilbert Blane, the year adverted to may be regarded as the era of its extermination. The accomplishment of this he attributes in an unqualified manner to the curative as well as preventive use of citric acid; no instance of the disease having occurred in his extensive experience which resisted its influence. To such testimony, perhaps, it behoves us to yield our implicit assent; but, satisfied as we are with the immense mass of evidence adduced in favour of the wonderful efficacy of the remedy referred to, we cannot but take into the account the co-operative influence of the great improvements in naval economy, successfully commenced with a view to the prevention of scorbutus by the justly esteemed navigator Captain Cook, and brought to comparative perfection under the happy auspices of the enlightened and venerable director of the medical department of the navy, Sir Gilbert Blane himself. The records of medicine abundantly prove the prevalence, and even the great fatality of scorbutus on our own shores at a former period, although its appearance at the present day is most rare, as is well known to every practitioner of medicine. This salutary change is fully accounted for by the drainage of the country; by the introduction of fresh vegetables as a considerable proportion of the habitual diet of the people; and those improvements in our national economy by which the use of fresh meats has been rendered available at all seasons of the year, and substituted for the dried and salted provisions formerly a principal article of subsistence throughout the winter. The want of fresh vegetables at former periods is plainly evinced by the historical fact, that as late as the commencement of the sixteenth century, the art of gardening was so little understood in our country, that Katharine of Aragon, queen of Henry VIII., to procure a salad, was obliged to despatch a messenger to the Netherlands for it; and it was near the close of Henry's reign before the necessary vegetables for the purpose, as well as cabbages, turnips, carrots, and some other edible roots, were produced; the small quantity of this kind of food previously used having been imported from Holland and Flanders. (Hume's History of England, ch. xxxiii.)

But to return to the general history of scorbutus. Krantz, the historian of Saxony, is supposed to be the first writer whose works are extant who calls it scurvy; and the next, Euritius Cordus, in his Botonologicon, published in 1534, wherein the chelidonium minus, called by the Saxons schorbock root, is extolled as a remedy. It is mentioned, also, in the same manner in the Medicina Herbaria of J. Agricola, published in the year 1539. But in an intermediate period, in 1535, we find that the most decisive and deplorable effects of it were evinced in the crew of James Cartier in his second voyage to Newfoundland, when we are informed of the providential discovery of a remedy (in previous use amongst the people of Stadacona,) viz. the decoction of the bark and leaves of the ameda or hanneda, afterwards gratefully designated by them "the tree of life."† In 1555, the History of Northern Nations, by Olaus Magnus, contained, amongst the diseases peculiar to them, a long description of scorbutus. Soon afterwards we find three cotemporary physicians of eminence treating expressly of it, viz. Rousseus, Wiems, and Ecthius. The works of the two former, in the opinion of the learned Astruc, were not published until the year 1580, and the epitome of Ecthius, which, according to Forrestus, was the transcript of a letter

* The Observations of Sir Richard Hawkins, knt. in his Voyage to the South Sea, A. D. 1593. — Purchas's Pilgrim, part iv. p. 1374.

† "I am inclined to believe, from the description given by Cartier of the ameda tree, that it was the large swampy American spruce. Some have supposed it to be the sassafras, others the white-thorn; but in his third voyage he mentions the white-thorn, and makes the ameda to be three feet in circumference." — Lind. on Scurvy, p. 178.

dated 1541, not until 1583. In 1604 appeared a work on the subject by Engelanus, which for many years was regarded as the standard of public opinion. This was succeeded in 1624 by that of Sennertus, and in 1627 by the description of Vander Nege, drawn from personal observation of its extensive prevalence at the siege of Breda. In 1667 Willis published a systematic treatise on the disease, which, like that of Engelanus, continued for some time to be the prevailing authority. In 1708, however, it gave place to the observations of Boerhaave, and to him succeeds a long list of writers; but, as of those who preceded him, we shall mention such only as have been held in estimation, attaching the dates to their several publications. (Lind's Treatise on Scurvy. Lond. 1757.) Mead, in 1749; Russell and Huxham, in 1750; Addington, in 1753; Bisset, in 1755; Lind, in 1757; Macbride, in 1767; Hulme, in 1768; Milman, in 1782; Trotter, in 1797; and Blane, first in his work on the Diseases of Seamen, published in 1785, and subsequently in a paper on the health of the navy, inserted in the sixth volume of the Medico-Chirurgical Transactions of London, in 1815, and transcribed in a pamphlet of the same title printed for private circulation in 1830. Besides the above mentioned, there are doubtless others which merit attention; and much valuable information on the subject is to be found in the periodical miscellanies, chiefly of a remote date.

Symptoms.—The symptoms which constitute scorbutus having rarely if ever appeared except when there has been an obvious exposure of the subject of them to the concurring influence of several of those termed its predisposing causes, other indications of the approach of the disease will be confirmed, or the suspicion of it diminished, in proportion as such a connection of circumstances can or cannot be ascertained. Of the predisposing causes the most uniformly present has been the combination of cold with humidity of atmosphere, either general or partial; whilst at the same time the diet has consisted of food defective in its nutritious qualities, and particularly of provisions rendered dry and hard by the process of salting as usually adopted to preserve them for sea use, together with a total privation, or the use of a comparatively insignificant quantity of succulent vegetables in their fresh state. Under this privation, as it has frequently occurred at sea, a craving desire for them, particularly for such as are of an acid taste, and also for pure water, when the supply of that article has been scanty, has been so often observed to precede the disease, that practical authorities have considered such desires as premonitory symptoms. Their operation has been feelingly portrayed in the narrative of Lord Anson's voyage, on the occasion of the approach of his ships to the island of Juan Fernandez: the scenery of which having been depicted, the writer observes, "Such a scene, so beautifully diversified, must have been delightful to an indifferent spectator; but in the distressed condition of the Centurion's men, who were in a manner languishing for the land and its vegetable productions, a situation of mind which always attends the scurvy, it is not to be conceived with what transport and eagerness they viewed the shore, and how impatiently they longed for the greens, the fresh water, and the other refreshments then in sight." And it is further observed, "that those only who have endured a long series of thirst, and can readily recall the desire and agitation which the ideas alone of springs and brooks have at that time raised in them, can judge of the emotion with which they eyed a large cascade of the most transparent water, which poured itself from a rock near one hundred feet high into the sea at a small distance from the ship." "Those who had been long confined to their hammocks now exerted all the strength they had left in crawling up to the deck to feast their eyes with the reviving prospect. Thus they coasted along the shore, contemplating the enchanting landscape, which improved as they advanced; but the night closed upon them before they had discovered a proper bay. At four the next morning the third lieutenant was despatched with the cutter to discover the bay they sought for, and at noon he returned with the boat laden with seals and grass; for the boat's crew did not stay to search for better vegetables, as they well knew that even *grass* would prove a dainty, and indeed it was soon eagerly devoured." (Anson's Voyage round the World, 1740–4, ch. iii.)

Another indication of the scorbutic diathesis, unnoticed by preceding writers, says Sir Gilbert Blane, is a soft indolent tumour, which arises under the skin on a part which has received a slight blow or contusion, so slight as not to break the skin. It most commonly appears about the elbow or forearm, and generally disappears without inconvenience, its contents being absorbed. (Observations on Diseases of Seamen, 1785, p. 465.) Scratches and wounds which under other circumstances would scarcely elicit attention, are apt to proceed to troublesome ulcerations, and betray their real character with the further development of the disease.

Amongst the more obvious symptoms, the earliest is usually a change of colour in the face, which, as well as the rest of the skin, becomes pale, and has a bloated appearance. When narrowly examined, it is seen that the lips and caruncles of the eye, where the blood-vessels lie most exposed, are of a greenish hue. The countenance denotes the state of the mind, which is depressed. The patient complains of lassitude, and is averse to all kinds of bodily exercise; the inability to use it is soon manifested by stiffness and feebleness of the knees, and excessive fatigue and breathlessness or panting are the consequences. The gums soon become itchy, swelled, and are apt to bleed upon the gentlest friction. On inspection they present a livid red appearance, are soft and spongy, and become extremely putrid and fungous. The odour of the breath is, as may be supposed, excessively offensive, and hemorrhages are apt to occur from the gums, as also from other parts of the body.

The skin at this time feels dry, and continues so through the whole course of the disease. If the patient be feverish, it is extremely rough, sometimes resembling that which is vulgarly called goose-skin. But most frequently it is smooth and shining, with suffusions of reddish, bluish, or rather black and livid spots. These are of different

sizes, occupying spaces from the smallest possible to that of a handbreadth or more, increasing generally with the progress of the disease. They are to be seen chiefly on the legs and thighs, often on the arms and trunk, but more rarely on the head and face. The legs are apt to be œdematous, the swelling at first being confined to the ankles, and conspicuous only in the evening, but gradually extending to the whole limb, and becoming less and less transient.

Such are the most constant and essential symptoms of the disease in its first stage; but a diversity is sometimes observed in the order of their appearance. Thus, when there has been great debility from previous illness, the gums for the most part are first affected; whereas, when the individual has been deprived of exercise in consequence of a fractured bone or other injury, the parts so affected become first scorbutic. As for example, if a patient is suffering from a strain of the ankle, the first indication of scorbutus will be pain, swelling, and œdema of the leg, with the purple subcutaneous spots and ecchymoses which more especially characterize the disease. It is remarkable, also, that if there have been previous disease, particularly rheumatism, chronic pains from bruises, and other effects of local injuries, these are apt to be renewed, and the disease on which scorbutus may have supervened to appear in a more aggravated form. (See Lind on Scurvy, chap. ii.) A striking instance in confirmation of the preceding remark is mentioned in the account of Lord Anson's voyage. The individual spoken of had been wounded, about fifty years before, at the battle of the Boyne, but had speedily recovered, and had continued well for a great number of years preceding an accession of scorbutus; but upon this, and during its progress, the same wounds broke out afresh, and appeared as if they never had been healed; nay, what is still more astonishing, the callus of a broken bone, which had been completely formed for a long time, was found to be destroyed, and the fractured part as if no consolidation had ever taken place.

The subjects of scorbutus frequently suffer from shifting pains: some complain of them, according to a common expression, throughout their bones, being particularly severe in their limbs and lumbar region, and in the joints and legs when they are swelled. But the most frequent seat of pain is the thorax; a sense of constriction in it with stitches on coughing being usual symptoms. "I believe indeed," says Lind, "it will universally be affected unless the bowels are very open. The pain shifts from one part of it to another, often to opposite sides, and is at first perceived upon coughing only; but in a more advanced stage it commonly fixes in a particular part — most frequently in the side, where it becomes extremely severe and pungent, so as to affect the breathing — a dangerous symptom." As scorbutic pains often change their position, so they are always exasperated by motion of the body, especially the pain of the back, which on such occasions proves very troublesome.

The next thing observable is, that if any epidemic should prevail at the same time with scorbutus, the subjects of the latter are in consequence predisposed to be attacked by it, even if there should appear to be no correspondence between the two diseases. Such a concurrence, however, Lind considers much more fortunate than when the new disease may be, as he terms it, of a putrid nature, as small-pox, measles, dysenteric fever, &c.; "it is then," he adds, "that co-operating with the scorbutic acrimony, they produce most fatal and malignant symptoms." The head is seldom or never affected with pain, unless when fever is present, which may be considered altogether an adventitious circumstance. When fevers supervene on scorbutus, they usually prove fatal; but that species which at a former period was most destructive, more so even than the plague, was the petechial or gaol fever, of which we read in works of the last century, contracted in large, crowded, and sickly ships or prisons. According to the habit and constitution of the patient, there will be some diversity in the performance of the alvine function. In some patients it is natural, in others there is extreme constipation; but generally the bowels are in a relaxed state, and the dejections are extremely fetid. The appearance of the urine is very variable at different times, even in the same patient, except that it is generally high-coloured, and soon becomes rank and fetid. It is said, also, to turn blue vegetable infusions to a green colour. The pulse varies according to the habit of the patient and stage of the disease, being in general slower and more feeble than in health. After a time the patient is commonly deprived of the use of his inferior extremities, the flexor tendons of the ham being contracted and the joints swelled; livid spots and ecchymoses are to be observed, particularly on the legs, and frequently hard and very painful swellings in different parts. "In some," says Lind, "I have seen, without any swelling, the calf of the leg quite indurated." There is great proneness to syncope upon exertion, and not unfrequently upon occasions of this kind, or any sudden exposure to a fresh atmosphere, scorbutic patients have instantly died. The tendency to profuse hemorrhages increases with the progress of the disease, and these are apt to take place from the nose, gums, lungs, intestines, &c., as well as from any ulcers which may be present.

Besides the morbid appearances of the gums already mentioned, they are liable to be affected with deep ulcerations, the teeth most commonly are loosened and often fall out; but caries of the jaw rarely ensues, nor is this affection of any of the bones a usual consequence, but has probably been considered so from the occasional complication of scorbutus with syphilis; as ptyalism has also from its synchronous occurrence when mercury has been exhibited for the cure of the latter disease.

When scorbutus approaches its fatal termination, the painful and livid swellings above referred to often break, and assume the fungous appearance characteristic of scorbutic ulcers. The hemorrhages become more profuse and general; the increasing dyspnœa is accompanied in some cases with pain under the sternum, but most frequently in one of the sides. In others, however, without any complaint of pain, the respiration becomes suddenly quick and laborious, and death unexpectedly puts a period to the disease. The mind throughout is depressed and anxious, but at last

there is generally a total indifference and apparent torpor of every faculty. The appetite for food is rarely impaired, and death has even seized the sufferer in the act of eating. Nyctalopia is an occasional occurrence in the progress of scorbutus, though rarely noticed in the descriptions of it. Dr. Hulme recorded its appearance in his inaugural dissertation printed in 1765; and Sir Gilbert Blane states that it had been reported to him by Mr. Telford. It was also a common occurrence amongst the scorbutic patients in the garrison of Gibraltar, during the siege of that place. (See NYCTALOPIA.)

To the complications of scorbutus with other diseases is to be attributed the Protean character which has frequently been ascribed to it, and which, from a comparison of descriptions, it would seem to have manifested. The conjoined diseases have been most frequently such as are incidental to the same predisposing causes, namely, fevers, continued, intermittent, and remittent; rheumatism, diarrhœa, and dysentery. It has often also been complicated with syphilis, and occasionally with catarrh and ophthalmia. Besides these, numerous other diseases are mentioned by writers as having preceded its occurrence; but scorbutus always exerts the predominating influence, and sometimes even has simulated the worst form of idiopathic disease, as phthisis pulmonalis,* the symptoms of which have subsided on the treatment appropriate to the removal of the former.

Scorbutic ulcers are to be recognised by the following characteristics: instead of pus they excrete a thin, fetid, sanious fluid, mixed with blood; their edges generally are of a livid colour, and as it were puffed up; a coagulum is soon formed on their surface, which can with great difficulty be wiped away or separated from its subjacent parts. These are soft, spongy, and putrid. When, however, the removal of this coagulum has been effected, the same appearance presents itself again after the lapse only of a few hours, and soon constitutes a soft bloody fungus of considerable size, formerly familiar to sailors, and commonly called by them *bullock's liver*, which in its boiled state the former resembles both in colour and consistence. "It often rises," says Lind, "in a night's time to a monstrous size, and although destroyed by cauteries actual or potential, or cut smooth with a bistoury, in which case a plentiful hemorrhage generally ensues, at the next dressing it is as large as ever."

Pathological Anatomy.—Although scorbutus, as we have already stated, was until the latter end of the last century a very fatal disease, and has been the subject of numerous dissertations, few accounts have recorded the *post-mortem* examinations of individuals who have died of it. On this part of the subject the essay of M. Poupart, from observations made at the hospital of St. Louis, in Paris, (Mémoires de l'Académie des Sciences, 1699, p. 237; also Lind on Scurvy, p. 255,) is the most minute and explicit we possess. Added to the external appearances of the body as described in the living subject of the disease, extravasations of dark-coloured blood have been found very generally under the integuments in the muscles, so as to render them hard and rigid, and in some of the glandular parts of the body, particularly the spleen. The brain was always in its natural state. Serous fluid was frequently found in the thorax, stated to have been of various colours, and so corrosive as to excoriate the hands which have been wetted with it. In some who had suffered from dyspnœa, and had died suddenly, the cavity of the chest and also the lungs were void of *serum;* but there were adhesions of the pericardium to the latter, and of the lungs to the pleura costalis and diaphragm. In some who died suddenly without any obvious cause, the auricles of the heart, it is stated, were as large as a man's fist, and full of coagulated blood. The glands of the mesentery were generally obstructed and swelled. Some of these were found partly corrupted and imposthumated. In the liver of some few, the extravasations were hardened. The spleen was three times bigger than natural, and fell to pieces as if composed of coagulated blood. Sometimes the kidneys and lungs were studded with imposthumes. The ligaments of the joints were corroded and loose, and instead of the synovial fluid there was only a greenish liquor, to the causticify of which the corrosion of the ligaments was attributed. The epiphyses were found entirely separated from the shafts of the bones, the cause in the living subject of a crepitating noise on motion, which was sometimes distinctly audible. In some, the cartilaginous portions of the ribs were separated from the bone, and the bony part, at the point of separation from the cartilage, was carious to the breadth of four fingers. In some subjects, on squeezing the sternal extremities of the ribs, the spongy portion was separated in a corrupted state, leaving only the external and internal bony plates. In some were found abscesses of the glands of the groin and axilla. Dr. Mead tells us, that upon opening the abdomen of a scorbutic patient, he was struck with amazement at the monstrous size of the spleen, which weighed five pounds and a quarter, whereas the liver weighed but four pounds and a quarter; but its bulk seemed to be its only defect; for it retained its natural shape and colour, and had not the least scirrhosity or other hardness. Its interior parts were as usual of a dark livid hue, with lax fibres and deep-coloured blood. (Medical Works of Richard Mead, M. D. Dublin, 1767, p. 421.)

In the beginning of the disease, according to the observations made by the surgeons of Lord Anson's expedition, (Mr. Ettrick and Mr. Allen,) the blood as it flowed out of the orifice of the wound might be seen to run in different shades of light and dark streaks. As the disease advanced, it ran thin and seemingly very black, and after standing some time turned thick and of a dark muddy colour; the surface in many places of a greenish hue, without any regular separation of its parts. In the third degree of the disease it came out as black as ink, and though kept stirring in the vessel many hours, its fibrous parts had only the appearance of a quantity of wool or hair floating in a muddy substance; and when it issued from the body, as in hemorrhages, the appearances of this fluid were the same as to colour

* Medico-Chir. Review, for June, 1824. On scurvy in his Majesty's ship Leander, on a voyage from Trincomalee to the Cape of Good Hope.

and consistence, whether it was discharged from the mouth, nose, stomach, intestines, or any other part. In dissected bodies, the blood in the veins was so entirely broken, that by cutting any considerable branch, the part to which it belonged could be emptied of its black and yellow liquor. The extravasated blood was also precisely of the same kind.

Diagnosis.—The symptoms already detailed as characteristic of scorbutus, considered in connection with the circumstances under which they are stated to occur, or in other words its immediate causes, are sufficient data to render it distinguishable from every other disease; but in the present state of our knowledge a consideration of the latter is necessary to prevent it from being confounded with certain forms of purpura, viz. purpura simplex and purpura hemorrhagica; both of which until a recent period were regarded as manifestations of the disease under discussion. Good, as already stated, has classed the three together as species of the same genus, under the name Porphyra, Scurvy,—an arrangement which was sanctioned by the opinion of Willan, who viewed them as allied. A comparison of the symptoms alone would seem to warrant the conclusion that they are constituted by diversities of degree only of the same morbid condition. But that this uniformity does not exist, particularly as regards purpura hemorrhagica and scorbutus, has been inferred from the successful issue of the treatment of the former by the pursuance of the antiphlogistic system, especially by the exhibition of purgatives, and in some instances even by bloodletting, when the occasional causes of the latter have not been found to exist, and the remedial measures appropriate to its removal had been resorted to in vain. In many instances a plethoric state of the system and a febrile disposition have pointed out the divergence from the line of symptoms which characterize scorbutus, and the peculiarity has been further marked by the nature of the diet and the previous condition of the patient. But it must be acknowledged that it is often impossible to recognise the distinction between purpura and scorbutus, or appreciate any difference in their occasional causes, except that amongst those of the latter the influence of a cold and humid atmosphere appears almost, if not always, essential to its production. When the state of the pulse and the condition of the patient have suggested the advantage of bloodletting in purpura hemorrhagica, the appearance of that fluid on being allowed to stand has been that of blood drawn in inflammatory diseases, presenting on its surface a thick and tenacious coat of coagulated lymph. The cruor has also been firm and cohesive, and difficult of diffusion when shaken in the serum, and altogether different, (as will be seen by comparison with the description already given,) from blood drawn in scorbutus.

Prognosis.—Although scorbutus has "slain its tens of thousands" on land as well as at sea, and from its former fatality was not inaptly classed amongst pestilential diseases, the means of treating it have been so well ascertained and established, that for the most part, having citric acid at command, and still more certainly an abundant supply of fresh and succulent vegetables, with the power of protecting the patient from a continuance of the operation of its occasional causes, its cure may be much more certainly anticipated than that of any other disease in which the visible effects are as general and as threatening to the extinction of life. When deprived of the means above specified, as formerly often happened at sea, and as is even now frequently the case as regards fresh vegetables, citric acid may in general be depended on as a very efficient antidote; but without it the probabilities of arresting the progress of the disease will be infinitely diminished, and the recovery of severe cases rendered hopeless.

The first favourable symptom in the advanced stages of the disease, when fresh fruits and vegetables have been obtained, is a change from a constipated to a lax state of the bowels; the skin becomes moist and soft; some increase of bodily power follows; a tranquil pulse together with an improvement in the appearance of any ulcers which may be present; and a change in the aspect of the petechiæ and ecchymoses, their livid colour gradually assuming a yellow hue from the centre to the circumference, the skin at the same time resuming its natural colour, is then observed.

The most unfavourable symptoms are dyspnœa, stitches in the side, frequent faintings, a weak and quick pulse, involuntary evacuations, and excessive hemorrhages. An unexpected and fatal termination of scorbutus has occasionally, we have said, taken place upon any unusual exertion, or on sudden exposure to a fresh atmosphere. When complicated with other diseases, as dysentery or diarrhœa, the unfavourable aspect of scorbutus is rendered still more so, in proportion to their severity and the difficulties there may be to encounter in checking their progress. Diseases, also, of an incurable nature, the tendencies to which have been previously established, may be developed by the presence of scorbutus, such as phthisis, and other organic lesions productive of hydrothorax, ascites, &c. But at the same time, in forming a prognosis, it must be borne in mind that phthisis itself and other organic lesions have been simulated by this disease, and that their symptoms have subsided when the peculiar affection which constitutes scorbutus has been subjected to its appropriate treatment; and that the most unfavourable sequelæ will sometimes disappear when solely consequent upon the disease under discussion.

Causes.—The predisposing causes, or those which induce an aptitude in the body to be attacked by scorbutus when exposed to its usual excitants, are numerous, and vary in their nature, but concur to occasion debility whatever they may have been. Thus we find that preceding diseases, whether acute or chronic, have been very common precursors, and that persons recovering from fevers, or who have been previously weakened by frequent relapses, have been often subjects of it. Indolence and inactivity appear also to have contributed to produce the susceptibility. The persons in a ship's crew termed *skulkers* or sluggards have been usually the first attacked; and it has been observed that those whose condition on board-ship exempts them from much exercise, have also been early amongst the number affected. We are told that in one of Lord Anson's ships,

the Centurion, out of fifty cases of scorbutus four only survived, and of the whole number of marines attached to the squadron (seventy), all but eleven died of it. It has been observed also in the Dutch service, that if there were seven on board that had the scurvy, four of these were marines, though the number of the latter was, of course, proportionately much less than that of the sailors. Corpulent persons have appeared to be peculiarly prone to it, and on shore it has been observed to affect individuals of sedentary occupations more frequently than those engaged in the active duties of life; and where it has been endemic, very frequently to attack the sedentary mechanics whilst the rural population have entirely escaped. On the other hand, however, excessive fatigue, over-exertion, and want of necessary rest, induce the same predisposing condition. Thus, it has not unfrequently occurred after long and harassing marches, and at sea succeeded occasions of much laborious duty; numerous instances of which might be adduced, if space were allowed us for the detail.

But of all the predisposing causes, none has been observed to have more frequently, if not invariably, exerted its influence, than cold combined with moisture either from the atmosphere generally, or from the equivalent influence of a humid apartment or damp clothes. When scorbutus made such havoc in Lord Anson's squadron on doubling Cape Horn, the weather had been very tempestuous, the wind cold and cutting, accompanied with snow and sleet. At the siege of Azof, when the Russian army suffered from it severely, the same circumstances existed. In the account of his voyage round the world, La Perouse states that he was very fortunate in preserving his crew from scorbutus, an effect which he attributed entirely to maintaining a dry state of the atmosphere between the decks. Captain Cook's success in this respect seems to have depended considerably on similar precautions. In Captain Parry's first voyage for the discovery of a North-West passage, the influence of humidity in this particular was very conspicuous. "Mr. Scallon," he states, "had been complaining for some days of pains in his legs,—first considered by the surgeon as rheumatic, but which he was soon convinced by the appearance of the gums depended on scorbutus. This occurrence, so uncommon amongst the officers of a ship, led to a particular inquiry as to its cause, and it was discovered that Mr. Scallon's bedding was in so damp a state in consequence of the deposit of moisture in his bed-place, as to render it no longer questionable." In Captain King's expedition in 1826, the crews of the two ships which he commanded, viz. the Adventure and the Beagle, continued healthy until May 1828, when scorbutus began to show itself whilst in the straits of Magellan, notwithstanding they were plentifully supplied with lemon-juice, sugar, preserved meats, pickles, cranberries, fish, wild fowl and wild celery. There was, however, excessive moisture of the atmosphere, and great mental depression prevailed in the crews from want of occupation, which in this instance would seem to have been excitants of the disease.

Mental depression, indeed, appears on most occasions to have had a powerful influence in predisposing persons to scorbutus. During its endemic prevalence, the timid, the discontented, and the inactive, have been frequently the first attacked. From this cause probably it is that newly impressed seamen have been particularly liable to it, and that it has often shown itself among the inhabitants of besieged towns. Hypochondriacs and persons of a melancholic temperament have been so commonly its subjects, that the hypochondriacal disorder, the atrabilious habit, and scorbutus, have by many of the old writers been considered as different degrees of the same disease. (Enquiry into the source of Scurvy, by Francis Milman, M. D. 1782.) Amongst a variety of other debilitating circumstances conducive to scorbutus, exposure to the impure air of crowded apartments and the free use of ardent spirits have been so commonly its precursors, that they require to be especially particularized. It has also been observed that individuals of uncleanly habits, both with regard to their persons and clothing, have been more liable than others to the disease.

Various opinions have been entertained as to the immediate or exciting causes of scorbutus, and, as frequently has occurred in reference to epidemic or endemic diseases, its propagation has been attributed to contagion. Sennertus, Boerhaave, and Hoffmann, are of the number of those who have advocated this opinion; and in Sir Gilbert Blane's work, published in 1785, we find that it was not discountenanced by him. It has been so completely subverted, however, by subsequent experience that it would be needless to discuss the question. Its hereditary transmission has also been asserted, but of this there is no satisfactory proof or even plausible argument.

At all times it has been an accredited opinion that its origin has been referable, with the concurrence of the predisposing circumstances already mentioned, to an insufficiency of nutriment, or to some noxious qualities of the ingesta, and these for the most part included in the following particulars—in certain impurities in the water or other liquids used for drink; in a preponderating proportion of farinaceous substances ill-fermented, or which have not undergone that process, or otherwise in a faulty state; in the use of animal food in a state of putrefaction, decomposition, or hardened and changed in its nature by the process of salting, as for sea use; simultaneously with privation or an insufficient supply of fresh vegetables, or a scanty allowance of such dietetic drinks as contain their elementary principles.

The connection of scorbutus with the use of such diet has to a certain degree been rendered obvious, by the successful issue of changes in the dietary of our own navy, determined on in consequence of the numerous facts corroborative of the supposed influence of the former system on the generation of this particular disease. The necessary concurrence of so many circumstances apparently essential to its production renders it impossible to estimate their individual operation, and this knowledge can be obtained only (if the opportunity should ever occur) by a more full and exact inquiry into the coexistent condition of the blood and other fluids of the body than

has ever yet been made. From its former prevalence principally amongst sea-faring people, an idea has been entertained that the large quantity of salt used in their food was exclusively an excitant of scorbutus; but Dr. Lind has shown that the daily use of considerable quantities of sea-water has in no degree aggravated it, and that an entire abstinence from salt or salted meat has had no mitigating effect on its symptoms. (Page 52.) It is certain also that scorbutus has prevailed where the operation of this article could not even have been suspected; as, for instance, on the occasion of Lord Anson's ships leaving the coast of Mexico, when they were plentifully supplied with fresh meat. The soldiers in the Russian armies, who suffered from scorbutus at the siege of Azof, had no salt provisions. During a scarcity of corn it raged amongst the poor inhabitants of the colder districts of Italy near the Alps, who subsisted chiefly on the decoction of roots, and often passed whole days without any food at all. In the Transactions of the College of Physicians, Dr. Milman has related two cases of the disease appearing in a very severe form in individuals who had lived for three months on tea, without milk or sugar, or any other article of diet except bread. (Milman on Scurvy, ch. ii.) From its occurrence also in prisons, and so lately as the year 1819 in the Milbank Penitentiary, under a dietary of fresh animal and vegetable food combined, it may be inferred that the prejudicial effect of salted meat depends either on its being deprived of its nutritious qualities, or upon its being otherwise rendered indigestible. It is also somewhat corroborative of this view, that the direct effect of the addition of salt to blood out of the body is a change of its colour from black to red, the reverse of which is the consequence of scorbutus in the blood of the living body. With regard to diet, however, the most constant peculiarity which has apparently caused the occurrence of scorbutus, has been a deficiency in the proportion or an entire privation of *fresh* vegetables, or rather, it should be said, of those which are of a succulent nature,—as an instance in point, may be mentioned the occurrence of scorbutus in Porchester Castle and at Norman Cross, about the beginning of the late revolutionary war, before those arrangements were put into practice which afterwards so effectually secured the health of the prisoners. Under similar circumstances it appeared in a prison-ship near Porchester Castle. (See a paper on the health of the Navy, by Sir Gilbert Blane, in the London Med. Chir. Trans. vol. vi. p. 502. 1815.) In these situations, however, it is to be remembered that there was a co-operation of several circumstances conducive to the disease, viz. deteriorated air, a dull uniformity of life, depression of spirits, want of exercise, &c. &c. It is scarcely necessary to observe that the saline effluvia in sea-air has been alleged as the cause of scorbutus. It is obvious that a circumstance so constantly prevailing at sea and on its shores could never have had so partial a consequence, and that the disease has almost entirely disappeared, though the cause alleged remains the same. It has been moreover remarked that there are few artificers so healthy as those who prepare salt from sea-water, and are thus continually exposed to the impregnated vapour which rises in the processes of drying and purifying this article. (*Lind*, ch. i. p. 53. Stevens on the Blood, p. 311. Lond. 1832.)

The hypotheses which have been promulgated in explanation of the physical condition on which scorbutus, or, in technical language, its proximate cause, depends, have accorded with the revolving doctrines of general pathology, but have been chiefly founded on those principles which refer disease to morbid changes in the fluids, or else to a corresponding condition of the properties of the living solids. For the most part, and up to the present day, scorbutus has been attributed to the former, even by those who have ably advocated the opposite opinions with regard to disease in general. Much further investigation, however, into the elementary components both of the solids and fluids of the body in their healthy and morbid state, and into the influences of external agents upon them, than has hitherto been made, is requisite to clear up the difficulties of this intricate question. The peculiar opinions on the subject which from time to time have elicited attention, require to be noticed in this place; but it must be premised that the principles of treating the disease founded upon them have been very inadequate to the end in view, which has been achieved most completely by observation alone, or, in other words, by that enlightened empiricism, which suggests the right application of established facts in the art of therapeutics, although much knowledge may be wanting to elucidate the nature of the changes produced in the body by which the object is effected.

The early writers on scorbutus have applied the general doctrines of the humoral pathology to the explanation of its various phenomena; more especially ascribing them to a putrid state of the blood, occasioned, as it was supposed, by defect in the function of the spleen, this organ at the period having been considered essential to the process of sanguification. Willis, (Tract. sec. de Scorbuto,) consistently with his pathological speculations in general, referred scorbutus to a state of *dyscrasy* of the blood, which he fancifully described as of two kinds, under the terms of the sulphureo-saline and the salino-sulphureous; the former to represent a supposed superabundance of sulphur, for the correction of which he taught that the depleting system was requisite, and above all things the avoidance of the hot and acrid antiscorbutics; whilst, on the contrary, in the *salino-sulphureous*, when the salts of the blood were supposed to predominate, he considered the warmer medicines were proper, and such as contained a volatile salt, together with preparations of steel and other tonics. The dyscrasy of the blood, he further presumed, was the occasion of a corresponding state of the nerves, or, according to his system, of the *liquor nervosus;* which thus secondarily, he imagined, conduced to the manifestation of some of the symptoms. The opinions of Boerhaave (Opera, cap. De Scorbuto) on this subject appear to have been equally hypothetical: he contended that scorbutus was occasioned by that part of the blood which constitutes the crassamentum being inordinately thick and viscid, and the serous portion too thin, salt, and acrid. The acrimony of this fluid

he imagined was either acid or alkaline, according to the nature of the food by the use of which the disease appeared to be induced: if, as at sea, it had consisted of salted meats, or of such as yielded little nutriment, as a consequence that there would be an acid, or, to use his own phrase, a muriatic acrimony; but if the food had been in a putrid state, that the acrimonious principle would be alkaline.

Although Hoffman exposed the fallacy of the humoral pathology in general, his views of the nature of scorbutus coincided for the most part with those of Boerhaave; and Cullen, who first and most successfully controverted the same system of pathology, admitted its influence in giving rise to this disease. Presuming from the appearance of the blood, from that of the secretions and excretions, and from the fetor of the breath, that a morbid condition of the blood does give rise to it, he contends that a putrefaction or a nearer approach to it than is consistent with health, is a necessary consequence of living entirely upon animal food, without a frequent supply of vegetable aliment, and thereby of producing and evolving a larger proportion of saline matter. In confirmation of this, he observes that every interruption of perspiration, that is, the retention of the saline matter, contributes to the production of scurvy, whether produced by the direct application of cold, or by any other circumstance which might weaken the force of the circulation, such as the neglect or want of exercise, fatigue, and despondency of mind. It will be sufficiently obvious, he adds, that if the preternaturally saline state of the blood in scorbutus be admitted, the throwing into the body along with the aliment an unusual quantity of salt may have a great share in producing the disease. Even (he proceeds) supposing such salt to suffer no change in the animal body, the effect of it may be considerable; and this will be rendered still more probable, if it may be presumed that all neutral salts consisting of a fixed alkali are changed in the animal body into an ammoniacal salt, which he apprehends to be that especially prevailing in scurvy. (First Lines of the Practice of Physic, by William Cullen, M. D.) Sir John Pringle supported a similar doctrine, that scurvy was the result of "a gradually accumulating putrefaction" in the blood, from the putrescency of salted food, which he deemed the chief cause of the disease. (Obs. on Diseases of the Army, Appendix, p. xci.)

The theory of fixed air, which was considered the principle of cement or bond of union on which the firmness, soundness, and cohesion of bodies depends, was advanced by Macbride in support of the opinions which referred scorbutus to a putrescent tendency in the blood; the loss of that principle appearing to him to account for the altered state of this fluid, and the method of cure depending on its restoration, which he proposed to effect by conveying it to the body by the free use of the infusion of malt and essence of wort. Dr. Trotter differed from his predecessors in his application of the pneumatic doctrines of pathology to this disease, the remote causes of which, in his view, tended to deprive the blood of oxygen; and to the restoration of this principle through the medium of the acid fruits he attributed their antiscorbutic efficacy. "We are of opinion," he remarks, "that the citric acid is decomposed by the organs of digestion and assimilation, after which the oxygenous principle is blended with the circulating mass." This supposition Dr. Trotter considers as further confirmed by the blackness of the blood discharged, and by the speedy change to a florid hue which the fungous ulcerations assume within a few hours after the acids have been administered. (On Scurvy, p. 141.) Dr. Beddoes adopted the same hypothesis, but extended it to the abstraction of oxygen from the whole system, in explanation of the phenomena of the disease.

Lind disputed the idea of putridity of the blood in scorbutus, and referred the primary changes to a relaxation of the tone of the animal fibres, a weakening of the powers of digestion, together with a stoppage of perspiration, the tendency of which, he admits, was to produce *spontaneous putrefaction*, the process of nutrition being suspended. (Lind on Scurvy, p. 234.) This view of the subject was followed up and most ably advocated by Dr. Milman, in an essay remarkable also for the elegance of its composition, published in 1782. "Whether," says he, "I consider the nature of the causes producing scorbutus, or the actual state of the blood in the disease, or the secretions which occur in its progress, they all concur to make me believe that it does not consist in a putridity of the blood. Nor does there appear to be any quality which can be discerned or defined in the blood of scorbutic persons by which the nature of their disease can be characterized." The theory which Dr. Milman has substituted, it would exceed our limits to enter into in detail, but it consists of the following propositions:—that scorbutus is not a disease of the fluids, but of the solids; that its seat is in the muscular fibre; that its proximate cause consists of a gradual diminution of the vital power; and that the subsequent diminished cohesion between the particles of the muscular fibres, and the tendency of these to putrefaction, are links of the chain. In reference to the action of salt provisions, he considers, with Lind, that they tend to excite scorbutus not by their saline, but by their indigestible nature, and through defect of nutriment occasion an enfeebling of the vital principle productive of languor in all the functions of the body, and ulteriorly of a general disposition to putridity. (Milman on Scurvy, chap. vi.) This view of the proximate cause of scorbutus is supported by the argument that all its predisposing causes are of a debilitating nature, and by the extraordinary influence of mental impressions in favouring its occurrence as well as its prevention and cure, such impressions being considered inadequate to the occasion of a sudden change in the chemical condition of the fluids. The agency of such impressions, however, through the medium of the nervous system, is supported by numerous illustrations in the phenomena of health and disease. On the other hand, it must be acknowledged that those means which appear to contribute in general to the strength and activity of the solids, such as fresh animal food, soups, wine, bark, and a variety of other tonics and stimulants, have been found to exert very inferior powers over the disease in com-

parison with the vegetable acids; which, nevertheless, are well known to produce an attenuating effect on the body, and this not unfrequently whilst they are accomplishing its cure.

Broussais contends that in scorbutus, whatever may be its cause, there is first an irritation of the internal membrane of the digestive canal; 2dly, an imperfect assimilation of the elements, especially of fibrin and gelatin, either in the tissues formed out of them, or in the blood which directs them to different parts of the body; 3dly, that in consequence of defect of nutrition a diminished cohesion of fibre ensues, which accounts, in his view, for the imperfect contractility and fragility of the muscular fibre, for the rupture of vessels and the escape of their fluids, and finally, for the easy disorganization of the issues on the occurrence of scorbutus. (Treatise on Physiology applied to Pathology, Transl. Philadelphia, 1832.)

We shall conclude this part of the subject by noticing some observations of Andral, which appear to us to be most consistent with all the facts on which an opinion of the nature of scorbutus can be established. In the threefold respect of the vital phenomena, intimate structure, and chemical composition, no line of demarcation can be drawn with strictness and precision between the blood and the solids. Physiologically speaking, it is impossible to conceive that one of these two parts of the same whole could be modified without the other being so likewise. On the one hand, inasmuch as the blood nourishes the solids, and as without its presence they cannot support life, the state of the solids cannot but be influenced by the state of the blood. The chemist might as well say that the nature of a body does not depend on the nature of the elements that compose it. On the other hand, the solids, considered with respect to their relations to the blood, form but two classes, the one contributing *to make* the blood, such as those concerned in the processes of absorption, digestion, arterial circulation, and respiration; the other contributing to *unmake* it, those, namely, concerned in the processes of venous circulation, secretion, and nutrition. No one solid, therefore, can undergo the slightest modification without producing some derangement in the nature or quantity of the materials destined to form the blood or to be separated from it. Physiology, then, leads us to the conclusion that every alteration of the blood must be succeeded by a modification of the solids. Viewed in this light, there is no longer any meaning in the disputes between the solidists and the humorists; and the system appears to constitute but one great whole, indivisible in the state of health as well as in that of disease. With regard to scorbutus in particular, he observes that the causes under which it is developed epidemically, the symptoms that characterize it, the remarkable state of the blood itself, and the nature of the lesions discovered on examining the bodies, all combine to prove that this disease depends on a primary alteration of the blood. (Andral's Pathol. Anat. translated by Townsend and West, vol. i. p. 641 and 678.)

Prevention of Scorbutus.—The prevention of scorbutus in this and in some other countries in which it formerly prevailed having been completely effected, or rather the disease having disappeared in consequence of the dietetic consumption by all classes of persons of fresh vegetable food at every season of the year, of drinks which contain their elementary principles, of water in a pure state, of milk, of fresh animal food, and the disuse, as an article of daily subsistence, of dried and salted meats, together with the general drainage of the country, the greater security, dryness, and warmth in the dwellings, the improvements in clothing, and greater attention to cleanliness, it would be superfluous to enter into a formal detail of measures for its prevention on land; more especially as the process of civilization advances us so much the farther from the sources of this and other epidemic diseases. But, although improvements comparatively as great have been effected in our naval economy, and have been sufficient to lead to the general extermination of scorbutus, yet under particular circumstances the greatest vigilance has been frustrated by the superior power of its occasional causes, and their unceasing operation at sea renders unremitting attention to certain prophylactic measures necessary to ensure security against its occurrence. These consist of the removal, if possible, or, at least, of the counteraction of the predisposing and occasional causes of the disease; and in the daily use of a certain quantity of lemon-juice, the preventive efficacy of which is well established although its operation has not been satisfactorily explained. The application of such preventive measures has for the most part been happily illustrated in the narrative of the memorable voyage of Captain Cook. To his sagacity we are indebted for the first impulse to those regulations by which scorbutus is so successfully prevented in our navy. It will be remembered that the crew of his predecessor Lord Anson, in a similar voyage of discovery, had experienced the most dreadful havoc from this disease, and the prevention of it seemed to present as great difficulty to himself as any circumstance of his projected voyage. The maintenance of the general health of his men he discerned was the main point of security, and to command this he was especially careful that they should not be subjected to excessive or unnecessary fatigue, and as much as possible that they should be protected from the noxious influence of a cold and damp atmosphere. In the first place he instituted three instead of two watches,* by which eight hours of uninterrupted rest were allowed to his men for four of duty; their strength was consequently more recruited, and they were also less exposed to the weather than if they had been at watch and watch, and if necessary they had dry clothes to change. The hammocks and bedding every fine and dry day were not only ordered upon deck, but each bundle was unlashed and so spread out that every part was exposed to the air. Besides the ordinary modes of whitewashing and scraping the decks, stoves were kin-

* Dr. Trotter disputes the advantage of this arrangement. "We," he observes, "who see things on the spot, and are daily accustomed to reason on the discipline of ships, are clearly decided in favour of two watches; our most accomplished and intelligent officers have also from experience put it beyond dispute."—Medical and Chemical Essays by Thomas Trotter, M.D., p. 25. We believe, however, that *three watches* are now the more general custom in our navy, at least in large ships.

dled and carried successively through them, which not only served to dry the ship, but, by heating the impure air below and rendering it specifically lighter than the common air, to make it rise and pass through the hatchways. In the torrid zone he shaded his people from the scorching sun by an awning over the deck, whilst in his course within the Antarctic circle they were provided with coats of woollen stuff, furnished with hoods to cover their heads. He attended also particularly to their diet, taking care that there should be always a plentiful supply of water both for this purpose and for the promotion of cleanliness. He prohibited the custom of using the fat which was boiled out of the salted meats in lieu of other food; having observed that symptoms of indigestion were the common consequence, and the latter not unfrequently a preliminary of scorbutus. (*Milman*, p. 33.) Captain Cook begins his list of preservative stores with malt. "Of this," he says, "was made sweet wort,* and given not only to those men who had manifest symptoms of the scurvy, but to such also as were considered most liable to it." This article, although he did not consider it adequate to the cure of scurvy, he praised as one of the best antiscorbutic medicines known in his day. Sooins or sowens,† an article of diet well known in Scotland, was also considered by him of great antiscorbutic efficacy, and was dealt out to his men in messes sweetened with sugar and flavoured with some French prize wine, which, though sour, was thought to improve the flavour. Captain Cook was provided with lemon-juice prepared for sea use, but the necessary quantity not being understood, it was neglected and erroneously underrated. But the article of most extensive use for the same purpose was sour kroute (sour cabbage), well known in German diet. Sour kroute or croute (*Saures Kraut*, German; literally sour herb or pickled cabbage,) is prepared by slicing the soundest and most solid cabbages in the way cucumbers are used in this country. In this state they are put into a barrel in layers, hand high, and over each is strewed a handful of salt and caraway seeds; in this manner it is rammed down, stratum super stratum, till the barrel is full, when a cover is put over it, and it is pressed down with a heavy weight. After standing for some time in this state, it begins to ferment, and it is not till the fermentation has entirely subsided that the head is fitted to it, and the barrel is finally shut up and prepared for use. Vinegar, as some have supposed, is not employed in its preparation. It was recommended to the use of the British navy by Dr. Lind, the great freedom of the Dutch from scorbutus having been attributed to the free use of it. The quantity allowed was two pounds weight to each man per week, besides a pound and a half to two pounds with every gallon of peas, for making soup. He was supplied also with portable soups, which, as far as possible, he made the vehicle of vegetable aliment; and by such means, and by diminishing the quantity of salted provision, to his honour be it said, he preserved his crew from scorbutus, although the period of his voyage had extended to three years and eighteen days, passed in all latitudes from 52° N. to 71° S. It is still more remarkable that of a company of 118 men he lost but one, who there is reason to suppose was labouring under phthisis previous to his departure from England.

The comparative exemption of our own navy from scorbutus during the last thirty-five years, is, we conceive, to be attributed in no small degree to the regulations enforced for the maintenance of the general health of the sailors, together with the improvements by which this object has been advanced. A frequent inspection of the men's clothing is made, to ascertain whether there is a sufficiency for the purposes of personal cleanliness and of protection from the effects of the weather, both as regards their bedding and wearing apparel. The strictest attention is given to the ventilation, cleanliness, and dryness of ships. For what are called windsails (which were found to be imperfect and inconvenient ventilators, from their use being inadmissible with hatches closed in bad weather when they are most wanted, and when the men were asleep, on account of the large volumes of cold air which they admitted) has been substituted a contrivance free from those objections, borrowed from a French frigate: this consists of square wooden trunks (for which brass tubes have since been used) running from the hold or lower deck and terminating in the open air. A contrivance which has still more recently been preferred, is a funnel placed vertically near the middle line of the ship, before the foremast, leading through the forecastle-deck where there is neither hatchway nor ladder, and under which are the sleeping-places. The removal of all offensive substances by sweeping and scraping has been much more particularly attended to than formerly; but instead of washing the decks, particularly in cold or damp weather, the preservation of dryness, so essential to comfort and health, as well as to the prevention of scorbutus, has been carefully studied, and rubbing with hot sand, scraping, and portable fires, have been generally substituted. By these precautions, also, the deteriorating agency of moisture on the ship's provisions, as well as on other articles in common use, has been prevented, and thereby a source cut off, which otherwise might have been largely conducive to the generation of this disease. This important point has been further promoted by having portable fires in iron stoves carried all over the ship. Formerly a prolific source of foul air and bad smells in ships were the putrescent matters absorbed and retained by gravel, sand, and other earthy substances used for ballast, for which are now substituted small masses or pigs

* Infusion of malt, proposed as a preventive as well as a remedy for scorbutus, was recommended by Dr. Macbride on the supposition that it would ferment after being taken into the stomach, and give out carbonic acid gas—its alleged remedial principle. Laying aside all regard to the theory on which it was suggested, experience seems to have determined that it is a nutritious beverage, and that it has been productive of considerable advantage in the objects for which it was proposed. It has been used rather as an article of diet than medicine, and has been generally directed in the quantity of from one to four pints daily.

† This food is prepared by putting some oatmeal into a wooden vessel, pouring hot water upon it, and continuing the infusion till the liquor begins to taste sourish, i. e. till a fermentation comes on, which, in a place moderately warm, may be in the space of two days. The water is then poured off from the grounds, and boiled down to the consistence of a jelly.

of iron; and iron tanks, instead of the lower tier of water-casks, are placed over the iron ballast. The tanks adverted to are cubes of four feet in dimensions, each capable of containing about two tons of water: as they are not corruptible, like wood, they impart no bad quality to it, and by their durability insure an ample supply; whereas the decay of casks in long voyages and in remote parts of the world where they cannot be replaced, has occasioned the utmost distress.

The improvement suggested by Sir Robert Seppings, Surveyor of the Navy, and explained by him in the "Philosophical Transactions" for 1814, the object of which was to add to the strength, solidity, and durability of ships, has been highly conducive to the purity of the air in them; first, by the obliteration of those cavities under the floor of the hold which used to be the receptacle of filth and vermin, and the perpetual sources of offensive and noxious exhalations; secondly, from commanding at all times the most perfect ventilation, the timbers of the frame which run up the side of the ship maintaining a constant communication with the open air, with the hold and spaces between the decks; thirdly, by virtue of this new construction, a ship being less liable to leakage, together with the new method of ballasting, all the unwholesomeness and offensiveness belonging to bilge-water is done away.

The promotion of the general health of seamen, and consequently the prevention of scorbutus, is further effected by the superior quality of all the articles of victualling; by the plentiful supply, when in port or within reach of it, of fresh meat, succulent vegetables and fruits; and when at sea, by the daily use of cocoa for breakfast, or of tea, coffee, sugar, &c. and a less proportion of ardent spirits. To these are to be added the more liberal allowance as to quantity of the diet at sea; and, under circumstances particularly conducive to the generation of the disease, an increased allowance of farinaceous articles in lieu of the necessary diminution in the rations of salted meats. The former consist for the most part of biscuit, wheat-flour, oatmeal, peas, and pearl barley, and, as substitutes for fresh vegetables, though of infinitely inferior antiscorbutic efficacy, dried raisins, currants, prunes, preserved fruits, spices, pickles of various kinds, vinegar, molasses, and as much wine for each man as is equivalent to one-half of the allowance of spirits, the latter being suspended. (See Paper by Sir Gilbert Blane on the Health of the Navy.—Med.-Chir. Tr. vol. vi.)

But to the general supply of lemon-juice, judiciously dispensed to ships of war since the year 1795, Sir Gilbert Blane ascribes the complete eradication or rather the prevention of scorbutus. Usually, after ships have been a fortnight at sea, to every individual in them a fluidounce of lemon-juice mixed with an ounce and a half of sugar is served out daily, which, with the addition of water and of wine or spirits, affords a grateful beverage, the use of which is enforced when the neglect of it is suspected, or under particular apprehension of the invasion of the disease. It is in consequence of this prophylactic, Sir Gilbert Blane infers, that there are now many surgeons in the navy of long standing who have never seen a case of the disease; and, as appears from the inspection of a great number of journals, that it has either not appeared at all, or else in so slight a degree that it was speedily checked by an increase of the quantity of the antidote. No other remedy yet known can ward off, he observes, this dreadful scourge of mariners under the use of salt provisions for an indefinite length of time; nor does it produce, he adds, any bad effects on the constitution like some specifics in other diseases. The decisive superiority of lemon-juice has led to the disuse of a variety of articles formerly in repute for the prevention of scorbutus, such as sour kroute, infusion of malt, essence of spruce, elixir of vitriol, &c. Of the sour kroute we have already spoken; and we have alluded to the use of the infusion of malt. "Although," says Dr. Trotter, "I have no idea of impeaching the veracity of those who established the credit of the malt preparation, yet I must beg leave to observe that in my own practice I have not seen it attended with any good effects. Lind speaks of it only as a very nourishing liquor, well adapted for scorbutic patients." The essence of spruce,* or rather spruce-beer, the form in which it has been commonly used, seems to possess, says Sir Gilbert Blane, similar and equal antiscorbutic virtues with fermented malt liquor, as beer or porter; and it has this advantage, that the materials for preparing it can be readily carried about and used as occasion may demand. (Observations on Diseases of Seamen, p. 302.) The use of elixir of vitriol in the cure of scorbutus was of very early date, and, on the principle that what will cure will prevent, it was recommended to the use of the navy by Dr. Huxham, who states that it had been found "greatly serviceable." The assertion, however, is not corroborated by general experience, and the converse of the proposition seems more applicable to the circumstance in question; at most, probably, it had been useful in correcting the unwholesome qualities of impure water, for which purpose it has been occasionally added to it in very minute proportion.

We have yet to mention the necessity, in a prophylactic point of view, of regular exercise. Although often called upon for extraordinary exertion, it occasionally happens with seamen that there are long intervals in which systematic attention to this branch of hygiene is especially requisite. Independently of its direct influence on the maintenance of the general health, it may be made subservient to an equally important object in the prevention of scorbutus, viz. to occupation of mind, and in sailors, its diversion from those gloomy views to which, under suspension of duties, they are peculiarly prone; a fact which, however astounding it may at first appear, reflection will assent to be consistent with his condition. To separate, as his duties require him, under perilous circumstances, from those to whom he is linked by the bonds of affection; to be peculiarly subjected to disappointment, and to unexpected delay in schemes to which the brightest hopes are attached; to have been taught by reason and experience that

* Captain Ball states that the essence of spruce a little diluted did wonders at St. Domingo, both in prevention and cure. It acted as a purgative, and was therefore carefully administered; it sat on the stomach when every thing else was rejected. — Med. Naut. by T. Trotter, vol. i. p. 349.

the perils which he has no fear to encounter are frequent and more than ordinarily liable to frustrate them; and in many instances the necessary system of moral discipline being wholly inconsistent with the physical condition, are circumstances sufficient to account for the state of mind above mentioned. The despotic system, formerly in force, of impressing seamen, doubtless had a powerful influence in predisposing them to disease. Their country, says Dr. Trotter, has taken advantage of their situation, and their service is indispensable to the safety of its commerce and territory. It is only therefore mild treatment that can reconcile an impressed sailor to his fate, and if he be so unfortunate as not to overcome it, some fatal disease, as scurvy, will be the consequence; among people of this description it first makes its appearance. An officer, therefore, cannot too minutely study the genius and the temper of those he has to command; but the good effects of it and the satisfaction he will experience, will more than repay his assiduity.

In the narrative of Captain Parry's voyage already referred to, it appears that that able officer was fully impressed with the expediency of amusement as well as of exercise for the preservation of the health of his men, and was particularly aware of the antiscorbutic efficacy of occupations being afforded to them. The mode of their pursuance must depend on the circumstances which are present, and much of the advantage must arise from the ingenuity and address with which the means are devised. The narrative of Captain Parry's expedition to the Polar seas affords a happy illustration in point, many circumstances of it having been congenial to the production of scorbutus, but which, nevertheless, by salutary precautions, was most successfully opposed. Although some of these have been already discussed, their practical application with that of others is so advantageously set forth in the following passage, that no apology, we conceive, is necessary for transcribing it. "The commander finding himself shut in for a long and dreary winter, devoted his attention, with judicious activity and a mixture of firmness and kindness, to mitigate those evils which even in lower latitudes had often rendered an arctic winter so fatal. His provisions being very ample, he allowed the sailors weekly a pound of Donkin's preserved meat and a pint of concentrated soup, instead of a pound of salt beef; beer and wine were served instead of spirits; and a certain allowance was made of sour krout, pickles, and vinegar. The sailors were also called together daily and made to swallow a quantity of lime-juice and sugar in presence of the officers; their improvidence being such as to afford otherwise no hope of their spontaneously imbibing this salutary draught. Their gums and skins were also regularly examined, in order to detect scurvy in its earliest symptoms. It was necessary to be very economical of fuel, the small quantity of moss and turf which could be collected being too wet to be of any use. By placing the apparatus for baking in a central position, and by several other arrangements, the cabin was maintained in a very comfortable temperature; but still, around its extremities and in the bedplaces, steam, vapour, and even the breath settled, first as moisture and then as ice; to dry and remove these annoyances became therefore a part of their daily employment."

Exercise, it is stated, was enforced on the men when they were prevented from leaving the vessel, by obliging them to run round the deck to the tune of an organ; this they did not at first entirely relish, but no plea against it being admitted, they converted it at last into a matter of frolic.

To keep their minds agreeably occupied, schools, masquerades, and plays, were adopted; in reference to the latter it is observed that the very expectation thus raised among the seamen, and the bustle of preparing a room, were extremely salutary, and when the *North Georgian Theatre* opened, with "Miss in her Teens," these hardy tars were convulsed with laughter, not a little excited perhaps by viewing their officers in the singular and novel position of stage performers. At all events the Arctic management was extremely popular. As the small stock of plays contained in one or two chance volumes was soon exhausted, original compositions were produced and afterwards formed into a collection. The officers had another source of amusement in the *North Georgian Gazette*, of which Captain Sabine became editor, and all were invited to contribute to this chronicle of the frozen regions. Even those who hesitated to appear as writers enlivened the circle by severe and good-humoured criticisms.

Treatment.—Recovery from scorbutus, to use an expression of Lind's, presents a remarkable instance of the quick diminution of the effect from the cessation of the cause; an observation which has been so amply confirmed by experience that it may be regarded as a most important axiom in the therapeutic consideration of the disease. There are remedies, nevertheless, which expedite and even effect its removal under disadvantageous circumstances, and this with a degree of rapidity which, considering its apparent ravages, seems most extraordinary and peculiar to itself, the more so from our knowledge of its nature being very imperfect, and the salutary operation of such remedies by no means obvious. We reject theory, therefore, from our consideration of this part of the subject, in the spirit of the following remark of one who has well appreciated its importance in practical medicine: "Cujus autem rei non est *certa notitia*, ejus opinio certum reperire remedium non potest. Verumque est, ad ipsam curandi rationem nihil plus conferre quam experientiam." (*Celsus*, lib. i.)

It has been found an essential step to the relief of a person suffering from scorbutus that he should have the advantage of a dry atmosphere, both as regards the apartment which he inhabits, and the various articles of his bedding and wearing apparel. Next to this, to gratify the cravings of his appetite, an instinctive index, apparently, to the chief corrective of his disease by a satisfying supply of esculent fruits and fresh vegetables: "be they of any sort," says Lind, and all experience has verified the remark, "they will for the most part prove effectual." At different periods, however, a specific virtue in the cure of scorbutus has been attached to particular articles of the vegetable kingdom, and those which are succulent and possessed of an aromatic quality, especially the alkalescent plants of the class tetradynamia, have been re-

garded as powerfully antiscorbutic;* but that their power in this respect does not depend on their alkalescent property is proved by the fact that the vegetables and fruits in which the acid principle abounds have been alike efficacious, and even in a still higher degree. Of the latter, those of the genus Citrus, and of the natural order Hesperidæ, viz. the Citrus medica, lemons—C. aurantium, oranges — C. acida, limes — C. decumana, shaddocks — particularly the three first, have obtained pre-eminent repute, even to the extent of being considered specifics — a denomination to which they appear to be as much entitled as medicines adapted to the cure of any disease. Their efficacy, however, having been gainsayed by a physician whose writings have attracted considerable notice,† and their claim to therapeutic estimation resting entirely on experience of their effects and deference to authority confirmatory of it, we conceive it necessary to enter into detail of evidence in support of the treatment of the disease by the remedial agents the efficacy of which has been denied.

The earliest notice we can find in reference to this point is in the third epistle of Rousseus, dated 1564, wherein it appears that some Dutch sailors who were suffering from scurvy, and the cargo of whose ship on their return from Spain consisted of lemons and oranges, accidentally discovered that their use was the means by which they recovered their health. "And if people," observes Lind, (p. 160,) "had been less assiduous in finding out new remedies, and trusted more to the efficacy of these fruits for preventing this fatal pestilence to seamen, the lives of many thousand sailors, and others, especially during the last war, might in all probability have been preserved. But some have been misled to recommend many other things, as of equal, if not superior, antiscorbutic qualities to these; and have reduced them to a level with other acids, and many falsely supposed antiscorbutic medicines; from whence the many unhappy disappointments hitherto met with in preventing this disease at sea seem to have arisen."

In 1593, Sir Richard Hawkins experienced the antiscorbutic efficacy of lemon-juice in his crew, who were attacked by it in its virulent form within three or four degrees of the equinoctial line. In a work of considerable merit, entitled the Surgeon's Mate, or Military and Domestic Medicine, by John Woodall, master in surgery, dated London, 1636, we find an excellent disquisition on scurvy, and the following apposite remarks: "further experience teacheth, which I have oft found true, that where a disease most raigneth, even there God hath appointed the best remedies for the same grief, if it be his will they should be discovered and used; and note, for substance, the lemmons, limes, tamarinds, oranges, and other choice of good helps in the Indies, which you shall find there, do farre exceed any that can be carried thither from England, and yet there is a good quantitie of juyce of lemmons sent in each ship out of England by the great care of the merchants, and intended only for the reliefe of every poore man in his neede, which is an admirable comfort to poore men in that disease. Also I finde we have many good things that heale the scurvy well at land, but the sea chirurgeon shall do little good at sea with them, neither will they indure. The use of the juyce of lemmons is a precious medicine, and well tried; being sound and good let it have the chiefe place for it will deserve it, the use whereof is: It is to be taken each morning, two or three spoonfuls, and fast after it two houres, and if you add one spoonful of *aqua vitæ* thereto to a cold stomack it is the better. Also if you take a little thereof at night it is good to mixe therewith some sugar, or to take of the syrup

* Formulæ for the preparation of medicines for the cure of scurvy were formerly inserted in the Pharmacopœias of London, Edinburgh, and Dublin, under the titles of Succi Scorbutici and Succi ad Scorbuticos; these were compounded of the juices of garden scurvy grass (cochlearia officinalis); brooklime (veronica beccabunga); water-cresses (nasturtium officinale); and Seville oranges. Besides these, of the infinite number of anti-scorbutics which have been in great popular estimation, and commonly recommended by medical writers until within the last half century, the chief are the horse-radish (cochlearia armoracia); garden purslane (portulaca oleracea); black and white mustard (sinapis alba et nigra); the biting stone crop (sedum acre); celandine (chelidonium minas); marsh trefoil (trifolium palustre); common and Roman wormwood (absinthium latifolium et tenuifolium); fumitory (fumaria purpurea); hemp agrimony (eupatorium cannabinum); the garden radish (raphanus sativus); the garden lettuce (lactuca sativa); the garden endive (cichonium endivia): common juniper (juniperus communis); dandelion (leontodon taraxacum); the common onion (allium cepa); garlic (allium sativum); the leek (allium porum); squill (scilla maratima); the potato, sliced and raw in vinegar (solanum tuberosum); the fir (pinus abies); sorrel (rumex acetosa); &c. Bishop Berkeley wrote a treatise, in 1744, to insist on the curative efficacy of tar water in scorbutus; and Alston, (1750) another on the superiority of lime-water for the same purpose.

† Dr. Stevens; see his Observations on the Healthy and Diseased properties of the Blood. 8vo, London, 1832. Dr. Stevens's denunciation of the treatment of scorbutus by the administration of vegetable acids, seems to rest on the general effect observed of their admixture with the blood out of the body—viz. that of changing its colour from red to black, and by consequence, on the supposition that in this as well as in some other diseases in which the latter quality has particularly characterized the appearance of that fluid, such means would be found not only to keep up but to aggravate the disease. This morbid appearance Dr. Stevens attributes to its privation of its saline constituents, and hence in scurvy, and in other diseases in which it is in a black and vitiated condition, he asserts that "the natural saline waters, or the active non-purgative alkaline salts, act like a charm" (p. 309)—it being the property of these substances (contrary to that of the vegetable acids) on their addition to black blood out of the body to change its hue to red. On this principle Dr. Stevens explains the good effect attributed to the nitrate of potash in the treatment of scorbutus, and on the same ground would administer the muriate of soda, to the excessive use of which its production (as observed in the text) has been commonly attributed. Dr. Stevens, however, in another place (p. 451), has stated that during a residence of twenty years in the West Indies *only one case of scurvy* had come under his notice, and that case, he asserts, was decidedly brought on by the excessive use of citric acid which an American gentleman had been recommended to use as a preventive against yellow fever; consistently with his theory too, that on its being laid aside and the carbonate of soda substituted, the patient was completely cured in three weeks. "To those," he observes, "who are disposed to see the contrast betwixt the effects of the neutral salts and the citric acid in the treatment of scurvy, I would recommend the perusal of Mr. Cameron's paper on this disease, which they will find in the Medico-Chirurgical Review, for 1829"—more conveniently, perhaps, for that purpose inserted in our text, and which, if considered with that degree of candour which the cause of therapeutic science demands, would only serve to prove what little credit is due to the following remark of his own, (p. 264.) "With respect to scurvy it would not be difficult to prove, from the writings of Trotter and others, that this disease, which at one period was so distressing in the British navy, was frequent and fatal almost exactly in proportion to the quantity of citric acid which was used as a preservative, and unfortunately also as a *cure* for the disease."

thereof is not amisse. Further note, it is good to be put into each purge you give in that disease. Some chirurgeons also give of this juice daily to the men in health as a preservative, which course is good if they have store, otherwise it were best to keep it for need." In want of these he adds, "use the juice of limes, oranges, citrons, or the pulp of tamarinds, and in want of all these use oyle of vitrioll, as many drops, as may make a cup of beere, water, or rather wine if it may be had, onely a very little as it were sower." In another place he writes, "And generally note that bitter and sower medicines prevail most to the cure of this griefe, amongst which you have that are approved goode thereto, those that follow as chiefe, juyce of lemmons, of limes, of citrons, and oranges." In the account of his voyage to the East Indies, published in 1683, Dellou, a French physician, recommends for the prevention of scurvy, that each person on board should provide himself with the juice of citrons, lemons, and dried fruits, especially prunes. The same remedies we find recommended in the treatise of Martin Lister, published in 1694.

It is remarkable, however, that epidemic scurvies were allowed to rage in various parts of the world, and in none more than in the British navy, for more than a century and a half after Woodall had pointed out the usefulness of lemon-juice, without its being generally employed. So complete was this neglect, that in 1740, when Lord Anson proceeded on his circumnavigation, no provision of any kind appears to have been made against the disease, and we find Mr. Walter, the chaplain of the expedition, and discriminating historian of it, declaring that "in some instances the prevention and cure of the malady could not be effected by any management or remedies which could be made use of at sea:" (p. 113.) But it is mentioned that on *nearing* the island of Tinian, lat. 15°. 8′. north, and in 114°. 50′. west longitude from Acapulco, it was part of a very grateful account of it they obtained from a Spanish prisoner, that it afforded plenty of lemons, limes, sweet and sour oranges, cocoanuts, and bread-fruit. We are informed also that on making shore their sick amounted to 128, and notwithstanding the extreme debility of the greatest part, twenty-one of them dying on the day of their arrival and the following day, yet during the whole two months in which they staid there, they did not lose above ten more, and that the remainder reaped such benefit from the fruits of the island, and "*in particular those of the acid kind*, that within a week most of them were so recovered as to be able to move about without assistance."

The calamities of this unfortunate expedition, and the sufferings they underwent, created a general interest, not only with medical men, but with the public at large, on the cause and nature of the disease, and the most likely means of controlling its ravages.

The stamp of correct observation founded on most extensive experience, which Dr. Lind's treatise on the subject, published in 1753, has been always acknowledged to bear, renders his testimony of the highest worth. "The result of all my experiments was," says he, "that oranges and lemons were the most effectual remedies for this distemper at sea. I am apt to think oranges preferable to lemons, though, perhaps, both given together will be found most serviceable." In another case, "I cannot omit upon this occasion observing what caution is at all times necessary in our reasoning on the effects of medicine, even in the way of analogy, which would seem the least liable to error. For some might naturally conclude that these fruits are but so many acids, for which tamarinds, vinegar, *sp. salis.*, *elixir. vitriol.* and others of the same tribe would prove excellent succedaneums. But upon bringing this to the test of experience, we find the contrary. Few ships have ever been in want of vinegar, and for many years before the end of the late war all were supplied sufficiently with el. vitriol. Notwithstanding which the Channel fleet often put on shore a thousand men miserably overrun with this disease, and many hundreds besides died in their cruises. Upon those occasions tar-water, salt-water, vinegar, and el. vitriol. especially, with many other things, have been abundantly tried to no purpose; whereas there is not an instance of a ship's crew being ever afflicted with this disease where the before-mentioned fruits were properly, duly, and in sufficient quantity administered."

Again, says this observer, "in seemingly desperate cases the most quick and sensible relief was obtained from lemon-juice, by which I have relieved many hundred patients labouring under almost intolerable pain and affliction from this disease, when no other remedy seemed to avail." Finding the acid to operate violently upon the stomach and bowels of those who were much weakened, he recommended the addition of wine and sugar, as constituting the best antiscorbutic, and was in the practice of ordering about four ounces and a half of lemon or lime-juice, and two ounces of sugar, to be put into a pint of Malaga wine, which he thought sufficient for any weak patient to take in twenty-four hours. Dr. Trotter, however, states as the result of his experience that any such preparation was unnecessary, and that the happiest effects were produced by allowing the patients to suck the juices immediately from the fruits themselves.

In another place Dr. Lind says, "summer fruits of all sorts are here in a manner specific, viz., oranges, lemons, citrons, apples, &c.;" he moreover devised a method of preserving the juice of the two first-mentioned, so as to render them available at all times and in all climates, whether in the midst of the ocean or under the arctic circle.

The testimonies of Sir Gilbert Blane and Dr. Trotter in favour of the antiscorbutic efficacy of these fruits are equally strong, and when we consider the extensive opportunities of observing this disease which fell to the lot of these three eminent physicians, their qualifications for forming correct opinions, and the immense mass of evidence adduced by them in support of the remedies in question, the conclusion is irresistible that their adaptation to the removal of this disease is established on as firm a basis as that of any article of the materia medica to any disease whatever. The late venerable and talented director of the medical department of the navy, has in the year 1830 confirmed the opinion he gave to the world of these remedies in 1785, by the triumphant fact that the

scurvy has been prevented, subdued, and totally rooted out of the navy by the general use of lemon-juice, supplied for the first time at the public expense in the year 1795, and which operated so speedily that in less than two years afterwards it became extinct and has remained so. (Brief Statement of the Improvement of the Health of the Navy, by Sir Gilbert Blane, M. D., London, 1830.) Of all the articles either for medicine or diet he had observed for the cure of scurvy, lemons and oranges are of much the greatest efficacy. They are real specifics, if anything deserves that name; but upon what principle their superior efficacy depends, and in what manner they produce their effect, he acknowledges that he was wholly at a loss to determine, the only sensible effect being a small increase of some of the secretions. In another place he says that he has never seen the scurvy resist the juice of these fruits, and in the perusal of several hundreds of surgeons' journals that he had met with only two cases which seemed to resist it. "It is sui generis—nil simile nec secundum." "It may be affirmed with truth that it performs not only what no other remedy will perform in this disease, but what no known remedy will effect in any known disease whatever." (Medico-Chirurgical Transactions, vol. vi., p. 500. London.)

Dr. Trotter, in his account of the health of the fleet in 1795, remarks, "from the middle of March to the 12th of June, upon comparing notes from the reports of surgeons, it appeared that not less than three thousand cases of scorbutus (the subjects of which were unfit for duty) had been cured on board ship by the fruit or preserved juice, and that twice that number with slighter symptoms were relieved by the fruit, the juice, and salads." (Medicina Nautica, vol. i. p. 134.) Mr. Moffat, surgeon to H.M.S. Triumph, 1796, in which scurvy had prevailed to a considerable extent, reported to Dr. Trotter, "that the scorbutic cases as usual yielded to the lemon-juice in every instance. So general," he adds, "was the tendency to it, that almost every case of contusion or ulceration was attacked with the disease, nor could their cure be accomplished without a few doses of the acid." (Ibid. p. 157.) In p. 151, vol. i. of the Medicina Nautica we find the following entry:—"Jan. 2, 1796. This day the squadron under Rear-admiral Harvey arrived at Spithead, after an absence of eighteen weeks from England, bringing three thousand soldiers from Isle Dieu. This squadron had been repeatedly supplied with refreshments from Plymouth and Cork. The scurvy appeared nevertheless *in all the ships*, but was quickly cured by lemon-juice." In the report of Mr. Kenning, surgeon, of the Invincible, dated June 8, 1795, (Med. Nautica, vol. i. p. 411,) in which ship there had been in all one hundred and sixteen cases of scorbutus, it is stated that of twenty-eight attacked in the month of April, the worst were supplied with three lemons and one orange daily, the others with two lemons, and that *in every instance* after the third day, and sometimes sooner, they began to recover, and were shortly well. In May fifty-six fresh cases were treated with the same remedies with equal success. In the latter end of the month the fruit was all expended, but there still remained a few gallons of lemon-juice, which lasted until the 2d of June. Patients continued to apply, and two of those that had been recovering before the lemons were expended, got worse in the short interval from the 2d to the 5th day, the day on which a fresh supply of lemons was received. Their complaints were soon checked by the *fresh fruit*, but not so fast by the juice, though it was given in some cases to a pint per day." In Lord Bridport's squadron, which (in 1795) had suffered severely from scorbutus, there was not a case in which lemon-juice was given where it did not produce a cure in the space of a few days. (Ibid. vol. i. p. 417.)

Dr. Baird, surgeon of the Hector, a ship in which scorbutus prevailed to a considerable extent, gives the following account: "I began with giving the lemon-juice in the quantity of an ounce and a half daily, and encouraged by the material change I perceived in about four days, I increased it to three or four ounces per day, always taking care to join a sufficient quantity of sugar to prevent it from irritating the bowels; in twelve or fourteen days the worst of them were able to return to duty, every symptom being then removed, except some slight degree of stiffness in the hams, which gradually wore off." "When I consider," he adds, "the alarming progress which the scurvy was making among the Hector's ship's company previous to the administration of lemon-juice as a preventive, the sudden check given to it afterwards and its powerful effect in very bad cases, I think I shall not be accused of presumption when I pronounce it, if properly administered, a most *infallible remedy*, both in the cure and prevention of the disease." (Ibid. vol. i. p. 426.)

Mr. Walker, surgeon of the Hannibal in 1795, writes, "during our late cruise, numbers were afflicted with the disease (scurvy); the citric acid to the quantity of three ounces per day cured many, and always stopped its progress. It was given with wine in the following manner:

℞ Vin. rub. ℥ii.
Succi lim. ℥i.
Sacchari, ʒii. *m.* fiat haustus ter die sumendus." (Ibid. vol. i. p. 407.)

Dr. Trotter himself remarks that the superior efficacy of the acid fruits in the cure of scurvy is so well ascertained, that it might seem superfluous to add any fresh remark to what is so fully admitted. These articles are certainly more beneficial as they approach to the nature of the citric acid, which is that abounding in the lime, lemon, &c. Our summer fruit in this country, such as the apple and gooseberry, lose their acidity as they come to maturity, so that in their immature state they contain most of that principle valued in the cure of scurvy. "In all cases of scurvy," he adds, "which I have attended, I have remarked the longings and desires of the patient for acids, which also have been mentioned by some of the earliest writers on the disease, and more or less by others since that time. It is one of the strongest instincts in nature we are acquainted with.—Having repeatedly observed the scorbutic slaves throw away the ripe guavas, while they devoured the green ones with much earnestness, I resolved to try if there were any difference to be remarked in their effects. For this purpose I selected nine

blacks, affected in nearly a similar degree with scurvy. To three of these I gave limes, to three green guavas, and to three ripe guavas. They were kept under the half-deck, and served by myself twice or thrice a day. They lived in this manner for a week, which was about the time we left the coast of Africa, and it is to be remarked that the three negroes restricted to the ripe guavas continued in much the same situation, while the others were almost well."

Whenever the fresh fruit, i. e. oranges and lemons, can be procured, they should be preferred to their juice prepared by evaporation for sea use according to the methods devised by Dr. Lind, and to the crystallized citric acid obtained according to Scheele's formula by combining the fresh vegetable acid with lime, and then precipitating by means of sulphuric acid. (See Pharm. Lond.) The former by keeping is somewhat liable to spoil, though as stated by Mr. Moffat, a naval surgeon of experience, he found it fully adequate to the purpose of the fresh juices at the end of fifteen months. The crystallized acid, reduced to the strength of lemon-juice by solution in from sixteen to eighteen parts of water, is, however, an excellent substitute for the fresh juice. This solution should not be prepared long before it is required for use, being apt to undergo decomposition, but in its recent state it has proved equally efficacious, according to the testimony of Dr. Trotter and others, with the fruits themselves. (Med. and Physical Journal, vol. iv. p. 154.) Although all the esculent fruits and fresh vegetables have been found effective in the cure of scorbutus, and particularly, as we observed before, those in which an acid principle prevails, it seems impossible to estimate their relative powers in this respect. The vegetable acids which have had trial, viz. the acetic and tartaric, appear to have exerted little if any power over the disease, nor have we any proof that the sulphuric, the nitric, and the muriatic acid, though frequently tried, have been at all beneficial.

Mr. Patterson, a surgeon in the navy, published a treatise in 1794, in which he infers that a solution of nitrate of potassa in vinegar is preferable to lemon or lime-juice as an antidote to scorbutus; its good effects he ascribes entirely to the oxygen contained in the former. At first he used a solution of two ounces of nitre in one quart of the ship's vinegar, and gave half an ounce of the solution, to some twice, to others thrice in the day, and as frequently bathed the local affections with it. From the good effect it produced, which was unattended either by nausea, colic, or diarrhœa, he was induced to increase the dose of the above-mentioned solution to an ounce, and to repeat it as before. At length, instead of two, he dissolved four ounces of nitre in a quart of vinegar, and used it in the same quantities and manner as before. He adds, "some patients cannot bear the solution without the addition of water, whilst others without the least inconvenience bear it undiluted. The discharge by stool, or the presence of gripes and nausea, guide me with respect to increasing or diminishing the dose; but, at the same time, it is not a slight degree of nausea, colic, or diarrhœa that renders an alteration in the quantity of the medicine necessary. To a great number of scorbutic patients eight ounces of this strong solution, containing one ounce of nitre, have, in the course of the day, as long as such a quantity was necessary, been administered to each with the greatest success. Also, a circumstance no less curious than pleasing, large and frequently repeated doses of this medicine have been given in cases of scorbutic dysentery, and instead of increasing I have always found it remove the disease. Sometimes, notwithstanding the free use of the nitric vinegar, I have known constipation take place to a considerable degree, in which case I have found intermediate doses of the potassæ supertartras necessary and highly advantageous. This very constipated state generally occurred where the disease was far advanced; but in a few particular cases in delicate habits, and where the disease was not far advanced, I perceived even small doses of the nitric vinegar ruffle the stomach and intestines; to prevent or remove which, I have found two, three, or four grains of camphor with each dose of the medicine very effectual."

The beneficial effect of the nitrate of potash in scorbutus has been more recently testified by Mr. Charles Cameron, surgeon in the Royal Navy, in a letter, dated December 10, 1829, to the Commissioners for Victualling. The Fergusson, he states, sailed from Ireland on the 16th of December the preceding year, with two hundred and sixteen male prisoners, amongst whom scorbutus, in several instances combined with dysentery, prevailed to a considerable extent. Before reaching Rio Janeiro, their state was such that he had reason to fear he should lose several, and others were fast approaching the same lamentable condition. Having on several occasions experienced the excellent effects of a "solution of nitre," as recommended by Patterson, he was induced to employ it. "From the moment I commenced the use of it," he observes, "many, although almost hopeless cases, began to improve rapidly, and before we accomplished one-third of our voyage, I found the health of the sick improve so fast under the new treatment, that I did not think it necessary to go into any port, and on our arrival at Sydney the general health of the prisoners was much better than when they embarked in Ireland. I am willing," he adds, "to ascribe much of this favourable change to the effect of climate, but I feel assured that a solution of nitre in vinegar or lemon-juice is the best remedy ever proposed in the treatment of scurvy."

Two of the patients who recovered exhibited symptoms of the last stages of phthisis, and expectorated large quantities of purulent matter. With regard to the patients in general, he says, the most distressing symptoms which they complained of in the early stages of the disease were, a sense of oppression and sinking at the pit of the stomach, which a few doses of medicine invariably relieved or totally removed. Mr. Cameron's preparation consisted of eight ounces of nitre dissolved in so much vinegar as made the solution amount to sixty-four ounces. Sometimes equal parts of vinegar and lime-juice were used, a little sugar was generally added to render it more palatable, and about four drops of ol. menth. piperitæ, diffused in a small portion of alcohol, was added to the whole, which rendered it more grate-

ful to the stomach. An ounce of this solution was a dose, and from three to eight doses, according to the stage of the disease and the severity of the symptoms, were given at equal intervals during the day, from six o'clock in the morning till eight at night. Mr. Cameron, at the conclusion of his letter, observes that he has previously tried nitre in several bad cases of scurvy, where neither vinegar nor lemon-juice could be obtained, and, except that sometimes it did not appear to sit so easy on the stomach, with the same beneficial effects.

With the view of restoring the supposed deficiency of oxygen to the scorbutic system, it has been proposed to impart it to the body through the medium of the lungs; but the attempt which was made in cases of the disease as it appeared in the voyage of La Perouse round the world, was wholly unsuccessful.

From the salutary effect in cases of scorbutus produced by vegetable matter in general, peculiar efficacy has been ascribed to particular articles, the use of which accident or analogy from time to time has suggested; it may be that future discoveries will determine their relative title to the estimation in which they may have been held, and the precise principle on which it depends, but the superiority of lemon-juice as an expeditious and certain remedy being well established, other articles of the vegetable kingdom, and the drinks prepared from them, are to be regarded rather as useful auxiliaries, and may be selected from those in popular repute as the inclination or particular habit of the patient may dictate. It will be no inconsiderable advantage also to introduce them to use according to the dietetic form most grateful to the taste, instead of prescribing the nauseating compounds which until the last half century were supposed to possess especial virtues conducive to the removal of this disease.*

[Of late, the antiscorbutic effect of raw potatoes has been frequently deposed to.]

Beer, porter, simple infusion of malt, cider, perry, spruce-beer, various wines made from the subacid fruits, and even pure water, will present useful and agreeable beverages to scorbutic patients. The Lisbon diet drink (decoctum sarsæ compositum) and the compound decoction of guaiacum, have also been found serviceable for the recovery of patients from this disease. Of the dietetic vegetable substances, those which have been commonly preferred and considered to be most especially adapted to the removal of scorbutus, have been the various subacid fruits, and the several herbs used in salads, a form in which with their usual additions, vinegar and mustard, they have been considered especially efficacious. Dr. Trotter, in his Medicina Nautica, has adduced numerous instances of their efficacy, and the popular favour they elicited serves to corroborate the opinion entertained of them by professional writers for this particular purpose.

Another agreeable method of supplying the system with vegetable aliment, and which has been advantageously adopted in scorbutus, has been the combination of it with fresh animal matter through the medium of broths and soups, as well as in the ordinary forms in which they are commonly prepared for dinner use. Lind states that milk is useful to scorbutic patients, with whom it generally agrees, but that whey, "by reason of its more diuretic and cleansing quality, is preferable."

"Thus," says the last-mentioned writer, "we have numberless instances of people after long voyages, miraculously, as it were, recovered from deplorable scurvies without the assistance of many medicines, for which, indeed, there is no great occasion, provided the green herbage and fresh broths keep the belly lax, and pass freely by urine, sweat, or perspiration."

Since scorbutus has become a very rare disease, the materia medica has been enriched by the addition of some valuable articles, the general properties of which suggest their adaptation to the purposes of its treatment; these are the chlorides of lime and soda, and the sulphate of quinine. At sea, the chloride of lime will doubtless be advantageously applied to the preservation of water and to the correction of such as may be putrescent, to the prevention of unwholesome exhalations, and to the general purification of the air. Solutions of it as gargarisms and lotions for ulcers give promise of considerable advantage, and from the little experience already had of its internal use, encouragement is given to its further trial. Dr. Robertson informs us that he has used the chloride of soda in one instance—with the benefit he anticipated. (See Dublin Hospital Reports, vol. v. 1830.) With some other remarks with which he has been so kind as to favour us on this disease, he observes,—"I had occasion, in the year 1831, to see a case resembling scurvy in all its phenomena, (indeed, had it occurred in a seafaring person instead of a person living in a midland county, I should have pronounced it a well-marked case of that complaint,) where the liquor chloridis sodæ, given in doses of half a drachm in conjunction with the decoctum lichenis Islandici, had a strikingly beneficial effect. The patient was speedily brought by it from a state of cachexia threatening death to a very tolerable degree of health and enjoyment. Were it ever my fortune to treat scurvy extensively again," he adds, "I should trust chiefly to quinine or the chloride of soda internally, and to the chloride of lime properly diluted as a topical application; with, of course, a liberal supply of vegetable matter where it could be obtained."

The costive state of the bowels which occasionally prevails to an extreme degree must be counteracted by aperient medicines, or, if need be, by the stronger purgatives. In many instances the advantage derived from the operation on the alvine canal of a single dose has led to their frequent repetition, and the most beneficial results have ensued. Lind was favourable to the combination of medicines of this class with diuretics, or to the

* "A vegetable substance called *nopal*, the stalk of the cactus opuntia, which keeps well at sea, has been lately discovered in India to be an extremely salutary article of diet, and to resist scurvy: but the author read in the surgeon's journal of one of the East India Company's ships, that in spite of the use of this and of spruce-beer at the same time, sixteen cases of scurvy arose, in one of which it was so severe as to prove fatal."—Paper by Sir Gilbert Blane, on the Health of the Navy; Medico-Chir. Tr. vol. vi. p. 501.

use of such as embraced the twofold property. Selections have accordingly been made from the supertartrate, acetate, and sulphate of potash, the tartrate and sulphate of soda, and the sulphate of magnesia, dissolved in the infusion of senna, of tamarinds, or of prunes, with the addition of some aromatic tincture, and further combined if requisite with jalap, rhubarb, aloes, scammony, colocynth, or some of their preparations.

The complication of inflammatory disease with scorbutus in constitutions naturally robust and not much debilitated, will sometimes require venesection and the general adoption of the antiphlogistic treatment, according to the nature and degree of the supervening disease; but diarrhœa, dysentery, pneumonia, and other morbid conditions which have been coexistent with it, have not unfrequently resisted modes of treatment peculiar to them, and have disappeared together with scorbutus when the remedies appropriate to the latter disease have been had recourse to.

In reference to the concurrence of scorbutus and dysentery, Dr. Trotter observed that they frequently disappeared together, and readily yielded to a diet of fresh meat, citric acid, and esculent vegetables; without requiring any of those remedies more particularly adapted to the last-mentioned disease, as it occurred under other circumstances. (Med. Nautica, vol. i. p. 377.) The same remark has been illustrated by Sir James M'Gregor, in his reference to a case of severe ophthalmia, which appeared conjointly with slight symptoms of scorbutus where the latter disease was endemic. It resisted a variety of applications, both external and internal, for five months, when the acid of limes was thought of, which in twelve days effected a cure. (Edin. Med. and Surg. Journ. vol. i. p. 283. 1805.)

In some cases of apparent phthisis accompanying scorbutus, we find in the observations of Mr. Cameron, already cited, that the disappearance of both forms of disease was evidently effected by the remedies appropriated to the removal of scorbutus alone.

It has been commonly observed, that however promising and speedy recovery from scorbutus may be, to prevent its recurrence it is necessary for a considerable time to persevere in the counteracting regimen, and to avoid as much as possible the predisposing and occasional cause of the disease. When fresh vegetables can be procured, and the object is not to cure, but to guard against a relapse, the use of acids will be advantageously suspended. Practical authorities have expressed opposite opinions as to the general effect on the constitution of their continued use, but on the whole there is good reason to believe that, when long continued, they have produced injurious effects on the digestive organs.

Great care should be taken that scorbutic patients be not too suddenly exposed to an atmosphere differing in its temperature or other qualities (except in point of dryness) from that which they have breathed for some time previously. Any sudden exertion should also be avoided, for numerous instances might be adduced in which inattention to these particulars has been immediately followed by death, in cases in which it was not in the least to be expected. We read in the narrative of Lord Anson's voyage, that in the removal of his crew from the Centurion to the island of Juan Fernandez, twelve of them died on being exposed to the fresh air; and on the first breaking out of the disease many of the people, though confined to their hammocks, were cheerful, talked in a loud strong tone of voice, and eat and drank heartily, but on being only moved in their hammocks from one part of the ship to another immediately expired. Others, trusting to their seeming strength, resolved to get out of their hammocks, but died before they could reach the deck, and it was common to see the men drop down dead upon a violent effort of duty.

The local affections which are manifested in scorbutus are often extremely distressing, but, it must be remembered, are always secondary to the constitutional disorder, increasing in malignancy with its progress, and manifesting a contrary disposition whenever a salutary change has been effected in it: this correspondence, too, takes place with an almost incredible degree of rapidity, and such as is rarely, if ever, exemplified under any other circumstances of disease. The constitutional disorder, therefore, should be the first object of regard in the cure of every local lesion which depends on scorbutus: a contrary procedure only can account for the numerous and complicated formulæ which are to be found in the early treatises upon it, all of which, it may be inferred from accumulated experience, will be nugatory whilst their immediate cause is allowed to continue uncorrected. Local applications, however, with the contemporaneous use of constitutional remedies, are not unproductive of advantage. To relieve the spongy and rotten state of the gums and of the mucous parietes of the mouth and pharynx, astringent gargles, particularly those containing sulphate of alum, have been found very serviceable. Two drachms of this substance, or more, may be dissolved in half a pint of water or of a decoction of cinchona for the purpose. Lind recommends also the tincture of cinchona, which may be used alone, or mixed with port wine or camphor mixture. The tinctures and other preparations of myrrh, of kino, of catechu, may likewise be selected from the class of astringents for the same purpose, and will be advantageously diluted with water or with camphor mixture, to be sweetened and inspissated with honey. In the advanced stages, the mineral acids have been found more efficacious; water, barley-water, the infusion of roses, or other vegetable substances acidulated with the sulphuric or muriatic acids, and made agreeable with the addition of honey or simple syrup, will form convenient gargles. "The quantity of the acid," says Lind, "must be proportioned to the greater or less degree of putrefaction. The fungus must be often removed, or if needful be cut away; and by frequent gargarizing the mouth kept as clean as possible. Where the ulcers appear deep and spreading, they are to be checked with a touch of *vitriol*, or *sp. salis*, either by itself, or diluted according as the patient bears it." Analogical reasoning leads us to infer that a solution of chloride of lime is peculiarly adapted to the purposes of this disease, whether in the form of gargle for the mouth, or as an immediate application to ulcers in other parts. To the latter the

astringent applications already mentioned as useful in the corresponding condition of the mouth and gums have been advantageously employed. "Sulphate of alum, in the proportion of two drachms to a quart of water," says the experienced and talented writer of the Medical Topography of New Orleans, Dr. Robertson, of Northampton, (Edin. Med. and Surg. Journal, vol. xii. p. 146,) in his observations on 'the Sloughing Scorbutic Ulcer,' as it appeared extensively in that place, "was upon the whole an admirable local remedy, and seemed to possess wonderful powers in stopping the ravages of sphacelus, and giving a healing tendency to spreading ulcers. In the same cases equal parts of basilicon and oil of turpentine (melted and applied warm to the ulcer), mixtures of lime-juice, or rum and water, charcoal cataplasms, common poultices, bark decoctions, and bark in powder, were employed; but though they kept the sores cleaner, they were often of no avail to arrest the sloughing process." Several of the early writers, and Lind amongst the number, particularize the unguentum *Ægyptiacum** as adapted to the ulcerations of this disease. Mr. Murray, a naval surgeon, in a communication to Dr. Lind, observes, "I have applied a strong tincture of bark lately to scorbutic ulcers, and have found it highly beneficial. The powder of the hydrargyri nitrico-oxydi sprinkled on the fungoid ulcerations, and the ointment of this substance, after the sloughs have been removed and the ulcers cleansed by carrot and other detergent poultices, have also been of some use; but no permanent benefit is to be anticipated from any other treatment than a diet of nutritious food of which fresh vegetables constitute a considerable proportion, the efficacy of which will be materially augmented by including amongst them the acid fruits or their juices, such as lemons, limes, shaddocks, apples, pears, gooseberries, &c. whilst at the same time the patient is secured from the influence of the predisposing and occasional causes of the disease." The latter remarks apply also to the œdematous swellings of the legs and the rigidity of the hamstrings, for which local relief also is often demanded. Frictions with warm flannels, (which for this purpose were formerly medicated with the fumes of benzoin, amber, and warm aromatic gums,) have answered this end, and have been advantageously followed up by gentle compression with bandages. But in extreme cases, warm fomentations, local steam-baths, or, as Lind has recommended, sweating the limb "by burning of spirits," (the local vapour-bath of the present day,) with some of the various other contrivances in common use for the promotion of heat locally, are better calculated to afford relief.

An important part of our duty would be unperformed were we to limit ourselves to the detail of those means by which scorbutus has been successfully treated, for we know not what additional light may be reflected on the obscure parts of this subject by a knowledge of such as have been found unsuccessful. The cost of the experience, too, by which it has been gained forbids its waste, and in practical medicine it must be acknowledged that a beacon is often of not less use than a guide. In the first place, "it is to be observed," says Lind, (page 216,) "that this disease, especially when advanced, by no means bears bleeding, even although the most acute pains upon the membranes, a high degree of fever, and dangerous hemorrhages would seem to indicate it. The patient generally dies soon after the operation. Nor does it bear strong cathartics, which are often injudiciously administered in its commencement. From blisters there is danger of a gangrene. As to vomits, though I have never had any great experience of their effects, yet by the observation of others squill vomits have been found serviceable. 2dly. Persons in the advanced stages of this disease are not, without great caution and prudence, to be exposed to a sudden change of air. On such an occasion they are to be given a glass of generous wine well acidulated with lemon or orange-juice, which is likewise the best cordial in their fainting fits. The sloth and inactivity belonging to the disease are not to be mistaken for wilful idleness. This," continues Lind, "has proved fatal to many, some of whom, when obliged by their officers to climb up the shrouds have been seen to expire and fall from the top of the mast. 3dly. After a long abstinence from green vegetables and fruits, scorbutic persons should be treated like those nearly starved to death; that is, not permitted for a few days to eat voraciously, or surfeit themselves; otherwise they are apt to fall into a dysentery which often proves fatal.

"Lastly, medicines of the fossil or mineral kind, such as steel, antimony, and especially mercury,† do manifest harm. Opiates occasion an unaccountable depression of spirits, with a sense of oppression on the chest, and when absolutely necessary, as in fluxes, should be of the warmest kind," (i. e. we presume combined with aromatics and cordials.)

W. Kerr.

SCROFULA.—The term scrofula is derived from the Latin *scrofa*, a hog; and χοιρας, the corresponding word in Greek, plainly acknowledges a similar origin, (χοιρος, a pig:) but whether this etymology has arisen from the filthy condition in which scrofulous children are often found, or from the hog being subject to a similar disease, or from the appearance presented by scrofulous glands lying in clusters under the skin, or from the tumid throat and neck of such subjects, is not so easy to determine and seems of small importance to inquire. It is sufficiently evident, however, that a strong association existed in the minds of the Greeks and Romans between scrofula and the animal in question. Another term by which this malady has been designated is struma. Celsus very distinctly describes the disease as it affects the absorbent glands under this name; and adds that it occurs also in the female breast. Among

* Gray, in his Supplement to the Pharmacopœias, gives the following as the formula for this ointment:—Rough verdigris ppd. v. oz. honey xiv. oz. vinegar vii. oz.; boil to a proper consistence.

† Sir Gilbert Blane stated to the select committee of the House of Commons appointed to inquire into the state of the Penitentiary at Milbank in 1823, that if he had found, when he was in office as commissioner, a navy surgeon who by his journal had administered a particle of this medicine in the treatment of sea scurvy, he should have felt it his duty to move that such surgeon be struck off the list.—Edin. Med. and Surg. Journ. vol. xxii. p. 142.

modern nations the French have named the disease *les écronelles*,* probably a corruption of *scrophules*; the Germans *der Kropf*, from the swelling under the chin; and the English the king's evil. This last term commemorates the imaginary virtues of the royal touch, to which, from the time of Edward the Confessor till the reign of Queen Anne, multitudes of cases of scrofula were submitted, and very many of them were supposed to have been cured. A similar practice existed in France, with equal belief in its success; and miraculous powers for the cure of scrofula were likewise claimed for different Romish saints, for the heads of certain noble families, for the seventh son, and for many consecrated springs in different parts of Christendom.

It may be truly asserted that no original temperament, complexion, or frame of body, confers complete immunity from scrofula; yet a little observation will convince us that individuals possessing certain characteristics are more frequently the subjects of this malady than others. The scrofulous constitution is often indicated by a fair complexion, light silky hair, long shining eyelashes, large, watery, and often blue eyes, with dilated pupils, and a red patch on either cheek, contrasted with a dazzling whiteness of the skin, which is itself usually thin, smooth, and readily irritated by slight causes. Thus scrofulous individuals are more liable to chilblains, which appear often on their hands; and in such persons the application of a blister is generally followed by an eruption of pustules on the skin around, and the formation of successive crusts. The insertion of a seton, the wounds of leeches, and even simple venesection sometimes produce the same effect: so great, indeed, have we known the irritability of the skin in scrofulous children, that washing with scented soap has caused the immediate appearance of a papular eruption. Scrofulous persons often present the look of florid health and a full habit; but the soft parts are flabby, and easily shrink away under fatigue, privation, or disease; and when the operation of these causes is completely at an end, such individuals are restored with the same rapidity to their former plethoric condition. The scrofulous habit is, in short, characterized by a deficiency of what has been termed *stamina*, and enduring tone. Children who possess this constitution are familiarly known as feverish children; a very slight irregularity of diet or exposure to cold or moisture throwing them immediately into a state of febrile excitement. Their frames possess an undue proportion of irritability, and they are peculiarly prone to attacks of inflammation. The mucous membranes of the scrofulous, like the external integument, are also delicate, and their vessels readily give way and pour out blood: thus bleeding from the nose is a common occurrence in persons of this constitution; and in them hemorrhage is more frequent from the urinary passages and ramifications of the windpipe. The conjunctiva in scrofulous individuals is very liable to inflammation, and the mucous membrane of the intestines is readily irritated and diarrhœa induced. In such subjects the mucous secretions are very abundant and often acrid, and the membranes themselves frequently become thickened: hence arise excoriations of the nostrils and of the upper lip, which becomes in consequence chapped and swollen; and the half-open mouth is a common characteristic of scrofulous persons, owing to the partially obstructed state of the nasal passages. Most scrofulous persons are of small stature, and have slender limbs; nor is it very uncommon in such individuals to find some member or organ imperfectly developed, defective in its power, or curtailed of its proportion: yet multitudes of scrofulous persons are met with of a very different description—individuals remarkable some for their lofty stature and apparent strength, and others for the surpassing symmetry and beauty of their persons.

The moral and intellectual qualities of the above, which is the largest class of scrofulous subjects, correspond with, and in all probability are derived from those of their bodies: the temper is quick and irritable; the desires and passions are ardent; the perception is keen, the imagination is predominant over the judgment; and the mind is characterized by a want of firmness and solidity, and an inability to persevere steadily in the pursuit of any one object. To this observation, however, there are many brilliant exceptions, where the strumous constitution is seen combined with mental qualities of the highest order.

In a second class of persons who are disposed to scrofulous disease, the complexion is dark, the skin harsh, and the habit indolent; the countenance is swollen and pasty, and all the functions of the body are sluggish and imperfect: the nervous energy is feeble, the feelings are obtuse, and the moral and intellectual powers occupy a very low rank. Scrofulous cases of this character are not by any means uncommon in Britain, although far more rare than those first described; but extreme instances are frequent in some districts of Switzerland and France; and in these human nature appears reduced almost to the level of the brute creation, assuming forms which awaken feelings of humiliation and disgust. Scrofula, which is always tedious and difficult of cure, becomes still more obstinate and unmanageable when it makes its appearance in those of a dark complexion and sluggish temperament.

[The writer's experience leads him to say, that scrofulosis occurs quite as frequently in the dark complexioned. The negroes of the south are very subject to it, and in its most severe forms. (Guersant, art. *Scrofule*, in *Dict. de Méd.* 2de édit. xxviii. 207. Paris, 1844.)]

This disease exhibits itself under a great variety of symptoms, according to the part of the body which it happens to affect: hence the difficulty of framing any definition of it which is at once accurate and comprehensive.

The most certain evidence of the existence of scrofulous disorder is afforded by the production of a soft, brittle, unorganized matter, resembling curd or new cheese, which is found mixed with the purulent contents of scrofulous abscesses, or deposited in rounded masses of different degrees of firmness, and varying in bulk from the size of a millet-seed to that of a hen's egg: sometimes it is contained within the natural cavities and canals

* In some parts of Scotland the disease is called by the common people "*the cruels*;" an evident corruption of the French word.

of the body, sometimes it is enclosed in cysts, and occasionally it is diffused, as if by infiltration, through the natural texture of a part. To the rounded masses of this substance, which, as they enlarge, often acquire the irregular form of a tube ous root, the name of *tubercle* has been assigned, and the substance itself has been named *tuberculous matter*. We venture to assert that the presence of tuberculous matter is a satisfactory proof of the existence of scrofula; but we do not by any means maintain that scrofula cannot exist without the deposition of this substance. The researches of pathological anatomy have satisfactorily shown that scarcely any living texture of the human body is altogether exempted from tuberculous deposits. This morbid production has been observed on the free unbroken surfaces of mucous membranes, within mucous follicles, and forming the contents of lymphatic vessels the tunics of which were themselves sound, (*Andral*, Précis d'Anat. Patholog. tom. i. p. 419, and tom. ii. p. 446): granules of tuberculous matter, sometimes insulated, sometimes clustered together, have also been detected within the clots of blood contained in the cells of the spleen. (*Andral*, op. cit. tom. ii. p. 431. Carswell's Illustrations, &c. Fascic. 1, plate iii.) The history of tubercle certainly entitles us to consider it as a morbid secretion; but when it is thus found lying free within a healthy lymphatic vessel, or enveloped in the coagula of the splenic cells, we are led to suspect that in such cases it has probably been formed by some change in the constitution of the lymph or blood, from an alteration in the proportions of their ingredients, or the addition of some coagulative substance, or the withdrawal of something which these fluids usually contain. The cellular tissue has been hitherto considered as of all others the most common seat of tubercle; but Dr. Carswell has stated that it is far more frequently met with in contact with mucous surfaces; and he has certainly adduced very strong arguments in support of this opinion, which he has also illustrated by most beautiful engravings. (See Fascic. 1.)

For a particular history of this substance in its etiological, pathological, and chemical relations, we must refer the reader to the articles Tubercle and Tubercular Phthisis, and content ourselves, in this place, with noticing such circumstances as have more especial reference to the subject of the present article.

According to Dupuy, (De l'Affection tuberculeuse,) all the domestic animals of France, not excepting the dog, as well as those imported from warmer countries, are subject to tuberculous deposits: his researches further show that this disease in the inferior animals is much more frequently combined with the presence of vesicular worms than it is in man. He has traced the conversion of the cysts containing these animals into collections of tuberculous matter, and has thus given a degree of support to the opinions of Dr. Baron, who maintains that all tuberculous disease originates from vesicular worms or minute serous cysts. But although we admit that such adventitious cavities often become, at least in the inferior animals, the nests in which the matter of tubercle is deposited, the assertion that all tubercles arise in this manner may well be disputed when we find that such cysts or vesicular worms, or traces of them, are by no means always co-existent with tuberculous disease, and that they often attain a very great magnitude without exhibiting any symptoms even of incipient transformation.

Opinions directly opposed to each other have been held by writers of great eminence as to the immediate cause of tubercles; one party ascribing their origin in every case to inflammation, (*Broussais*, Examen des Doctrines Médicales, tom. i. *Alison*, Edin. Med. Chir. Trans. vol. i. and iii.); another as exclusively asserting that they are in no instance dependent on inflammatory action, and that when inflammation co-exists, it does so as the consequence, and not the cause, of tubercles.* After carefully reviewing the discussions on this question, we have come to the conclusion, that on some occasions tubercles have been found where no symptom of previous inflammation could be recollected, nor any trace of it discovered on inspection after death, (*Andral*, Précis d'Anat. Pathologique. *Lombard*, Essai sur les Tubercules); while in other instances the deposition of tuberculous substance seems to have been distinctly connected with the development of inflammatory action. But as inflammation often occurs without the formation of tubercles, it is obvious that this alone is not sufficient for their production, and that the addition of something else is required to that end. Inflammation, therefore, may be viewed as an occasional cause of tubercles, producing this effect only in frames of a scrofulous disposition.

Some organs are more liable to tuberculous deposits than others, and the liability differs at different periods of life: the organs which are most frequently affected with tubercles in children are not those in which they are oftenest met with in adults. In children the disease tends more to implicate several organs at once; and in them it is more common to find the lungs unaffected, although tubercles be discovered in other parts of the body. (*Lombard*, op. cit.) The existence of tubercles in the fœtus is certainly rare, but it has been proved beyond question by the dissections of Langstaffe, (Lloyd on Scrofula,) Lombard, West, Orfila, (*Velpeau*, Thesis ad aggreg. p. 10,) and Chaussier, (Procès verbal de l'Hospice de la Maternité, 1812, p. 62): they continue infrequent from birth till two years, after which they are often met with; and during the fifth year their occurrence appears to be much more common than at any period before puberty. From eighteen till forty, tubercles very frequently occur; affecting, however, chiefly the lungs, intestines, and some parts of the lymphatic system.

* *G. L. Bayle*, Recherches sur la Phthisie.—*Laennec*, Auscult. Médiate.—*Gendrin*, Hist. Anatom des Inflammat.—*Lobstein*, Anat. Patholog. tom. i. This able advocate of these opinions admits the production of what he terms miliary granulations on the surfaces of inflamed serous and mucous membranes, but denies their identity with tubercles. In this manner he endeavours to set aside the arguments drawn from such cases as those of Dr. Alison, and also the results of the experiments of Cruveilhier and others, who produced the appearance of myriads of small tubercles by injecting mercury into the bloodvessels and lungs of animals; each minute globule being found enclosed within an effusion of tuberculous-like matter. These experiments we have always considered as any thing but conclusive: for where is the evidence that the effused matter is truly tuberculous?

These results are drawn from the researches of pathological anatomy; but to speak merely from symptoms, independent of the verifications of dissection, scrofula has been observed by us in the form of enlarged axillary glands within the first fortnight after birth: it is not usual, however, for the absorbent glands to be affected till the period of the first dentition; the occurrence is still more frequent during the second. At puberty the disease often disappears spontaneously, and after this age external scrofula is very rarely observed to originate; but instances are not wanting in which persons well advanced in life have been attacked for the first time by scrofula, more especially among those who have been long confined in prisons or workhouses. To show the various ages at which the disease may develop itself, Lalouette (Traité des Scrophules, Paris, 1780) states that in a scrofulous family one daughter was affected at fourteen, another at sixteen, a third at twenty-six, and the father at sixty-six. Cases have occurred to the writer where scrofula has appeared in youth, undergone an apparent cure, and again manifested itself in advanced life, when it proved fatal.

In former times it was believed that scrofula was communicable from one individual to another; and the occurrence of the disease in many members of the same family, and its diffusion among the inhabitants of particular districts, seemed, through a loose mode of reasoning, to afford ground for this opinion. Positive experiments have been made by Kortum, (De Vitio Scrofuloso. Lemgov. 1798,) Goodlad, (On the Lymphatic System,) Hebreard, (Dissertat. sur les Tumeurs Scrofuleuses,) Le Pelletier, (Sur la Maladie Scrofuleuse, p. 16,) and others, to propagate the disease by rubbing in scrofulous matter, and by inserting it under the skin of animals, and even of the human subject; while Pinel, Alibert, and Richerand, (Nosograph. Chirurg. tom. i. p. 161,) have carefully watched the effects of allowing scrofulous and healthy children to associate together without restraint; but in no instance was there the least reason for believing the malady to be communicable by any of these modes of infection. The observation of British practitioners fully corroborates the opinion of the non-contagious nature of scrofula, although the writers of this country have not directed so much attention to the subject; because a belief in the contagion of scrofula was abandoned by our physicians long before it ceased to be current among those of the continent.

In this respect scrofula differs remarkably from that form of tuberculous disease in animals which has been named glanders: for this last is not only communicable from one animal to another, but also to man.* It would be curious to inquire whether glanders in man is itself communicable to other human beings: that it is so is by no means improbable, for it has been proved by expement to be capable of being communicated from man to the inferior animals. (*Coleman*, in Travers on Constitutional irritation.) It is proper here to state that M. Dupuy has expressed strong doubts of the contagious nature of glanders, and has asserted that he knows of no well-conducted experiment in favour of this doctrine, but some against it. He is disposed, on the contrary, to refer glanders to hereditary transmission, and to various unfavourable circumstances in the rearing of horses, similar or analogous to those which are admitted as predisposing to scrofula, such as cold, damp, and shady pastures, insufficient nourishment, and the debilitating effects of castration. (De l'Affection Tuberculeuse.)

Daily observation must convince us that a scrofulous constitution is often transmitted from parent to child; therefore the disposition to the disease may be truly said to be hereditary; nay, the dissections already referred to prove the actual development of scrofula even before birth, in the progeny of a strumous mother. Like other hereditary gifts, it may miss one generation and reappear in the succeeding; just as some individuals are observed to resemble in external appearance their grandfathers more than their fathers.

A striking example of the hereditary nature of scrofula was lately presented to the writer by a family respecting whom he was consulted. The father was a tall, thin, and sickly man, who suffered much every year from winter cough; the mother a person of full relaxed habit, with a look of florid health, and in fact not often affected with illness. Of nine children to whom she had given birth, two females and six males had died with phthisical or mesenteric symptoms, between the ages of three and fifteen months; the survivor was a boy nearly twelve years old, who enjoyed moderately good health. The last of these little victims of transmitted disease died just as he had completed his third month, after having suffered under symptoms of phthisis. On inspecting the body, the lungs were seen mottled with many yellow spots, and when cut into they exhibited myriads of tubercles, varying from the size of a small mustard-seed to that of a pea: all of them were opaque, and many converted into pus. The glands at the root of the lungs were enlarged, indurated, and some of them converted into abscesses, the walls of which were lined with firmly adherent fibrin, and their contents were a thick purulent fluid. The mesenteric glands were enlarged, hardened, and many of them contained softened tuberculous matter. The spleen contained some small granules of a white colour and cheesy consistence. There was a good deal of subcutaneous fat, but none in the omentum. A very few weeks after the death of this child, the father, who had been eager to learn whether his offspring drew their fatal disease from himself or from their mother, declined rapidly in strength, and fell a victim to phthisis.

Scrofula is supposed by most writers to be of more frequent occurrence among females than males; and Le Pelletier (Sur la Maladie Scrofuleuse,) has stated, as the result of a comparison of the cases in the Parisian hospitals, that the proportion of strumous females to males is as five to three. In all inquiries into the relative prevalence of disease in the two sexes, it must be recollected that the female population, especially of large towns, considerably exceeds the male; and

* *Elliotson*, in Lond. Med. Chir. Trans. vol. xvi. p. 171. *Travers*, On Constitut. Irritat. 2d edit. p. 398. *Schilling and Weiss*, in Rust's Magazin. fur die gesammte Heilkunde, 1821. Also *Remer*, in Hufeland's Journal, March 1822.

hence it is to be expected that a great number of scrofulous females will apply for medical relief. But on reviewing the matter carefully, and referring to an examination of hospital patients made for another purpose, we are convinced that the disease is really more frequent in the female sex. Dr. Cullen was of opinion that scrofula was oftener transmitted from the father than the mother, which he conjectured might arise from the circumstance that more scrofulous men than women enter the married state; but he has nowhere explicitly asserted that males are more liable to the disease than females. (First Lines. *Scrofula.*)

We proceed now to pass briefly in review the various parts and organs of the human body in which scrofula most commonly appears, and to point out the modifications of this disease induced by the different properties and textures of the parts affected.

The first which presents itself is the common integument; and here several forms of cutaneous disease are distinctly referable to the class of scrofulous affections. The three species of porrigo named favosa, larvalis, and furfurans, together with eczema impetiginodes and rubrum in their chronic forms, may be fairly enumerated among strumous diseases; at least if we are entitled to draw any inference from the facts that these eruptions are found in combination with the generally admitted symptoms of scrofula, and are as often benefited by anti-strumous remedies as the symptoms just mentioned are usually observed to be. Eruptions of this description, when they affect the scalp, ears, and face, are very apt to occasion swelling of the glands at the back part of the head, on the sides of the neck, and under the jaw; at first from simple irritation, or perhaps the absorption of morbid fluids; afterwards, the swelling becomes permanent, from the deposition of tuberculous matter. Other causes of an irritating or inflammatory kind, as dentition and exposure to cold, are known to produce such glandular tumours, terminating like the others, where the habit is strumous, in the deposition of the same curdy substance. Thus we have a second order of parts more deeply seated than the skin affected with scrofula, often from the causes stated above, and sometimes, it would seem, spontaneously. The absorbent glands, indeed, are the parts of the body which have long been regarded as the peculiar seats of scrofula, and their enlargement and induration are still considered as affording more unequivocal evidence in the living body of the presence of that disease than any other circumstance except the discharge of tuberculous matter. A lymphatic gland, when first affected with scrofula, is soft and fleshy, and its size is increased; the texture, as proved by inspection, then becomes firmer, and the colour paler than in health: as the disease proceeds, portions of the gland are observed to have altogether lost their flesh-colour, and acquired a degree of semi-transparency, and a texture approaching to that of cartilage; at length a deposition of soft white or yellowish curd-like substance is found to have taken place, and the true scrofulous tubercle is now manifest. (*Abercrombie*, Edinb. Medico-Chir. Trans. vol. i. p. 683.)

The size to which strumous glandular tumours attain is in some instances enormous. The lower jaw and upper part of the neck are occasionally seen hung round with such voluminous swellings as completely to deform the countenance; and we have seen, in the case of a strumous middle-aged male, both groins occupied by vast glandular tumours, the larger of which equalled in size the half of a child's head at birth. These inguinal swellings were firm, nodulated, and without pain; they had commenced only six months before as clusters of hard kernels, which by degrees enlarged and coalesced into the enormous morbid masses now described. It has been stated by a very able and accurate observer that scrofulous glands always possess a higher temperature than the healthy parts in the vicinity; but the trials which we have made, and they were often repeated, did not detect any greater heat in such swellings, unless when they were actually inflamed.

Scrofulous glands are commonly supposed to be obstructed and impervious to the fluids which are naturally transmitted through them, but it is certain that they are in many instances capable of being injected with mercury from the intrant lymphatic, (*Soëmmering*, De Vasis Absorbentibus, sect. 37, p. 90); and hence we may infer that, though partially changed, some portion of them may still give passage to their proper fluids.

Scrofulous tumours do not uniformly originate from the degeneration of lymphatic glands, but arise in many cases from the deposition of tuberculous substance in the subcutaneous cellular tissue, in different parts of the body, quite independent of any absorbent gland: their resemblance, however, to glandular swellings is such as to deceive the inexperienced; nay, they were named even by Wiseman, the first surgeon of his day, *adventitious glands*. When these scrofulous tumours are cut into, they are found to be composed of cysts varying in size and density, usually lined with a fibrinous exudation, and filled with tuberculous substance, sometimes crude, at others softened, or converted into curdy pus.

Absorbent glands affected with scrofula, and cysts of tuberculous matter in the cellular tissue, may remain for a long time without exciting any irritation; but their tendency is to become soft by the secretion of purulent fluid from the internal surface of the cavity, which is soon followed by inflammation of the integuments. Ulceration succeeds, and the morbid contents are discharged from the body, sometimes by one, at others by many small apertures: but a cure does not follow; either fistulous openings remain, discharging a thin glutinous fluid mixed from time to time with curdy particles, or an indolent ulcer succeeds, or both may result from the expulsion of tuberculous matter. The contents of scrofulous glands and tumours on the surface of the body occasionally undergo the cretaceous transformation; after remaining long indolent, suppuration at last takes place, and masses of earthy substance, sometimes of considerable bulk, are extracted from their cavities. On macerating these calculous concretions in water, we have found them to separate readily into a multitude of gritty particles like dried mortar. In some instances, strumous glands are converted into prominent spongy tumours of a

red colour, and covered by a silky cuticle, which frequently breaks, and gives issue to small superficial collections of purulent matter.

Scrofulous ulcers are characterized by their flabby and often pale granulations, and the thin unhealthy integument which usually overlaps their margins. This undermined skin is of a purplish or livid hue; showing the languor of its capillary circulation, and its proneness to be destroyed by gangrenous erosion. Such ulcers, though usually productive of little uneasiness, sometimes become exceedingly irritable and painful, requiring the employment of powerful narcotics to give relief to the patient. The thin discharge which scrofulous sores yield often concretes upon their edges into straw-coloured crusts, under which the ulcer, if small, sometimes heals. Scrofulous cicatrices possess a peculiar wrinkled and puckered appearance, with small portions of projecting skin, and even complete bridges admitting a probe to pass beneath them; features by which their real origin, long after a cure, may be readily discovered. These appearances of scrofulous scars seem to be produced by the great attenuation and irregular destruction of the integument, and the slow and interrupted mode in which such ulcers heal; and they may always be in a great measure prevented by careful and judicious surgical treatment. When scrofulous cicatrices are cut into and examined after death, the affected glands are found wasted away, no vestige of them being left excepting a few bands of condensed cellular tissue attached to the cicatrized integument. The healing of a scrofulous ulcer is often followed by the advance of other tumours to suppuration, or perhaps the formation of new ones in some adjoining or distant part of the body. Thus one train of evils succeeds another, till the constitution of the patient begins to yield to the debilitating effects of the irritation and discharge, or the disease fastens on some organ of greater importance in the economy, and life is at length destroyed by hectic fever, colliquative perspirations, and diarrhœa.

Another form in which scrofula sometimes attacks the integument is that of lupus, the usual seats of which are the lips and nose; but we have also seen it affecting the genitals. Scrofulous lupus commences by the appearance of small red button-like prominences, which usually remain indolent for some time, then become excoriated and form eroding ulcers, with pale shining spongy granulations and encrusted margins; or, perhaps, the work of destruction goes on under a thick incrustation, which drops off from time to time, to show the ravages which have been committed. The progress of the disease is sometimes hastened by the formation of sloughs, especially when the parts are cartilaginous; and in this way perforations are made into the nostrils, and sinuses scooped out within the thickness of the lips. In lupus of a well-marked scrofulous character, the face usually becomes swollen and raised into pallid flabby prominences, which deform the countenance, and give to it a very sickly and disgusting aspect. See the article Noli me Tangere.

Scrofulous individuals are subject to the formation of large chronic abscesses, which sometimes arise with great rapidity, as if from a sudden deposition of fluid rather than as the consequence of regular suppuration. The usual seat of such abscesses is in the cellular tissue connecting the large muscles, or within their sheaths, and under fasciæ; and their contents are at first a serous effusion, afterwards sero-purulent fluid, with curdy flakes; and more rarely a thin pus. In such cases, sloughing of the cellular tissue is not uncommon; spongy masses of it, like wet tow, coming away along with the discharge, or plugging up the lancet puncture. These abscesses are named by French writers *abcès froid* and *abcès par congestion*; and their origin is usually the irritation of some diseased joint or bone in their immediate vicinity. It does not appear that abscesses of this description result from the softening of tuberculous matter previously deposited, but that the curdy flakes are thrown out from the internal surface of the abscess during the formation of its more fluid contents.

The lymphatic system has been generally considered as the primary, and by some the only seat of scrofula; and in all treatises on the diseases of the absorbent vessels, this malady occupies a prominent station. In almost every case of advanced scrofulous disease of the mesenteric glands, the lacteals connected with them will be found affected, and more or less filled with tuberculous matter; but the absorbents in other situations have not been very often observed to be the seats of strumous disease. Several well-authenticated cases, however, are recorded, in which tuberculous matter was found deposited within these vessels, and that in such quantity as completely to obstruct them.*

The following instance of scrofulous affection of the lymphatic vessels occurred to the writer. A gentleman, after applying an astringent lotion to a simple excoriation of the cervix glandis, was affected with indurated swelling of the prepuce, and the appearance of hard tortuous cords within the integuments of the penis, which after a few days could be traced all the way to the pubes. A glandular swelling took place in one groin, which after a considerable interval suppurated, burst spontaneously, and at length healed. No perceptible benefit accrued from a slight mercurial and purgative plan of treatment; but amendment commenced under the use of sarsaparilla and iodine, and the disease wholly disappeared after a tour of several weeks' duration, since which the individual has continued to enjoy good health.

The inflammation of the superficial lymphatics in the horse, is believed by the best writers on veterinary medicine to constitute the disease named *farcy*, (*Percival*, Lectures on the Veterinary Art, vol. iii.), and M. Dupuy (De la Maladie Tuberculeuse) regards the small tumours termed *farcy buds* as tuberculous deposits.

The sublingual and submaxillary glands are often the seat of scrofula; the parotid more rarely, but a chronic swelling of that organ is occasionally seen in scrofulous subjects of a dark complexion. Tumefaction of the tonsils is seldom

* *Sir A. Cooper*, Medical Records and Researches, vol. i. 1st and 2d Cases.—*Paletta*, Exercitat. Patholog. p. 109, fig. 4.—*Lieutaud*, Hist. Anat. Méd. vol. ii. obs. 770, 771, 771 a.—*Otto*, Seltene Beobachtung. Theil ii. No. 33.—*Andral*, Précis d'Anat. Patholog. t. i. pp. 419–421.

absent, when the strumous constitution is strongly marked: this exists from an early period of life, and is perhaps in some instances congenital. The tonsils so affected jut out in rounded tumours from between the arches of the fauces: they are peculiarly prone to inflammation, and when it occurs, the swelling is often such as to threaten suffocation, especially when stimulant astringent gargles have been incautiously employed. The inflamed tonsils become speedily spotted with aphthous crusts, which are succeeded by superficial ulcerations, always indolent, and sometimes ending in brown excavated ulcers, which we have known to exist for weeks without any remedy being used, and then to yield rapidly to cinchona.

Scrofula occasionally attacks the tongue,* the disease alternating with strumous eruptions, especially in the face: it sometimes assumes the form of aphthous ulcerations and fissures of the margin; but its most characteristic features are small knots or nodules superficially imbedded in the substance of the organ, varying in size from a grain of small shot to that of a horse-bean. They cause no uneasiness unless when firmly pressed, and then the pain is slight and pricking. The mucous membrane covering them is red and prominent, and soon breaks in the centre, giving rise to an ulcer, which spreads and destroys by sloughy erosion, with much pain, profuse salivation, furred tongue, and fetid breath. The ulcers under proper treatment become clean, contract, and heal; but the hardness remains, fresh nodules form in other parts of the organ, and the same train of suffering is gone through after a longer or shorter interval, according to the state of the patient's health and the regularity of his mode of life, until a decided improvement be produced on the constitution by time, change of climate, or the employment of remedies.

The mucous membranes are frequently affected with scrofulous disease: allusion has just been made to the aphthous exudations and superficial sores which appear on the tongue and tonsils of strumous individuals; in other instances there are small blisters and excoriations on the inside of the lips and cheeks, and on the fauces, and that wholly independent of any syphilitic disease, or the previous exhibition of mercury. The pituitary membrane in scrofulous subjects is easily irritated, and the secretion of mucus is usually copious and often acrid: nay, in some instances the morbid condition of the part proceeds so far as to induce small ulcerations, constituting one form of ozœna. If the progress of this affection be not arrested, the fine long laminæ within the nostrils become in part denuded, and at length necrosed; and it is from the decomposition of dead osseous substance that the horribly offensive odour is produced which renders this malady so peculiarly disgusting. To those around the patient it is always so; but he himself is sometimes unconscious of the odour, in consequence of the diseased condition of the pituitary membrane, and the loss of smell resulting from it. The most frequent cause of ozœna is, without doubt, syphilis; but it occurs chiefly in those syphilitic cases where the habit is strumous, and it is met with also as the effect of scrofula alone. It has not been ascertained whether ozœna ever originates from the deposition of minute tubercles on the pituitary membrane; but that this sometimes occurs is far from improbable. In the glanders of horses, which is an analogous affection, the existence of tubercles in the lining membrane of the nostrils has been satisfactorily shown by Dupuy to form a leading feature. (De l'Affection Tuberculeuse, pp. 30 & seq.)

Scrofulous children are more liable than others to inflammatory affections of the windpipe, and to that fibrinous exudation on its mucous surface which occurs in croup; yet this cannot properly be classed among strumous diseases.

But the ultimate terminations of the respiratory mucous membrane are frequently the seat of scrofula: some eminent pathologists, indeed, are of opinion that the air-vesicles of the lungs are the usual situations in which tuberculous matter is originally deposited in cases of scrofulous phthisis. Dr. Alison informs us that he has repeatedly found tuberculous matter in the air-vesicles, these minute cavities being partly filled with air and partly with this substance, (Edin. Medico-Chir. Trans. vol. i. p. 427); and the dissections of Dr. Carswell, (Illustrations of the Elementary Forms of Disease, Fascic. 1,) which he has so happily perpetuated by his drawings, appear to us to have set this point completely at rest. M. Gendrin, however, asserts that the substance effused into the air-vesicles is nothing more than the product of common inflammation, and not at all tuberculous; but he candidly admits that Laennec expressed a contrary opinion while the subject was before them, and he is ready to acknowledge that inflammation is a powerful occasional cause of the production of tubercle. (Hist. Anatom. des Inflammations, tom. ii. pp. 310, 601.)

The digestive mucous membrane is subject through its whole extent to scrofulous disorder of function, and in its intestinal portion at least to extensive scrofulous transformations. A feeble action of the stomach is an almost uniform accompaniment of well-marked strumous disease; and the mucous lining of the alimentary canal is in such cases either torpid or unduly irritable, the food remaining lodged as a source of oppression and disturbance, or being hurried rapidly forward, and expelled before it has had time to afford adequate nourishment to the system. Tubercles are met with in the walls of the intestinal tube in children, and still more frequently in adults: Louis states that in his examination of more than 350 phthisical subjects above the age of fifteen, he found tubercles in the small intestines of one-third, and in the large intestines of one-ninth of the whole. (Recherches sur la Phthisie.)

The subsidiary organs of digestion and assimilation suffer also from scrofula; but the spleen and the pancreas are more frequently the seats of tubercles than the liver; yet the last of these organs is more or less functionally deranged in almost all strumous cases, which the chalky and various-coloured motions of such patients sufficiently demonstrate. The great irritability of the mucous tunic of the intestines in many scrofulous cases, and the tubercles which so often form within the mucous follicles and walls of the tube, naturally lead to ulceration, and hence arise many

* Mr. Russel has alluded to this affection, but without describing it. See Russel on Scrofula.

cases of disease of the mesenteric glands. At first they become merely swelled, but ultimately tuberculous deposits take place within their substance, constituting what has been named mesenteric consumption, or tabes mesenterica. For a full account of this affection, we refer the reader to the article TABES MESENTERICA.

Scrofulous disease of the mucous membrane of the female genital organs is of frequent occurrence, and forms the most obstinate description of leucorrhœa, producing languor and debility, disordering and sometimes putting a total stop to menstruation, and in very many cases preventing conception. The morbid discharge in this disease is interrupted on the appearance of menstruation, and is increased in quantity before and after that occurrence. It varies in character from an opaque white mucus to a greenish yellow or blood-streaked purulence; and the surface which furnishes it is not limited to the vagina, but apparently extends throughout the whole internal lining of the uterus. It does not appear that tubercles have been detected in the vagina, but scrofulous ulcers have been seen there, probably arising from the destruction of tubercles, while the cavity of the uterus itself and the Fallopian tubes were found filled with tuberculous matter. (*Carswell*, Op. cit. pl. ii.) Tubercles have also been found imbedded in the walls of the uterus, and still more frequently in the ovaria. (*Meckel*, Handbuch der Pathol. Anat. B. ii. Theil. ii. s. 386. *Louis*, Recherches sur la Phthisie. *Lombard*, Essai sur les Tubercles.)

In men, scrofulous disease of the mucous membrane of the urinary channels and cavities is not unfrequent; and it is an affection particularly obstinate and unmanageable. The writer has known it to continue in the urethra for five years, at the end of which time it came under his care. The urethral membrane was then so soft and spongy that the most cautious attempt to introduce an instrument occasioned a profuse hemorrhage: after a lengthened treatment, the discharge at last yielded to tonics, the cold plunge-bath, and astringent injections. Chronic, or mucous cystitis, is often of a scrofulous character, (see CYSTITIS;) and there is ground for believing that the same affection passes up along the ureters, and even extends itself within the chambers of the kidney. Tuberculous deposits have been found within the coats of the bladder, (*Louis*, Op. cit. *Lombard*, Op. cit. *Delaroche*, Bulletin de la Société de Méd. t. 13. 14,) and lining the interior of the ureters, (*Laennec*, Auscult. Méd. t. i. p. 556. *Louis*. Also *Carswell*, Op. cit. pl. ii.); very frequently also in the cavities and substance of the kidneys, and sometimes in the renal capsules. (*Baillie*, Morbid Anatomy.) The glands of Cowper, the prostate, vesiculæ seminales, and testicles, have all been found the seats of tuberculous deposits. They occur most frequently in the prostate gland and testicles, particularly in the latter; and the symptoms to which they give rise render them objects of considerable importance to the practical physician as well as to the surgeon. See PROSTATE GLAND, DISEASES OF.

The changes produced in the testicle by scrofula vary considerably, according to the degree of attending inflammation, and the rapidity with which the disease has formed. We have, most commonly, a hard solid enlargement of the organ, usually affecting first the large head of the epididymis, slow in its growth, and obstinate in resisting the operation of remedies. It may remain indolent for some time, but at length abscess forms, the scrotum inflames, adheres, and gives way, discharging a curdy substance mixed with pus. The disease now extends to other parts of the epididymis and to the body of the testicle; sinuses form under different parts of the inflamed integument; and fistulous openings take place, which give issue to a thin, ill-conditioned fluid, mixed with curdy particles. At other times a more rapid inflammation occurs, and an abscess forms, which on bursting discharges scrofulous pus; a fistulous opening succeeds, the gland wastes away, and at length nothing remains but a small, shrunk, and hardened mass. On dissecting a strumous testicle, the natural fabric of the organ is found more or less indurated by the deposition of dense organized substance; tuberculous matter is discovered in different spots, in the tubuli seminiferi epididymis, and sometimes even in the vas deferens. Small scrofulous abscesses are also occasionally found disseminated through the substance of the gland. (*Sir A. Cooper*, On the Testis. Carswell's illustrations, pl. ii.) This disease is much more common after puberty, when the actions of the testicle are awakened, and it has become exposed to numerous causes of irritation and injury; but we have known it occur at a very early age, in the case of a child which exhibited other strong marks of the strumous constitution. In almost every instance only one testicle is attacked at first, but after a time the other is usually affected; and it is not uncommon for both to continue suffering from the disease at the same time. Andral has well remarked the frequency of scrofulous affection of the testicle, and has pointed out the palpable omission of Louis, who has assigned no place either to the testicle or the bones in his enumeration of parts in which scrofulous deposits have been found.

Another organ which is subject to scrofula is the mamma; scrofulous disease of which occurs both before and after puberty, but much more frequently after that period, and often during the excitement of the first lactation. Scrofula of the mamma appears under different shapes, and in its earlier stages is not always easily distinguished from disease of a more formidable character. Sometimes a hard lump forms in the breast, and remains nearly quiescent for several years; at others the whole gland is affected with scrofulous enlargement; but in every case of the disease its tendency is to suppuration, and the purulent matter discharged is more or less mingled with curdy flakes: instances likewise occur in which large masses of tuberculous substance come away. (*Lloyd*, On Scrofula.) In the progress of such cases the integuments become inflamed, assume a livid colour, and are extensively detached from the parts beneath; new abscesses and apertures form, and the adipose and glandular tissues are traversed by many fistulous passages, while the contiguous parts are condensed and hardened. In strumous disease of the breast, there is always an enlargement of the gland instead of that contrac-

tion which occurs in one form of carcinoma: the tumour is tender when squeezed, never possesses the stony hardness which exists in the disease just named, and there is never, we believe, retraction of the nipple.

The mucous membranes of the eye and lachrymal passages are peculiarly liable to scrofulous disease; its influence on the latter is indicated by the long-continued discharge of puriform mucus, varying in its colour and consistence; while strumous inflammation of the conjunctiva constitutes a very large proportion of all the inflammatory affections to which this organ is subject. Beer asserts that in Vienna nine-tenths of all the cases of ophthalmia in children are of a scrofulous character, (*Jos. Beer*, Lehre, &c. b. i. s. 588); and Benedict of Breslau estimates the proportion in that city as high as ninety-five in the hundred. (Handbuch, &c., b. ii. s. 165.) The eruption of the minute vesicles, (phlyctenulæ) or pustules, which occurs in scrofulous inflammation of the conjunctiva, seems to approximate it to other diseases of the same class, when numerous crops of very small tubercles are seen on the investing membranes of various organs; but it does not appear that true tuberculous matter has ever been detected in any part of the eye.* Scrofula likewise attacks the margins of the palpebræ and Meibomian follicles, causing the appearance of vesicles and ulcerations named ophthalmia tarsi; and it is believed by Mr. Todd to occasion chronic enlargement of the lachrymal gland. (Dublin Hospital Reports, vol. iii.)

The organ of hearing, like that of sight, is the frequent subject of scrofula, which in many instances is productive of early deafness, and, there is reason to believe, is the cause of that imperfection of hearing which is sometimes seen to pervade several members of the same family. The lining membrane of the external auditory passage is in most instances the seat of the disease, which is usually marked by profuse watery, then mucous, and at length purulent discharges, forming what may be named strumous otorrhœa. It is in general unattended with danger, but it rarely exists without producing a greater or less imperfection of hearing. In some instances, however, the disease spreads more deeply; the membrane of the tympanum becomes inflamed and is perforated, the small bones of the ear are discharged, and irremediable deafness ensues; or perhaps caries of the petrous portion of the temporal bone takes place, and the result is fatal. (See Oralgia and Otitis.) Strumous otorrhœa has been known to alternate with other mucous discharges, such as leucorrhœa and chronic cystitis, (*Lallemande*, Recherches sur l'Encéphale, lettre quatrième); and its disappearance has been followed by enlargement of the cervical glands, swelling of the testicle, and various diseases of the eyes and skin. (*Itard*, Maladies de l'Oreille.) Like other scrofulous affections it sometimes resists all remedies, and at length disappears at puberty.

The synovial membranes of joints are undoubtedly much more liable to disease, in scrofulous subjects, than others; inflammation is more readily excited, and effusion of fluid into their cavities is more easily induced. In such persons we frequently observe several joints affected at the same time. In a case of six years' duration, lately placed under the writer's care, the left hip-joint, the right knee, and the joints of the right great toe were all suffering under disease, with displacement of the head of the femur and shaft of the tibia; there were, besides, many ulcers and sinuses around the joints, and indurated cervical glands: this patient had a strongly marked strumous countenance. The secretion of scrofulous pus into synovial cavities is not uncommon, but the existence of tubercle within the substance of the membrane itself appears to be of rare occurrence. Dr. Craigie states his belief that tubercle has been found in the synovial membrane of the hip-joint. (Elements of Patholog. Anatomy, p. 810.) There is indeed a remarkable change of structure, which takes place slowly in the synovial membranes, particularly that of the knee-joint, and which, as it occurs most frequently in the scrofulous, some may be inclined to regard as of scrofulous origin. This morbid alteration of texture, which was first accurately described and illustrated by Mr. Brodie, (Pathological Observations on the Joints,) consists of the conversion of the synovial membrane, and afterwards of the adjacent soft parts, into a pulpy substance of a light brown colour, intersected by white membranous threads, and traversed by minute red vessels. But there is another affection of the joints, in which the characters of scrofula are unequivocally exhibited; in this the disease originates in the cancellous structure of the bones, which is found to contain deposits of tuberculous matter: and the cartilages and synovial membranes are affected secondarily by the spreading of the inflammation.

In scrofulous persons the bones are more slender throughout; their cortex or outer wall is much thinner, and their interior more soft and vascular than the bones of persons of sound and vigorous constitution: in the inferior animals affected with tuberculous disease, according to Dupuy, (De l'Affection Tuberculeuse,) this peculiarity is still more strongly exhibited. Scrofulous children sometimes fracture the thigh or leg merely by falling on the carpet; and in other instances the bone does not snap across, but bends like a piece of tin; and the injury may be remedied by straightening it as we do a rod of that metal. The effects of scrofula on the bones are considerably different, according to the comparative density of their texture; but in all instances the process of disorganization appears to commence by an increase of their vascularity, or a greater or less degree of inflammation. In the dense fabric of the bones of the skull and the shafts of the long bones, scrofula is a frequent cause of necrosis; while in the spongy heads of bones, the small bones of the hand and foot, and the bodies of the vertebræ, this disease manifests itself, first by increased vascularity and softening of the cancellated structure while the firm exterior remains entire and unchanged; then a deposit takes place of a clear yellow fluid, which is succeeded by or probably converted into a soft cheesy substance or

* Strumous disease of that organ seems to exist also among animals. M. Dupuy considers the specific ophthalmia of horses as one of the consequences of the tuberculous affection.

true tuberculous matter. (*Brodie*, Patholog. Observ. on the Joints.—*Lloyd*, On Scrofula.) This alteration in the texture of the bones is slow in its progress, and its existence is not indicated by any decided symptoms until it is considerably advanced. A dull and deep-seated pain gives the first warning of the disease, the soft parts then become swelled, the motions of the neighbouring joint are restrained and painful, and abscesses now form around it, containing a scrofulous pus; the investing cartilages and synovial membrane next suffer, effusion takes place into the articular capsule, and perhaps a high degree of inflammation is induced by the escape of tuberculous matter or a portion of necrosed bone into the cavity of the joint. In the progress of the disease the destruction of the head of the bone or edge of the socket, and of the ligaments which preserve the bones in their places, enables the more powerful muscles to draw the lower one from its situation, and produce what is named secondary luxation. The writer has repeatedly observed dislocation of the tibia produced by the separation of the epiphysis from the shaft of the bone; the leg being in this manner completely displaced, although the articular surfaces of the knee-joint were in proper apposition.

Not only the bones but also their investing membrane of periosteum is subject to tubercular deposits,* giving rise to swelling, inflammation, suppuration, detachment of the periosteum from the bone, and ultimately to necrosis, or absorption of the osseous tissue, which is replaced by dry tuberculous substance without softening of the bone. To this form of tuberculous disease we would refer some of those cases which have been named osteo-steatoma. This morbid deposition, which we have seen lying in contact with the bone in large angular masses, bears a striking resemblance to suet or adipocire; but its nature is truly that of coagulated albumen, for it emits, under a strong heat, the odour of burnt cheese or horn, and produces no greasy stain when rubbed on paper.

Scrofula manifests itself by unequivocal proofs both in the bodies of the vertebræ and the fibro-cartilaginous substance which is interposed between them. The former become more vascular, are softened by the partial absorption of their earthy and saline constituents, and afterwards receive a deposit of yellow, cheesy, or true tuberculous matter. These changes naturally lead to caries and destruction of the bone, which yields to the superincumbent weight; and the spine bends at an angle more or less acute according to the number of vertebræ which are diseased. The bend is in general directly forward; but when the sides of the vertebræ have suffered most, the curve is of course lateral. (*Brodie*, Opus cit. p. 289.) In the progress of this disease the soft parts around become affected, and collections of purulent matter form, which, passing down in front of the spine and along the course of the psoæ muscles, ultimately make their appearance under Poupart's ligament at the upper part of the thigh, and sometimes on both sides, nearly at the same time. On other occasions the matter points in the loins, or near the anus; and in some rare instances it has burst into the spinal canal, with an immediately fatal result.

When chronic disease has thus been producing such extensive disorganization in the osseous substance of the spinal column and in the soft parts around, it is not to be expected that the membranes of the spinal cord, the medullary substance itself, and the nerves which branch from it, should escape injury; accordingly we find that the first symptoms of caries of the spine are, a feeling of weight and aching in the part, itching and numbness, pains shooting round to the front of the trunk; and, when the disease is farther advanced, pains and twitchings of the limbs, succeeded by palsy of all the parts below the affected vertebræ, and of the sphincters of the bladder and rectum. The nervous symptoms are not always limited to the parts below the seat of the disease: in some cases we have pains of the arms, although the disease be situated in the middle dorsal vertebræ. (*Copland*, on Diseases of the Spine.) On inspecting the contents of the spinal canal, where death has occurred during the existence of caries of the bones, effusions of serum or plastic lymph are found between the osseous surface and the dura mater, and sometimes they are found firmly adherent; plastic lymph and pus are also discovered within the arachnoid, or the membranes are found glued together. Tuberculous deposits have been observed within the substance of the spinal dura mater, and between that membrane and the arachnoid; most commonly connected with scrofulous disease of the bones, but sometimes wholly independent of it. (*Ollivier*, De la Moelle Epinière, t. ii. pp. 760–764.) The medullary substance itself has in such cases been found softened or attenuated; sometimes entirely destroyed for a short space, and the vacuity filled up with a sanious pus.

When scrofulous disorganization of the bones has been effectually checked, it is astonishing to mark the efforts made by nature to repair the loss and support the fabric by new osseous growths: we have even occasionally seen them formed in the vicinity of the disease, even although its activity was still unabated.

Scrofulous affections of the spine often commence in the intervertebral substance, which becomes soft in the centre, and is then destroyed by ulceration and absorption; the disease afterwards extending to the bodies of the vertebræ. There is no reason to doubt that ulceration of the intervertebral substance is in most cases of a scrofulous nature; yet it must be admitted that tuberculous matter has very rarely been observed in this texture; partly, perhaps, because it has not often been carefully sought for. Andral states that he once met with a mass of tubercles within the substance of the intervertebral cartilages. (Précis d'Anat. Patholog. t. i. p. 424.)

Lateral curvature of the spine has been supposed by some writers to be in almost all cases produced by strumous disease of the bodies of the vertebræ. Certain it is that scrofulous individuals are most liable to lateral curvature of the spine; but this may with more propriety be ascribed to a general debility and relaxation of the

*Otto has found tubercle within the tissue of the periosteum. See Compend. of Pathol. Anat. translated by South, vol. i. p. 240.

frame, and of the muscular and ligamentous system in particular, than to any positive softening of the osseous texture. Were the bones softened from scrofula in every case of lateral curvature, how is it possible that so many cures should be effected, or that such multitudes of females should be met with in comparatively good health, yet having permanent lateral flexure of the spine? Scrofulous disease of bones in other cases requires powerful counter-irritation to check its progress; but in this form of spinal disease, rest in the horizontal posture, friction, a regulated exercise of the muscles, and attention to the general health, are sufficient, in a great majority of instances, to accomplish a cure. Lateral curvature of the spine not unfrequently precedes angular projection from caries: hence it has been inferred that the latter is but the second stage of the former disease: of this, however, there is no proof; nor is it at all unnatural that a feeble individual, whose spine sinks readily into a serpentine bend, should afterwards become the subject of a more formidable disease, affecting the bones themselves. The vertebræ after death, in cases of serpentine curvature, are most commonly found free from disease,* which would seem to show that scrofulous softening of the bones is rarely the cause or this deformity; for it is highly improbable that so great a change in the texture and form of the vertebræ should be repaired without leaving behind it some traces of its previous existence.

The serous membranes in different parts of the body often exhibit decided marks of scrofulous disease, myriads of minute tubercles or tuberculous granulations being found adhering to their surfaces or imbedded in their tissue; and sometimes enveloped in the false membranes connecting them, which have formed during inflammation. Thus the pleura, the arachnoid, the pia mater, the peritoneum, are frequently found affected with scrofula; and a few instances are recorded where tubercles have been observed in the pericardium. (*Baillie*, Morbid Anatomy, p. 9.) When this disease attacks the membranes of the brain, its symptoms are usually the same as those of acute hydrocephalus; and its termination takes place by effusion within the skull or spinal canal, to which sometimes is superadded softening of the medullary substance. The children of scrofulous parents are well known to be more prone than others to cephalic disease; and in this manner the whole offspring of such individuals are sometimes cut off in succession during infancy. When tuberculous disease affects the peritoneum, it seems, whether originally induced by inflammation or not, to produce, after a time, that state: dropsical effusion then follows. As the disease proceeds, the fluid is absorbed, and the opposite surfaces, loaded with tuberculous matter, become glued together, obliterating the cavity of the peritoneum, and fixing the floating viscera in their places. We have seen this disease in a boy of twelve years pervading the whole trunk, gluing the contiguous viscera to each other, to the parietes of the chest and abdomen, and to the diaphragm, filling up the anterior mediastinum, and presenting numerous white cheesy tumours within the substance of the viscera themselves. The heart alone was free from disease. A separation of the lowest part of the sternum, which was much softened, had taken place, and the point of the ensiform cartilage was directed forwards and upwards; a consequence apparently of the swelling of the abdomen, and the restraint imposed by the strong adhesions on the motions of the chest in respiration. Such cases are always complicated with scrofulous disease of the mesenteric glands, and usually with ulceration of the coats of the intestines, which have thus been perforated, allowing a free communication through the adherent sides of the contiguous tubes. In some cases it has appeared that the ulceration had commenced in the peritoneal surface; (*Gregory*, Lond. Med.-Chir. Trans. vol. ii. p. 269;) while in others the mucous lining of the bowel seems to have been the first eroded. (*Howship*, Practical Observations in Surgery and Morbid Anatomy, p. 269.) The same result will follow from both processes; but certainly the ulceration from within outwards is what we consider most likely to happen from the greater proneness of mucous membranes to that state.

The frequent occurrence of scrofula within the central organs of the nervous system has been satisfactorily ascertained. Wiseman, whose knowledge on this subject greatly surpassed that of most of his contemporaries, appears to have suspected the fact; but it was reserved for modern pathologists† to show how frequently tubercles are formed within the encephalon and spinal cord. Before the age of two years they are not common; but from this period onwards till puberty they are of frequent occurrence. Their most usual seat in the brain is the upper part of the hemispheres; and in the spinal cord they occur much oftener in the cervical than in the dorsal or lumbar portions: according to the most accurate observers, they are very often enclosed in cysts. (*Andral*, Précis d'Anat. Pathol. tom. ii. p. 841.) It is singularly deserving of notice that tubercles have been repeatedly found in the nervous centres where no symptom during life had induced any suspicion of their existence; and the scalpel has as frequently been unable to disclose any deviation from healthy texture in the substance immediately surrounding them.

The thyroid gland was long believed to be peculiarly subject to scrofula; and the chronic enlargement of that organ, named bronchocele, was at one period regarded by the best writers of their day as a distinctly scrofulous disease; (*Sennertus*, Medicina Practica.—*Laurentius*, Hist. Anat. corporis humani;) nay, it is remarkable that even in recent times the introduction of iodine as a general anti-strumous remedy originated in the supposed connection of bronchocele with scrofula. But on reviewing the history of the two diseases, we shall find so many points of difference as to convince us that they are altogether distinct and

* *Shaw*, Diseases of the Spine. We have lately examined a number of preparations with a view to this point, and the result fully corroborates the assertion of Mr. Shaw.

† *Leveillé*, Becherches sur les Tubercules du Cervau, 1824. *a thesis.*—*Gendrin*, Sur les Tubercules du Cervau et de la Moelle Epinière, 8vo.—*Ollivier*, Sur la Moelle Epinière.

independent. (See article Bronchocele.) In support of this opinion it may be sufficient here to state that bronchocele is of rare occurrence in the large manufacturing towns of Britain; while scrofula prevails throughout their population, cutting off thousands in infancy, and scattering among the survivors the germs of debility and protracted disease. The thyroid body, though rarely the seat of true scrofula, is not wholly exempt from it, more than one instance of its occurrence having come under our observation. The disease commences with a moderate degree of swelling, which is followed by the formation of a small indolent abscess: this after a time bursts spontaneously, discharging a thin pus mixed with curdy flakes; the apertures remain fistulous for a considerable time, while the tumefaction of the gland subsides.

The lungs have long been known to be particularly liable to scrofulous deposits; and so rare is it to find tubercle in any other situation without also finding it in the lungs, that Louis states he never met with an instance in all his numerous dissections excepting once, in the case of a man who had died of fever. (Recherches sur la Phthisie.) Scrofulous disease of the lungs constitutes what has been named tubercular phthisis; to the article on which, the reader is referred.

[Scrofulosis is very analogous to, although not identical perhaps with, tuberculosis. They both occur in persons who have like habits and general appearance; but there is this difference, as regards at least tuberculosis of the lungs, that it is most frequently developed after puberty,—the period when the tendency to scrofulosis is usually diminished or arrested. Moreover, scrofulous disease manifestly exists where there is no reason to believe in the existence of tuberculous matter. (*Scrofula, its Nature, Causes and Treatment*, by W. Tyler Smith, M. D. p. 6. Lond. 1844.) A person having scrofula, however, in early life, would seem to be more liable to tuberculosis at an after period. Some recent observers, however, argue strenuously for the identity between scrofulosis and tuberculosis. MM. Rilliet & Barthez (*Traité Clinique et Pratique des Maladies des Enfans*, iii. 5. Paris, 1843,) affirm, that having examined the bodies of a large number of scrofulous children, at the Hôpital St. Louis, they met with no instance in which tuberculous deposits did not exist in some part or other. Many affections, commonly termed scrofulous, as ophthalmia, they consider of a secondary nature, accidentally complicating the original scrofulous or tuberculous habit, but not essentially scrofulous in their nature. They propose to banish the term scrofula from medical nomenclature, as being vague and apt to mislead, and to substitute for it the term *tuberculization*. M. Bredow, of St. Petersburg, (*Ueber die Scrofelsucht*, Berlin, 1843,) seems to entertain a similar view; but he proposes to retain the word scrofula, to designate tuberculous disorganization of the lymphatic glands; and the terms tubercle and tuberculous disease for the same affection existing in other organs. (Dr. West, *Brit. & For. Med. Rev.* April 1844, p. 565.)]

The heart has been found affected with scrofula but rarely: Dr. Otto, (Compendium of Pathological Anatomy, translated by South, p. 290,) of Breslau, a very learned and able pathologist, never once met with a case of this sort; yet several cases of its occurrence are on record from Fabricius Hildanus, (Observ. Chirurg.) and Needham, (Wiseman's Surgery, vol. i. p. 404; at the apex of the heart,) down to Andral, (*Andral & Bayle*, Revue Méd. Franç. et Etr. 1821,) Lobstein,* and Macmichael.† Tubercle of the heart never occurs except when the system is strongly imbued with strumous disease; and its existence in this situation does not appear to have been indicated by any peculiar diagnostic symptom.

The occurrence of scrofulous disease in the voluntary muscles appears to be not less uncommon than in the heart: instances, however, have been met with of tuberculous deposits in these organs, both in the human subject and the monkey.‡

The effect of scrofula in modifying the symptoms of a large proportion of the diseases to which the human frame is subject, has been long known to medical observers, and meets us daily in the course of our practice. Inflammatory affections, in a particular manner, exhibit the effects of this influence; losing the acuteness of their character, and becoming tardy and indolent, difficult of cure, and requiring for its accomplishment the use of stimulants and tonics. Frequent and striking examples of these facts are presented to us by many of the early consequences of syphilitic infection, and by the extensive tribe of ophthalmic diseases. Injuries of the soft parts, particularly where there has been much loss of blood, also often afford unequivocal evidence of the presence of a strumous habit: hence it is common for persons who are jealous of the imputation of scrofula to declare that their wounds are always readily healed. So strong sometimes is the modifying power of scrofula, that the writer has known the stump of a strumous girl's arm, which was removed on account of an extensive laceration, to discharge distinct curdy matter at the second dressing.

Scrofula appears to possess a certain degree of connection with several other diseases. Some congenital affections, such as hare-lip, spina bifida, and external hydrocephalus, are more frequently met with among scrofulous children than others; and it is worthy of remark that in many cases of congenital peculiarity or defect, the same have been observed in ancestors, or near collateral relatives of the patients.

Of all the diseases allied to scrofula, perhaps the most closely connected is rickets, (see art. Rickets;) yet the distinction between the anatomical characters of the two diseases is sufficiently well marked. In rickets the whole texture of the bone is softened, though not exactly in the same manner in both species of that disease; but in scrofula, tuberculous matter is deposited in the can-

* Anat. Patholog. At the apex of the heart, as large as the point of the thumb, and apparently formed in the substance of a false membrane.

† Lond. Med. and Phys. Journal, 1826, p. 119. The tubercles in the heart were connected with others in the lungs; yet they may have been originally distinct.

‡ *Otto*, Opus cit. p. 252, in the sterno-mastoid of a girl —in the muscles of the neck and thigh of scrofulous monkeys.—*Laennec*, Auscult. Médiate, tom. i. p. 556. In the sterno-mastoid of a phthisical man. *Lombard*, Opus cit. Intercostal Muscles.—*Reynaud*, Archive Gén. de Médecine, tom. xxv. 1831, pp. 149. 301. This writer has given a very interesting account of the tuberculous affections, particularly phthisis, occurring in monkeys at the Jardin des Plantes.

cellous structure, the outer wall remaining entire, or becoming necrosed: or tubercle invades the bone from the periosteal surface, the osseous substance being removed by absorption. Encephaloid or medullary tumours may also be enumerated among the affections connected with scrofula; they occur chiefly in individuals of a strumous habit, and the materials of which they are composed bear, in their last stage of softening, a considerable similitude to those of tubercle.* There is a fungous tumour, occurring in the lips and cheeks of young scrofulous subjects, which we have repeatedly met with; in its external characters it bears a very close resemblance to encephaloid; but it is formed with much greater rapidity, and admits of cure by a well-directed alterative and purgative treatment, and the application of leeches, astringents, and escharotics. It is the opinion of some experienced practitioners, that carcinoma occurs more frequently in persons of a strumous constitution than others; and our own observation inclines us to entertain a similar belief. The concurrence of scrofula with urinary calculus has led to the supposition that the two diseases are intimately connected; but it does not appear that they are in any way dependent on each other: the same causes, however, are likely to induce both. (See art. CALCULOUS DISEASES.)

The greater sensitiveness of most scrofulous individuals renders them more prone to diseases of the nervous class: hence an aggravated form of hysteria is more frequent in such persons; and we think with Dr. Cheyne, that epilepsy affects strumous subjects oftener than others. (See EPILEPSY.) The diseases of the mind claim an alliance with scrofula, which has not attracted the attention of writers on this subject so much as it seems to merit. An eminent physician of great knowledge and experience in the treatment of insanity has stated to us his belief that more than one-half of those who are subject to mental derangement are of a scrofulous constitution, having some manifest indication of its existence in their persons. With the view of elucidating this subject, we examined all the paupers of a lunatic establishment. Of forty-four females, exactly one-half presented indurated or enlarged glands of the neck or throat, and several had extensive scrofulous cicatrices. Of forty-six males, twenty-eight had no decided symptoms of scrofula, though several of these had the strumous aspect; sixteen presented the marks already mentioned in reference to the females; and two belonged to families known to be afflicted with scrofula in an aggravated form. All of these ninety lunatics were adults, and not one of them exhibited any active symptoms of scrofulous disease. It has been remarked to the writer by the physician already referred to, that he has often observed active scrofulous symptoms to alternate with attacks of mania. In several cases he has known the purulent expectoration of phthisis to cease during the urgent symptoms of insanity; and, on the other hand, reason has been seen to return before the pulmonary disease proved fatal—soothing the feelings of affectionate relatives, and shedding a calm over the last days of the consumptive lunatic. In accordance with what has just been stated, the severity of the symptoms of scrofula does not appear to promote the development of mental disease, but rather to impede it; for in families eminently scrofulous, we have sometimes observed the individual least afflicted with that malady to be the victim of insanity; while those who suffered most from scrofula possessed sound minds; as if the local irritation, or the drain from the body afforded some protection against mental derangement. It has often been remarked by medical writers, and the observation of every physician must confirm the accuracy of the statement, that precocity of mental development, and superior genius, are in a great majority of instances the accompaniment of the scrofulous constitution.

Causes.—In considering the causes of a disease so deeply rooted in the constitution as scrofula is universally acknowledged to be, it is necessary to direct our attention to circumstances very remote in the history of those who are its subjects. The foundation of a scrofulous habit is frequently laid during the fœtal state, by the transmission of that peculiar organization of the frame from parents who themselves possess it. Nothing, indeed, can be better established as the result of general observation than the hereditary nature of scrofula. This peculiarity of constitution may also be communicated to the fœtus by some defect of energy in one or both of the parents, arising from extreme youth, or very advanced years, or great disparity of age, or that premature decay which is induced by a life of dissipation, or the debilitated states resulting from protracted illness; or, on the part of the mother, repeated miscarriages, and by defective nourishment and other similar causes. Various occurrences, likewise, may take place during gestation—such as accidents, frights, prolonged disease, mental distress,—which interfere with the proper development and growth of the embryo, and entail upon the child that feebleness of constitution which, if not identical with scrofula, leads to its appearance on the application of causes not adequate under other circumstances to produce that disease. The writer was recently called upon to examine a boy of six years, labouring under a complication of scrofulous ailments; the history of whose case may serve to illustrate the influence of injuries received by the mother during gestation. In this instance the mother was a tall and rather slender woman, apparently enjoying good health; the boy was puny for his age, his movements were quick and restless, his articulation very imperfect, and his mind in a state approaching to idiotcy: the lips were seamed with the scars of former ulcers, the conjunctivæ relaxed and injected, the tarsi inflamed, ulcerated and almost without cilia; the countenance pale and bloated; the skin dry and scaly; many of his teeth were gone, and most of those which remained were in a state of decay; the cervical glands were indurated, but not much enlarged. The last phalanx of one thumb was double, and each extremity of the fork had a perfect nail. He had always been a very sickly child, had had repeated suppurations in the groins, and was then labouring

*The earliest distinct account of encephaloid as it affects the extremities, is to be found in Ruysch, Observat. Anatomico-Chirurgic. No. 81, where he describes it under the title of the spongy or ossivorous tumour, and states that it was known to the Germans under the name of *schwamm*, and to the Dutch under that of *been eter*.

under chronic diarrhœa, part of his food passing undigested. During the time that his mother was pregnant with him she had suffered many severe falls, the first towards the end of the third month.

Scrofula is also observed to originate in the healthy offspring of healthy parents under certain circumstances, the principal of which are habitual exposure to cold and damp, privation of free air and light, and want of healthful exercise. Instances are recorded where persons previously in good health have been affected with scrofula after being confined in the dungeons of a prison, and there scantily fed. (*Pinel*, Nosog. Philos. t. iii. pp. 380, 385.) The influence of such causes in producing tuberculous disease in the inferior animals has been made the subject of experiment by Dr. Jenner, (*Jenner*, in Beddoes on the Med. Use of factit. Airs), Dr. Baron, (Delineations, &c., pp. 25 et seq.,) and others; and the results have satisfactorily shown both the great extent of that influence, and the power which we possess of removing the factitious disease by replacing the animals in healthy situations, and supplying them abundantly with wholesome food. The operation of cold and damp, as causes of scrofula, is greatly augmented even by a slight local injury.

A moist, cold, and variable climate, like those of Great Britain and Holland, is particularly favourable to the development of scrofula; in proof of which it is sufficient to adduce the great prevalence of the malady in both of those countries. A very cold or a hot climate, on the other hand, serves rather to protect us against scrofula; the former, dry and bracing, invites to exercise and promotes digestion, and thus strengthens the system; while the latter favours the excretions, particularly that of the skin, and preserves the body from those sudden changes of temperature which in our island so often lay the foundations of scrofulous affections. But when an individual whose constitution has been formed in a warm climate is removed to a cold and variable one, the occurrence of scrofula is exceedingly frequent; convincing proofs of which are every day afforded by those natives of warm climates who reside in our island, as well as by the diseases of birds, monkeys, and other animals which have been brought to us from warmer latitudes. (See *Reynaud*, on the Diseases of Monkeys at the Jardin des Plantes. Archives Gén. de Méd. t. 25.) Indeed it is not necessary for the inhabitants of warm climates to leave their native countries to experience the effects of a cold and variable atmosphere in the production of scrofulous disease: it is sufficient for them to ascend their own mountains, when they will be exposed to the same influences, and suffer the same evil consequences as if they had removed to a more northern climate.* The information communicated by Dr. Ferguson regarding the diseases of the black troops in different situations in the West Indian islands, illustrates this point in a very interesting and satisfactory manner. (*Alison*, in Edin. Medico-Chir. Trans. vol. i. p. 398.)

* In every latitude there is a point of elevation above the plains where the thermometer never sinks below 32° Fah. Even at the equator this exists at a height of 15,207 feet. See Suppl. to Encycl. Brit. art. *Climate*; also *Humboldt*, Geography of Plants.

Among the causes which appear to give rise to scrofula in children, are the practices of rearing them by the hand and suckling them too long—two extremes, both of which often lead to the same result, the imperfect nourishment of the child. The former of these is a fruitful source of scrofula in England, the latter in Scotland, where it is usual among the labouring classes for children of sixteen and eighteen months to be still at the breast: in some instances we have known them suckled for upwards of two years. A similar injurious effect will be produced by allowing the same wet-nurse to suckle several children in succession, which we have known to be pursued as far as three, when debility and symptomatic amaurosis forced the woman to resign her charge. Imperfect nourishment of the child, and consequent tendency to scrofula, is also likely to be induced in those cases where the wet nurse menstruates regularly during lactation. It is an opinion professed by Wiseman and other writers of great ability and experience, that a scrofulous wet-nurse may occasion the disease to appear in the child to whom she gives the breast; and the idea appears consistent with reason, not on account of the existence of any scrofulous poison, capable of being imbibed by the infant, but because it is natural to suppose that the milk of a scrofulous female will not afford the same substantial nourishment as that of a woman in sound and vigorous health.

[When a close investigation is made, it will be seen, that infants of the scrofulous habit display evidences of imperfect formation—Dr. Stokes says—of arrest of development. Their development resembles, in some respects, that of the fœtus prior to the seventh month of intra-uterine existence: the abdomen is prominent; the liver large; the head large; and the extremities small. The writer has always entertained the view, that the condition of the system is such as to require an increase of the plastic powers; and a radical error appears to him to have been incurred by those who apply to all scrofulous inflammations the rigid system of regimen and therapeutics which are adapted for ordinary phlegmasiæ. These views have been strengthened by the observations of recent histologists. It has been remarked by Gerber, (*General Anatomy*, by Gulliver, London, 1842,) that "albuminous or unorganized tubercles (which with great propriety are called scrofulous tubercles,) can only be produced from exudations abounding in albumen, poor in fibrin," and such exudations, it need scarcely be said, are more likely to take place from blood itself defective in the fibrinous or essentially plastic element.]

Another case of this disease is confinement in ill-ventilated apartments; for the deficiency of pure atmospheric air cannot be long endured, especially during youth, without the most injurious consequences. While the frame is building up and the constitution acquiring that character which is to distinguish it through life, all the processes of the economy are peculiarly active, and any defect of what is to perfect the animal fluids and give energy to the nervous power, is felt with greater force, and is productive of much more injury than at an after period. Ill-aired apartments are in general imperfectly light, and the want of this vivifying influence of light favours

the formation and development of scrofula; for the human body requires a certain exposure to light for the proper performance of its function, little less perhaps than plants, although in them the loss of colour renders the effects of seclusion more strikingly manifest. The experiments of Edwards on the spawn of frogs and on tadpoles clearly demonstrate the agency of light on the formative processes of living organization. He found when the light was excluded that the eggs were never fully hatched, and that tadpoles did not undergo their transformation at all, or did so after a considerable delay; but their size increased, although they were kept in darkness. (De l'Influence des Agens Physiques sur la Vie, p. 398 et seq.) In accordance with the results of these experiments, it has been observed that monstrous births are exceedingly frequent among the miserable occupants of the dungeons under the fortifications of Lille. (London Medical Gazette, Sep. 29, 1832.) We may in part ascribe to the deficiency of light the prevalence of scrofula among the inhabitants of cellars and of narrow alleys, where the beams of the sun never gain admittance. We are even inclined to think that the custom now so general among the wealthier classes in this country of sitting in darkened rooms during the day is far from being conducive to vigorous health; and where the young are concerned, we do not hesitate to say that it must be injurious. It is a custom borrowed from the luxury and effeminacy of warmer latitudes, and one which is calculated to enervate the body and induce a tendency to strumous disease.

In a great metropolis like London, where the moving crowds of human beings and the number of carriages are such that children cannot be allowed to go abroad in the streets, they grow up feeble and often scrofulous; while in villages and even in some populous towns, where they are almost constantly at play in the open air, they prove healthy and vigorous. The mischievous effects of the want of air, and sun-light, and healthful exercise, may be seen among the rich as well as the poor, though not to the same extent. The confinement, mental fatigue, and anxiety to which female children in particular are so unremittingly subjected during their education, prove fertile sources of scrofula in boarding-schools, and even in the families of the higher classes: bodily health is too often sacrificed to the idol of accomplishment, and the intellectual powers, perhaps originally of excellent quality, are forced into a state of extreme culture and morbid precocity, destructive of all genuine soundness and vigour.

Acute diseases, especially those accompanied with cutaneous eruptions, as small-pox, measles, and scarlet-fever, are often observed to have the effect of producing the development of scrofula; and the more tedious the convalescence, the more frequently do symptoms of this disease ensue. Various other causes of debility prove the means of developing scrofula — as long watching, protracted anxiety of mind, severe study, especially in the young, habits of dissipation, excess in sexual indulgences, solitary vice, profuse discharges of all kinds, repeated syphilitic disease; the abuse of mercury, of narcotics, of warm bathing, and of powerful evacuants. Different local irritations have the effect of causing the neighbouring lymphatic glands to swell, and where a strumous tendency exists, to become the seats of tuberculous deposits, as we see exemplified in the consequences of difficult dentition, and of the inflammatory affections of the mucous membranes of the respiratory and alimentary canals. Too great indulgence in sleep has been enumerated among the causes of scrofula, and excess in this particular will certainly debilitate and thus dispose to the disease; but we are inclined to believe that the indulgence in sleep which appears to induce scrofula is, in fact, usually occasioned by that feeling of weakness and exhaustion which is among the earliest symptoms of the approaching development of the disease.

[**Nature.**—The pathology of scrofula, and the definition of the term, are differently expressed by different authors. Some define it to consist essentially of inflammation of the lymphatic ganglions, especially of those of the neck. This acceptation, however, is too incomprehensive, and expresses but imperfectly the grand characters of the disease. Although inflammation of the ganglions, and chiefly of the cervical, is very common in scrofulosis, it is often absent; and it can only be regarded as a functional expression of the morbid diathesis. The disease, as has been shown, often expresses itself elsewhere, as in coxalgia, white swelling, vertebral caries, &c. &c. Scrofulosis is a morbid condition of the whole system of nutrition; and hence, ought to be classed amongst the cachexiæ—the inflammation and enlargement of glands, like the eruption in variola, rubeola, &c. being merely attendant phenomena. The lymphatic ganglions are liable to simple inflammation from ordinary irritation. A thorn, run into the finger, may cause enlargement of the ganglions in the axilla; inflammation or irritation of the mucous membrane of the intestines may give rise to mesenteric ganglionitis, owing to the extension of the irritation to the lymphatic ganglions that are seated between the irritated part and the centre of the lymphatic system. In like manner, nutritive irritation, occurring in one of a scrofulous diathesis, may occasion inflammation of the same glands; but, being general in its influence, scrofulosis may express itself in various other forms besides ganglionitis. With some, it has been a question, whether it be not dependent upon a morbid state of the blood. This is not probable, inasmuch as the disease, or rather a tendency to it, must exist prior even to the formation of blood. An impulse to it must be present in the materials furnished by one or both parents at a fecundating copulation; which impulse may persist and be developed at an after period of the individual's existence. This tendency may not be received in sufficient force from the parents to be developed in their immediate progeny; but, like facial resemblances, may be strongly exhibited in the grandchildren. Some writers, among whom is Dr. Stokes, (*Lectures on the Theory and Practice of Physic*, 1st Amer. edit. p. 311, Philad. 1837,) place scrofulosis in the system of white vessels; in which, according to them, the lymphatics execute the function of veins. This view, however, implies a something which probably has no existence—*white* blood. The want of colour in cer-

tain of the tissues, as in the conjunctiva and serous membranes, is probably due to the thin stratum of *red* blood circulating in their vessels, which renders the colour inappreciable. A very thin stratum of any coloured liquid, viewed by transmitted light, appears to be colourless; but if the quantity of liquid be increased, the colour becomes manifest. This is what occurs in inflammation of the white tissues: the quantity of red blood in the vessels is increased sufficiently to render its colour perceptible—not that there is an enlargement of arteries, destined in health to convey white blood, so that they now admit red corpuscles, as supposed by some. There would, in fact, seem to be no white arteries, and, consequently, no white veins. Were such vessels to exist, they would be liable to constant obstruction from the red corpuscles. The function executed by the lymphatics would seem to be to break down the old tissues and convert them into lymph—a fluid essentially the same in every part of the lymphatic system—which eventually enters the circulation. They are engaged in the great process of assimilation, or in the decomposition and renovation of the tissues. Scrofulosis, then, must be regarded as a peculiar morbid condition of the whole system of nutrition.]

Treatment.—The treatment of scrofula naturally divides itself into the preventive and curative, the former of which is the more generally successful, and obviously the more important. All children are liable to become scrofulous, and those more especially whose parents or near relatives are the subjects of this disease. Hence particular attention is required to prevent the formation of the strumous constitution in children, and the development of the disease in those who may from birth be marked by this peculiarity of organization. Indeed, it will not be undeserving of our care to influence as far as we can the sound and perfect formation of the embryo, by more than ordinary attention to the health of the mother during her pregnancy, wherever there is reason to apprehend the existence of a scrofulous disposition.

When the child of a scrofulous father is born, the infant, unless the mother is free from all traces of the disease, ought to be consigned to a wet-nurse of sound and robust constitution, having an abundant supply of milk. This alone ought, for some months, to be sufficient for the nourishment of the child; but after a time, should it appear delicate, a little isinglas jelly may be allowed in addition, or liquid yolk of egg, or beef-tea, together with some preparation of wheaten meal or flour, or pure starch. Daily immersion in cold water, and gentle friction of the whole body will be found of great utility. The child ought to be warmly clothed, to be carried about in the open air as much as possible, and the apartment in which it sleeps ought to be kept at a steady moderate temperature, and perfectly well ventilated. All rooms occupied as nurseries for children ought to be spacious and lofty, never situated in a sunk floor nor in an attic, and, if possible, considerably above the level of the ground—directions which will be readily understood, when it is recollected that low rooms are ill ventilated and often damp, while those in the attic story are particularly liable to variations of temperature.

As the child grows up, a similar plan of management will be found to avert, as far as it can be accomplished, the formation of a scrofulous habit, and the development of the disease in those who exhibit that tendency. A plain and nutritious diet, containing a larger than usual proportion of animal food, warm clothing, daily exercise in the open air, the cold plunge-bath, cool and well-ventilated rooms, moderation in the pursuits of pleasure, of study, and of business; strict temperance and virtuous habits; may be said to comprise all that is most likely in our mode of living to give protection throughout life against the occurrence of scrofulous disease. To those in affluent circumstances who can be removed to a climate more genial than that of Britain, such a change, if judiciously made in early life, will confer a still greater security from scrofula. (*Dr. James Clark*, On the influence of Climate. See also art. CLIMATE, in this work.)

When a well-marked strumous tendency exists, the management of the mind urgently demands our attention; and attempts ought to be made at a very early age to correct whatever is deficient or excessive in its operations. Children who are of a dull and apathetic character ought to be roused by presenting to them objects which are likely to interest and enliven, while the ardour of others in the pursuit of knowledge should be cautiously repressed; and when the genius gives promise of unnatural precocity, means should be used to retard the unfolding of the mind, and allow the faculties to mature themselves by slow degrees. The moral feelings, in an especial manner, require a strict control for the purpose of giving them a just direction, and preserving individuals of a sensitive character from indulging in those extravagant manifestations of sensibility which, if permitted, are apt to endanger the soundness of the mind.

Before proceeding to consider the cure of scrofula, it will be necessary to direct our attention to the different conditions of those who are afflicted with this disease. It is frequently engrafted on a feeble and attenuated frame; but it exists also in combination with a plethoric habit, perhaps deceiving with a false show of strength; the first of these forms being often exemplified among the poor, the second among the rich, although not by any means uniformly so. Hence a broad line of distinction arises between the methods of treatment adapted to such different types of the disease. In the former a generous diet and stimulating remedies are required; in the latter spare living, moderate evacuants, and local depletion are necessary: both, however, demand the employment of those tonic means which tend to communicate vigour to the constitution, and which increases that power of resisting the occasional causes of disease and repairing the injuries of the frame; a power which it is the remarkable characteristic of the scrofulous constitution to be devoid of, or to possess in a very imperfect degree.

To consider in detail, the method of treating each of the extensive class of strumous affections would involve us in the repetition of what will be found under various specific heads of disease, and swell the present article far beyond its due limits. It will be sufficient, after premising a few general

remarks, to pass in review the chief of the numerous remedies which have been held in estimation for the cure of scrofula; pointing out, as we proceed, the particular circumstances under which they have appeared to produce most benefit.

The management of scrofulous patients, in respect of air, exercise, clothing, and diet, must be conducted upon the principles already laid down, but varied according to the exigencies of each individual case, still keeping steadily in view the improvement of the constitution.

On the subject of diet it is deserving of notice that, besides those varieties before alluded to, a very nourishing food may be prepared by boiling a small bag filled with suet in cow's milk. We have made trial of it on the recommendation of Dr. Paris, (On Diet, 2d edit.,) and found it to answer remarkably well in cases of scrofulous marasmus when almost every other article of diet caused irritation of the bowels, and passed through undigested. It bears a near resemblance to goat's milk, but has the advantage of being more astringent.

Some eminent writers have not hesitated to state their belief that air, exercise, and proper clothing and diet, comprise the best and only method of controlling and removing scrofula. To such an opinion we cannot subscribe, although we fully acknowledge the vast importance of attending to these particulars, and the natural progress of cases of external scrofula towards a cure, after the age of puberty. An amusing instance of the effect of air and exercise alone in the cure of a scrofulous sore in the leg is afforded by the case of a young nobleman, who, after suffering under a variety of regular treatment, had a hole cut in his stocking, and was sent to range the fields, when a crust soon formed, and the ulcer healed. It is worthy of remark that this individual became afterwards insane.

1. *Evacuants.* — Although it be true, in a general sense, that scrofula is a disease of debility rather than of strength, and that profuse discharges, whether natural or artificial, prove among the most powerful of its exciting causes; yet in the early stage of many scrofulous diseases, and sometimes during their progress, a cautious employment of evacuants is found to be productive of the best effects; but it is only by a careful study of the existing symptoms of inflammation in each individual case that we are enabled to make use of depletory means with confidence and success. In strumous persons the occurrence of inflammatory symptoms is to be watched with unceasing care, and above all those of the respiratory mucous membrane, as well as of the serous membranes of the head and abdomen: a well-timed venesection in such cases may be the means of cutting short symptoms which would speedily induce the eruption of a crop of tubercles; on the fatal consequences of which, whether slow or rapid in their progress, it is unnecessary to enlarge. Leeches are often preferred from the timidity of patients and their friends, and sometimes perhaps from the indolence of medical attendants; but their effects are frequently irritating and exhausting, and, even in children, far inferior to those of the lancet. Cupping is also preferable to leeching, the ease and rapidity with which blood can be taken by this method placing it nearly on a level with venesection. The detraction of blood from the vicinity of parts suffering from scrofula, or in danger of becoming the seats of scrofulous affections, is in very many cases necessary; and in these both leeches and cupping may be employed, but under the guidance of a wise discretion, for which no general rules can be given. To promote the efficacy of sanguineous depletion, and supply its place when circumstances render it unsuitable, the tartrate of antimony may be exhibited in small doses, as a nauseant and diaphoretic; and it will sometimes be necessary to have recourse to this remedy during the progress of the tonic plan of treatment when it appears, as often happens, to be producing too much excitement. The tartrate of antimony or ipecacuan is also used, with excellent effects, in emetic doses, for the purpose of preparing the stomach for the reception of tonic medicines in many scrofulous cases.

Long-continued nausea, whether produced by sea-sickness or by the persevering use of tartar-emetic, has a powerful effect in dispersing indolent tumours, and has been successfully employed for that purpose. Two cases of this nature, and one of presumed tuberculous phthisis, cured by the use of nauseants, have been communicated by Dr. Jenner; and he has expressed a hope that by such remedies we shall be enabled to affect the absorption of tubercles. (Baron's Inquiry, pp. 158, et seq.) All that we know of the action of the absorbents leads us to believe that they are capable of removing tubercles; and that such an operation, to a certain extent, does really take place, is proved by the changes which that substance undergoes in its progress to the cretaceous transformation. If tuberculous masses of long standing are thus changed, what reason have we to doubt that the soft curdy matter of which they are at first composed is often absorbed and carried back into the circulation, to be converted into some less noxious constituent, or altogether expelled from the system?

The action of strong purgatives is sometimes, though rarely, required in scrofulous diseases; but the neutral salts combined with the administration of mercurials are very useful, as we shall presently point out. Moderate aperients, and those which tend at the same time to improve the powers of digestion, are required in the treatment of almost all scrofulous cases. Rhubarb and soda, and rhubarb and magnesia are well adapted to such cases; and as a mild evacuant, when the bowels are loaded, castor oil is very serviceable.

2. *Mercurials.*—Of all the remedies employed in the treatment of scrofula, perhaps none have enjoyed a greater reputation than mercurials; but it is only from their purgative and alterative effects that they prove beneficial, and not when they produce that powerful influence on the frame which so rarely fails to ensue from their free exhibition. In the forms of calomel and blue-pill, mercury enables us to relieve the bowels from those morbid accumulations which are so apt to collect in strumous cases, and to restore to the liver its healthy action, which is rarely preserved, at least for any length of time, during the existence of scrofula. The success of a mild alterative plan of treatment,

aided by the use of saline purgatives with senna, has been admirably illustrated by Mr. Abernethy (On the Constitutional Origin of local Diseases); and more exclusively in reference to the disease now before us by Mr. Lloyd. (On Scrofula.) Other mercurial preparations are also employed with benefit in different forms of scrofula: thus the hydrargyrum cum cretâ will be found very serviceable when the secretion of bile is faulty or deficient, whether combined with a torpid or relaxed state of the bowels, as in the early stages of mesenteric disease. The internal use of corrosive sublimate is also valuable, particularly in scrofulous ulcerations and leucorrhœal discharge; provided it be administered cautiously and in minute doses such as the eighth of a grain three times daily. It seems to act rather by stimulating the mucous membrane of the alimentary passages, and promoting perspiration, than by any influence it exerts over the secretion of the liver. Mercury has likewise been employed in the form of ointment, rubbed on the skin for the relief of scrofula, and, according to the report of Mr. Brandish (On the Use of Caustic Alkali in Scrofula, &c.), with the most beneficial effects. It was his practice to use it in small quantities, continued nightly for months, but never during the cold season; it is proper to add that he avoided the full operation of the mineral, and combined its employment with the internal exhibition of liquor potassæ, with a generous diet, and the occasional use of vegetable tonics. Of this practice in cautious and experienced hands, we are inclined to think favourably, although it must be admitted that medical opinion in the present day is adverse to the employment of mercurial frictions in scrofulous cases generally. But the local application of camphorated mercurial ointment to diseased joints and indurated testicles is now acknowledged to be in very many instances highly efficacious. (*Scott*, Observations on the Treatment of Chronic Inflammation, &c.)

As a sequel to the subject of mercurials, it will not be out of place to mention another remedy, less hazardous in its operation, but not of less approved efficacy in scrofula,—namely, *sarsaparilla*. We find it recommended by Wiseman (Vol. i. pp. 410 et seq), and after a period of neglect it has been again restored to merited favour. It is a mild tonic, and well adapted to those cases where the skin is in a harsh and unkindly state: it proves a restorative to the stomach, and is found very useful in the chronic diarrhœa of strumous children. The decoction is the usual form in which this drug is exhibited, but the bulk of this preparation often renders it objectionable, particularly for children; and in most cases, both of children and adults, a much more concentrated preparation, such as the solid or fluid extract, will be found to possess many advantages. Powdered sarsaparilla, conjoined with soda, is an excellent form, though much less palatable than the extracts: it has been given with marked benefit in scrofulous disease of the tongue.

A feeble digestion, and prevailing acid condition of the stomach and alimentary tube, are the frequent concomitants of scrofulous disease; hence the employment of the *alkalies* and alkaline earths, but particularly the former, has been attended with very beneficial effects in its treatment. All the alkalies have been used with advantage in scrofula; but the liquor potassæ is that which in our hands has proved the most decidedly useful. The dose must be large, as Mr. Brandish has shown—from half a drachm to a drachm and a half three times daily, for an adult; given in malt tea, mild ale, or infusion of hops. (*Brandish*, Op. cit.) Carbonate of soda is generally more agreeable to patients, and may be given freely with good effect, especially when combined with sarsaparilla, cinchona, or bitters. The volatile alkali (carbonate of ammonia) has also been administered in scrofulous cases (*Charles Armstrong*, on Scrofula), and with excellent results. But its stimulant and diaphoretic properties render it suitable only for cases in which there exist torpor, languid circulation, impaired appetite, and a dry husky state of the skin, such as we often meet with among the poor, and in that form of the disease so well characterized by Alibert (Nosologie Naturelle), under the designation of *scrofule nomie*.

A considerable number of the remedies which have enjoyed reputation in the treatment of scrofula, have belonged to that class which increase the secretion of urine. The alkalies which we have just considered are of this description; and besides these, we may enumerate the muriate of lime, the muriate of barytes, and nearly all the mineral waters to which scrofulous patients are in the habit of resorting. These saline remedies not only promote the secretion of urine, bnt act gently on the bowels, and thus, especially when conjoined with the exercise and free air enjoyed at a watering-place, increase in a remarkable degree the powers of digestion, and so prove beneficial to the scrofulous invalid. In their specific effects we have no confidence. Muriate of barytes is now very rarely prescribed; and muriate of lime almost as seldom, excepting in the combined form in which it is furnished by nature at various mineral springs.

The opinions which we have already expressed regarding the nature of scrofula may have prepared our readers to look for the most valuable remedies in this disease under the head of *tonics*. Even inflammation, which in most cases requires depletory measures, is, when combined with scrofula, and thus rendered indolent in character, often successfully treated by tonic remedies; this is especially true of those inflammatory affections which are attended with little or no constitutional disturbance, as in strumous inflammation of the conjunctiva, where the efficacy of cinchona has so long been acknowledged. This admirable drug is, without doubt, the most efficacious of all the tonics used in scrofula, and, from the concentrated form in which it can now be exhibited, the most generally available. The virtues of cinchona in strumous diseases were first brought into notice by Dr. Fordyce, (Medical Obs. and Enquiries, vol. i. p. 184; see also *Fothergill*, ibid. p. 303,) and from that time until now it has enjoyed more or less favour. Sulphate of quinia has now very generally superseded it, having become a remedy of every day prescription. It is one, however, which requires to be carefully watched and immediately intermitted when it produces, as it often does, a degree of feverishness. Other vegetable tonics and bitters have been administered with

advantage in scrofula, such as calumba, gentian, and hop; and in Germany, coffee made from roasted acorns has found many advocates, although, as Benedict (Handbuch der Practish. Augenheilkunde) informs us, it often proves constipating and induces a feverish state.

[Of late, different preparations of the leaves of *Juglans Regia*, walnut tree, and especially the extract, have been highly extolled by M. Négrier as anti-scrofulous remedies. (*Archiv. Général. de Méd.* x. 399, Paris, 1841.)]

Of the metallic tonics used in scrofula, iron is that which has been found the most beneficial. The best forms of exhibiting it are the vinum ferri, the muriated tincture, and the subcarbonate in powder: the chalybeate mineral waters also have often proved eminently serviceable in this disease.

Arsenic is a metal of much more questionable efficacy; but we have known it productive of great benefit in allaying the pain attending strumous affections of the bones and periosteum. Gold was given by Lalouette in scrofula, and its use has lately been revived by Chrestien as a remedy for syphilis. [From recent trials, it would not seem to be possessed of such efficacy as to recommend it to great confidence.]

In the advanced stages of scrofulous affections, one of the most permanent and exhausting symptoms is profuse perspiration; for the purpose of checking which, the mineral acids, particularly the sulphuric and nitric, have been given with great benefit: their use, however, is apt to cause irritation of the bowels, and thus we are forced to alternate them with opium, or altogether to abandon their employment. The root of the tormentil has been recommended as a substitute, but it seems to possess very feeble powers of repressing either perspiration or diarrhœa. The mineral acids are also useful in restoring the tone of the stomach, and thus they frequently prove of great service in the treatment of scrofula.

Scrofula as a chronic disease, often accompanied with febrile action of the stomach, and indeed, of all the assimilative organs of the system, seems naturally to require the exhibition of stimulating remedies. In regard to dietetic stimulants, animal food, as we have already stated, is proper in a large proportion of strumous cases, and in some ale and wine may be given with great advantage. Of these, ale is the more nutritious and less heating, and when sound and well seasoned with hops, it proves in many cases a valuable auxiliary to the medicinal treatment of scrofula,—an opinion which is not given on theoretical grounds, or the mere authority of others, but from what we have had frequent occasion to observe. Bitter tinctures have been prescribed in this disease, and that of Peyrhile, which contains also a proportion of alkali, was long a favourite among the French. Its effects, however, are known to have been often injurious, because too stimulating; and in the present day it is seldom or never employed.

Iodine, a powerful stimulant of the alimentary mucous membrane, and of the whole absorbent system, has lately been added to the catalogue of anti-strumous remedies; and as yet it can scarcely be said that a just estimate has been formed of its real virtues. The evidence contained in the writings of numerous authors, and the results of our own experience, prove satisfactorily that iodine possesses a very considerable efficacy in removing scrofulous swellings of the lymphatic glands; and there is some reason even to believe that it is capable also of inducing the absorption of tuberculous deposits. (*Gairdner*, On Iodine, pp. 52 & seq.; also, Baron's Inquiry.) This remedy is successfully employed both internally and locally, in each of which modes it increases the action of the absorbents; and in the latter it likewise often induces suppuration of strumous tumours, and thus hastens their removal. After attracting for a time the attention of the medical profession, iodine was beginning to experience a degree of neglect, when the appearance of M. Lugol's Memoirs restored its reputation. (*Lugol*, Mémoires sur l'Iode, Paris, 1829, 1830; and Dr. O'Shaughnessy's Translation, with Appendix.) His extensive series of experiments in the employment of this substance have placed in a very clear and convincing light the powers which it possesses of controlling and even curing scrofula. The trials which we have made of it serve to confirm the representations of M. Lugol; but we are ready to admit that his strong partiality in its favour may in some instances, perhaps, have led him a little beyond the limits of legitimate induction. For farther information regarding the employment of iodine in scrofula, we beg to refer to M. Lugol's last memoir, where a full account will be found of his most improved method of administering this powerful drug. Iodine, like arsenic and some of the mercurial preparations, is apt to cause pain of stomach, and in some instances headach; and when taken in excess, to produce an inflammatory condition of the alimentary mucous membrane, diarrhœa, and even bloody motions. The first of these symptoms is relieved by wine of cinchona, but the others require that the remedy be discontinued; and when resumed, that the dose be reduced. In cases where iodine has produced debility and loss of appetite while manifestly reducing the scrofulous swellings, we have obtained a return of health and continued diminution of the tumours, by administering in its place sulphate of quinia with extract of sarsaparilla and aromatic sulphuric acid. The evidence of many practitioners, whose veracity and correctness of observation are above suspicion, proves that iodine, when long continued in full doses, frequently produces great weakness and emaciation; but M. Lugol is disposed to throw doubt on this opinion, and he even asserts that in his experience, thin females have not become emaciated, nor corpulent ones lost flesh. It ought to be remarked in explanation of this discrepancy, that the doses which he prescribes are usually small, always moderate, and much diluted; and that he endeavours to accomplish by long perseverance what others have attempted by rapidly pushing the remedy to its utmost limit. In these particulars, we conceive, consists the superiority of M. Lugol's mode of treatment. It is proper to state here, that he also avails himself in the treatment of scrofula, of the auxiliary means of air, exercise, warm clothing, and good diet; and employs, besides, baths of watery vapour, of iodine, and of sulphureous water.

[The general condition of the system in scrofulosis might appear to suggest more especially the iodide of iron, in which eutrophic and tonic properties are combined. Accordingly, it has been extensively used, and with valuable results. Of this, a grain may be given three times a day, and the dose may be gradually raised to three grains.

Codliver oil—*oleum jecoris aselli*—which has been found to contain iodine, has been given largely in various forms of scrofulosis, and there is much testimony in favour of it. One writer, Schenck, (Hufeland's *Journal der Praktisch. Heil kunde*, May, 1838,) esteems it as certain a remedy in scrofula and rickets, as cinchona is in intermittent fever. The writer has had no experience with it. Recently, skateliver oil has been recommended as preferable to codliver oil. In Holland and Belgium, the oils obtained from the livers of *Raia clavata* and *R. batis* have been used in place of the latter, on account of their being less disagreeable to the taste, and even more efficacious as a therapeutical agent. It is said by MM. Girardin and Preisser to contain a per centage more of iodide of potassium; and in point of purity and other properties, appeared to be superior to it. (*Edinb. Med. and Surg. Journ.*, Oct. 1842, p. 504.)

Dr. Ure has suggested the use of codliver as a diet for those for whom the oil is considered to be indicated. (*Pharmaceutical Journ.*, Nov. 1, 1842, or Braithwaite's *Retrospect*, vi. 104, Lond. 1843.)

Bromine, whose properties resemble those of iodine, has been given in the same cases, but it possesses no advantage over the other, and is by no means as easily attainable.]

The use of *baths* in the treatment of strumous affections is of great value, the kind of bath made choice of being determined by the existing state of the patient. Sudden immersion in cold water, and especially sea-water, has long been an approved remedy in scrofula; but when the strength of the patient is so reduced that no kindly glow follows, and when there is decided feverishness, the cold plunge bath is not admissible. In such cases the warm-water bath, and still more that of vapour, will be found highly soothing and restorative. To weak scrofulous invalids, the well-managed application of steam has very often proved signally beneficial. A greater degree of excitement may be communicated to the cutaneous surface, when the general torpor of the system or the indolence of the diseased parts demands it, by the employment of warm saline water, or impregnating the water or steam with irritating gases, such as sulphuretted hydrogen, carbonic acid, (see the Remarks of Prof. Osann on the Gaseous Baths at Eger. Osann und Trommsdorf Die Mineral Guellen, etc., Berlin, 1822,) chlorine or iodine. The use of baths of every kind ought always to be followed by friction, and this alone is a valuable mean of restoring the healthy actions of the skin, and furnishing a substitute for that bodily exercise which the condition of the scrofulous patient often disables him from using. In cases of abdominal obstruction and affections of the spine and joints of the extremities, the great benefit derived from friction is attested by all who have seen it carefully practised.

Other modes of stimulating the scrofulous patient are afforded by electricity and galvanism: hitherto these have been employed principally as local remedies for the dispersion of strumous swellings, and with excellent effects; (*Underwood*, Surgical Tracts.—*Birch*, on the Medical Application of Electricity;) but they will be found equally, if not more beneficial, as general means of exalting the nervous energy, and improving the tone of the whole frame.

Like all diseases occasionally attended with pain, scrofula requires at such times the use of narcotics, and, among these, opium under various forms of preparation certainly holds the first place. Hyoscyamus, belladonna, and conium, are also used with advantage; and the last obtained at one period, through the writings of Dr. Stöeck, a particular celebrity for its anti-strumous virtues. It has both as an internal and external remedy a considerable power of relieving pain; but none which we have observed of a truly discutient nature.

Topical Treatment.—Of the local treatment of scrofula, it may be supposed that the physicians ought not to speak; but, although this branch of the subject falls immediately within the province of surgery, we may yet be permitted to state generally our views regarding this matter. Long observation of scrofulous diseases has convinced us that much active surgical interference is usually injurious, and that mild and soothing modes of treatment are, on the whole, more generally successful. Thus the laying open of sinuses, the cutting away of undermined integument, and the application of strong escharotic ointments, often exasperate instead of improving the case; while small counter-openings, moderate pressure, brushishing the integuments around ulcers and fistulous openings lightly with nitrate of silver; and the application to strumous sores of bread-and-water poultices, astringent washes, lime-water, and the black mercurial lotion, proves very serviceable. When a scrofulous ulcer is highly irritable and painful, the bruised fresh leaves of the hemlock applied as a poultice seldom fail to give relief. In ulcers of the tongue, carrot pulp and Peruvian balsam are the best applications.

Indolent scrofulous tumours, when the health is little reduced, may be dispersed or made to suppurate by continued pressure or by blistering, which can be employed when the situation of the swelling will not admit of pressure. As soon as suppuration has taken place, and the matter approaches the surface, it ought to be evacuated by a small puncture, which will hasten the cure and diminish the chance of an unseemly scar. When the parts continue inflamed and hardened, poultices of bread and water, or rags dipped in cooling lotions, are the best applications; but when the discharge is considerable, finely carded cotton with gentle pressure checks the profuse secretion, and gives comfort to the patient. In those sudden depositions of fluid which sometimes occur in strumous cases, it is not always prudent to make an opening as soon as fluctuation can be detected; for by a little delay and soothing means we have not unfrequently known the fluid to be wholly absorbed.

[When the strumous swellings are very indolent, along with the internal remedies, and re-

gimen inculcated above, many local applications may be made use of to discuss them. Chlorinated lime has been applied with advantage in the form of ointment, as well as the aqua chlorini. Iodine has been used advantageously in the form of tincture, applied repeatedly by means of a camel's-hair pencil. The ointment of iodine, of iodide of potassium, of the iodurетted iodide of potassium, and of the iodide of lead, have likewise been used with advantage, rubbed on the part night and morning, and the iodo-hydrargyrate of potassium has been prescribed both internally and externally. An ointment of veratria has likewise been strongly recommended, but it has not been much employed.]

The eczematous and impetiginous eruptions which occur in scrofulous individuals are greatly benefited by astringent applications, such as the liquor subacetatis plumbi and liquor aluminis compositus; and when these diseases have proved obstinate, the unguentum picis will often completely remove them. This last application we have found particularly efficacious in those crops of psydracious pustules and extensive exfoliations of the cuticle which are so frequently seen on the fingers of scrofulous females and delicate children.

The tumid upper lip, so distinctive of scrofula, and often amounting to a deformity, may be greatly reduced or altogether removed by the repeated application of nitrate of silver. When the ulcerated fissures of the lip are very painful, relief will be obtained from the hemlock poultice, and nitrate of silver can be afterwards had recourse to.

Strumous enlargements of the tonsils were formerly treated by excision, and cases requiring this procedure do sometimes occur: the practice is as old as Celsus, and is still a favourite with the Baron Dupuytren; Dr. Hosack of New York has also lately borne testimony to the safety and advantage of this operation, [and it is now frequently — perhaps too frequently — practised.] When it is not absolutely demanded, the employment of iodine, leeches to the throat, the light application of nitrate of silver to the tumours, and a gargle of oak-bark, will generally prove sufficient, if not for a complete cure, at least to keep the swellings within moderate bounds.

Scrofulous diseases of the bones and joints require, in their first stage, local depletion, and at a more advanced period counter-irritation by croton oil, blisters, tartar-emetic ointment, caustic issues, or moxa. The warm-water douche and careful friction are also eminently useful in indolent cases. A very successful plan of managing diseased joints has of late been made public by Mr. Scott, (Observations on the Treatment of Chronic Inflammation, &c.,) — consisting of the application of camphorated mercurial ointment, pressure, and complete rest of the affected articulation without confinement of the patient.

When all hope of recovering a diseased portion of the body is at an end, the question immediately presents itself whether such part ought not to be removed by an operation, and the patient thus freed from what is in itself useless, perhaps burdensome, the cause of constant irritation, and in many cases of exhausting discharge. Scrofulous bones and joints are peculiarly of this description, and the question of their amputation is seldom determined without the concurrence of the physician. It has been asserted that amputation in such cases merely puts off the evil day, and that the patient, at no distant period, is destroyed by scrofulous disease of some other and more important organ; but the futility of this opinion is daily attested by the numerous living instances, not only of those who have suffered amputation for scrofulous affections in early life, but of multitudes of others who have survived with contracted and distorted limbs from the ravages of the disease. In considering the propriety of amputation, it is necessary to determine how far the continuance of the affection brings the patient's life into hazard, and whether he has still sufficient strength left to undergo the operation. It is truly surprising to observe how small a degree of vital force is adequate to carry a patient safely through an operation under such circumstances; but it must be remembered that amputation, severe as it certainly is, removes the very sources of irritation and exhaustion which are rapidly undermining life. This operation is nugatory when another joint, or a vital organ, as the lungs or bowels, is already the seat of incurable disease; and in such cases unquestionably it should not be performed. Great caution, however, is required in making our final decision; for every practitioner of experience has seen instances where the symptoms of visceral disease appeared almost to preclude hope, and yet have yielded on the removal of the local irritation, and a cure has been the happy result.

W. Cumin.

SEDATIVES, from *sedare*, to calm. These are medicines which directly depress the energy of the nervous system, and diminish preternaturally increased action. They exert an immediate influence over the nervous system, by which its energy is either greatly weakened or wholly destroyed. They thus have a twofold action, first, upon the nervous system, and, secondly, through it upon the muscular: if the dose be large, the individual quickly loses his volition and becomes vertiginous; the nerves of sensation cease to respond to ordinary impressions; consciousness fails; syncope supervenes, and in a few seconds life is extinct.

With the exception of Dr. Young (Introduction to Medical Literature,) and Dr. Billing,* medical authors in general have confounded sedatives with narcotics. There is no doubt, however, that the distinctive characteristics of both classes are well marked, and that the boundaries of each may be readily traced. The only circumstance, indeed, which has prevented the distinction from being at all times perceived, is the transitory nature of the excitement which follows a large dose of a narcotic, and the rapidity with which the symptoms of diminished sensibility and mobility supervene, as if they were induced without any previous increased action. In the operation of every narcotic the depressing effect, therefore, is preceded by increased action; and both the degree of the collapse and the rapidity of its appearance depend on the extent of the previous excitement. In

* First Principles of Medicine, p. 44. [The separation is made by the writer in his *General Therapeutics*, Philadelphia, 1836 & 1843.]

small or moderate doses, narcotics augment the force and increase the frequency of the pulse, promote the secretions, and elevate the powers both of the body and the mind, and if these doses be repeated at proper intervals, this excitant effect is maintained; but, if the dose be not repeated, the transitory nature of this excitement becomes conspicuous, and a state of depression or collapse follows, in which languor, dullness of sensation, and sleep ensue.

Such are the effects of a narcotic. The administration of a sedative, on the contrary, whatever be the dose, is not followed by any perceptible quickening or augmentation of the pulse, but by an immediate diminution both of its force and frequency, and by a general feeling of depression, too decided to be overlooked. It is, indeed, evident that this effect is exactly the opposite of that of an excitant: and if the dose be large, not only is the sensibility diminished, but the whole power of the sensorium is at once completely paralyzed. We are perfectly aware that Magendie and others regard the sedative influence of one of the most efficient of this class of medicines, the hydrocyanic acid, as that of transient excitement, followed by an immediate state of collapse; but the result of our own experiments on living animals is adverse to this supposition: the instantaneous diminution of the general powers of the system, the prostration of strength, the stupor, numbness, sleepiness, vertigo, and depression of the animal spirits, all indicate an immediate influence on the nervous energy. With these observations in view, and with the experiments of Mr. [Sir B.] Brodie on some poisonous substances before us, we may venture to assert that it is upon the nerves of sensation chiefly that *direct* sedatives operate.

When sedatives are taken into the stomach, if they do not destroy life, their influence is much weakened after a certain time has elapsed, and soon afterwards it altogether ceases. It may, however, be maintained in the same manner as that of narcotics, by the repetition of the dose at moderate intervals; but the impression becomes weaker after each renewal of it, until it is almost lost, unless the dose be greatly augmented. If these statements be correct, it is evident that sedatives operate directly on the nerves of sensation, and that this effect is not the result of a stimulus rapidly exhausting the excitability of the nerves, but of a direct impression of a peculiar kind on the nervous system, which instantaneously destroys the susceptibility of the nerves for receiving impressions from external stimulants.

Owing to the ideas which we acquire in early life, the effects of excitants are connected with mechanical impressions, and, therefore, the mind has less difficulty in admitting the hypothesis that every instance of collapse must be preceded by a previous state of excitement, than that something is either abstracted from the nerves, or that some alteration takes place in these organs, which diminishes their faculty of receiving impressions. It is true that no organic change can be detected in the nerves of animals killed by sedative poisons, and we are equally unable to affirm from inspection that any thing has been abstracted from them, yet that some change has occurred is undoubted, as they are no longer susceptible of being excited.

Whether we can assume that the sedative effect is immediate, not secondary, is questionable: but we imply its direct character from the local effect of powerful sedatives where they are applied in small quantity to a limited portion of the surface of the body; as for example, if the finger be held over the mouth of a bottle of hydrocyanic acid, it is numbed, and it continues so for a considerable time without any extension of this effect to the rest of the body. When the quantity is larger, their influence ceases to be partial, and is extended over the system: and when it is very large, the same rapid destruction of life follows as when the sedative is taken into the stomach. Sedatives consequently differ from many of the other classes of medicines, in their effects being more regulated by the extent of the dose than by the state of the body. Upon the whole we conceive that there are sufficient reasons for separating sedatives from narcotics, and allotting to each a distinct place in the arrangement of the materia medica.

Let us examine their influence, as physiological agents, on the different organs of the living system.

1. **On the Digestive Organs.**—No sensation in the stomach is experienced when a sedative is taken into it, except occasionally that of nausea: the influence of the sedative is rendered obvious rather by the change which follows in the state of the digestive function than by anything which can be referred to the condition of the organ itself. If the viscus be morbidly irritable, the influence of the sedative is acknowledged by the diminished susceptibility of the gastric nerves, by the improvement of digestion from the lessened irritability favouring the formation of a more healthy, because more slowly secreted, gastric juice.

In this respect, when the dose is moderate, the direct influence of the sedative is local and confined to a certain set of nerves, although the general system ultimately benefits by the change thus affected, a fact daily illustrated in the administration of hydrocyanic acid in dyspepsia; whereas the influence of narcotics is invariably propagated over the system, even when they are administered in small doses.

If the dose of the sedative, however, be increased, the impression then extends to the brain, and is manifested by slight vertigo, transient insensibility, sinking of the pulse, failure of the muscular energy, particularly in the thighs, general lassitude, and mental depression. If the dose be larger, but within the limit of a poison, it must be admitted that sensations, for example weight and an obtuse pain in the forehead, are superadded, which seem to indicate previous excitement; but that this has not existed is highly probable, since we know that coma may proceed from inanition as well as from increased action in the brain, and that stimulants are frequently requisite to relieve symptoms closely resembling those requiring venesection and depleting remedies. Taken into the stomach, therefore, sedatives operate directly upon the nerves of that organ, and, within a certain limit with respect to dose, the effect which follows is strictly local.

2. **On the Circulating and Respiratory Organs.**—When the influence of a sedative extends to the general system, the action of the

heart and arteries is diminished, but not in the ratio of the impression on the nervous system. Schubarth asserts that the heart loses its contractility, but the experiments of Coullon, (Researches, &c. p. 146,) with which those of the author accord, lead to an opposite opinion. In poisoning by hydrocyanic acid, the heart continues to pulsate, and the intestines continue to display their peristaltic and vermicular movements after the death of the animal, and they do not lose their contractility for some time; at least such is the case when hydrocyanic acid is taken, and it is probable that the same occurs when other sedatives are employed. As far as relates to the lungs, if sedatives be applied directly to them either in the form of gas or of vapour, the effect is both more rapid and more decisive than when they are swallowed; the respiratory function is almost instantaneously suspended; no change takes place in the blood, which retains its venous character, and, on examining the organs, nothing is perceived which can authorize the idea of excitement having existed: death, in fact, is the result of the complete destruction of muscular irritability. When taken into the stomach, the action of sedatives on the lungs is greatly modified; the blood, however, remains dark-coloured and retains its fluidity.

3. **On the Nervous System.** — It is unnecessary to repeat that the nerves are the organs on which the influence of sedatives is chiefly and directly exerted; but little is known with regard to the nature of the impression, except that it is different from that of any exciting agent; and after the most minute inspections of the brain, the spinal cord, and the nerves, in cases of death from poisoning by sedatives, no other conclusion has been arrived at. Whatever may be the impression, it is assuredly not that which is followed by excitement.

4. **On the Secerning System.** — Sedatives produce effects which, to an ordinary observer, might seem almost at variance with the foregoing opinions: thus, salivation has occasionally followed the employment of hydrocyanic acid; (Lond. Med. Journ. Feb. 1823, p. 128,) and the secretion of urine is not unfrequently greatly augmented by whatever produces a sedative effect on the system. But such results do not necessarily imply previously increased vascular action in the salivary glands and the kidneys: thus we know that in the lowest condition of the nervous excitability in fatuity, salivation is one of the most ordinary attendants, and under the influence of fear and other depressing passions, nothing is more common than a sudden and copious secretion of urine. Upon the whole, we have sufficient reason for concluding that there are powers which can destroy excitability and life without causing previous excitement, or, at least, without any signs of its being discoverable. This is not the result of the administration of narcotics, and therefore we feel authorized in forming a distinct class of sedatives.

In treating of sedatives employed as therapeutical agents, we may arrange them under two heads; 1. *direct*, or those which operate by their immediate influence on the nervous system; and, 2. *indirect*, those which operate through the medium of the vascular system.

1. The first and most powerful of the direct sedatives is *hydrocyanic acid*.* This acid, as prepared for medicinal use, is one-sixth only of the strength of the concentrated acid, but it differs from it in no other particular. It is colourless, limpid, and has a penetrating odour, which causes headach, nausea, and fainting, when inhaled in considerable quantity by the nostrils. This odour has been erroneously compared to that of the peach-blossom,—an error originating from the odour of the volatile oil, which is, in some instances, as in the peach kernels, blossom, and leaves, and in the bitter almond, mingled with this acid. The odour of the free acid, when well examined, cannot be confounded with that of the peach-blossom.†

The pure acid is extremely volatile, and even the diluted or medicinal acid is so much so as to be greatly weakened when not carefully preserved. It is also spontaneously decomposed when it is not kept in a cool place: the best method of preventing this decomposition is to place the bottles containing it in water, or in porous jars saturated with moisture. In prescribing hydrocyanic acid, it is essential to know that it is decomposed by the aqueous solutions of chlorine and the oxides of antimony, and is precipitated by nitrate of silver and sulphate of copper. These substances are, therefore, incompatible in prescriptions with hydrocyanic acid, but it may be combined with the salts of iron if no alkali be present. This acid is the active principle of laurel-water, the distilled water of the leaves of the prunus *lauro-cerasus*; cherry-water, distilled from the bark of the cluster cherry, prunus *padus*; the kirsch-wasser of the Germans, which is a spirit distilled from the fruit of the same species of prunus; and the oil of

* This name is a compound of ὑδῶρ, water, and *cyanogen*, (a compound substance, named from κύανος, *blue*, and γένναω, *to produce*,) signifying a produce of blue, as it gives the blue colour to the ferrocyanate of peroxide of iron, or Prussian blue.

† The plan of this work forbids any detailed account of the various methods proposed by Vauquelin, Gay, Lussac, Robiquet, Pessinau, Frantwain, and others, for preparing the medicinal hydrocyanic acid; but it may be useful to describe the following processes, by which any practitioner can readily prepare it for himself.

1. Put into a wide-mouthed phial a solution of one part of bicyanide of mercury, dissolved in eight parts of distilled water, and pass through it a stream of sulphuretted hydrogen gas, extricated in another phial from a mixture of equal weights of sulphuret of iron, and strong sulphuric acid, diluted with two parts of water. The gas must be passed as long as any sulphuret of mercury in the form of black powder is formed; the fluids then filtered, and any excess of sulphuretted hydrogen removed by agitating the solution with a little carbonate of lead, and filtering a second time.

2. Put into a phial twenty-two grains of cyanuret of potassium, and pour over it a solution of fifty grains of pure tartaric acid in six fluidrachms of distilled water, and eight of rectified spirit. After agitating the phial occasionally, secure the stopper, and set it aside until the precipitate falls to the bottom: then decant the clear acid. The acid thus formed should contain one grain of hydrocyanic acid in every fluidrachm, which is easily ascertained by adding in small quantities to a given portion of it peroxide of mercury finely levigated, as long as agitation enables the acid to take it up. By dividing the weight of the peroxide dissolved by four, the quotient expresses the quantity of real acid contained in the diluted acid. No heat should be employed. [See the form for the preparation of hydrocyanic acid, in the Pharmocopœia of the United States.]

bitter almonds, now occasionally employed as a medicine, and very generally in confectionary.* But along with the acid in these and similar preparations, there is a volatile oil, the odour of which, as we have already stated, is very distinct from that of the hydrocyanic acid, is stimulant, and possesses poisonous properties nearly equal to those of the acid.† It is, however, not a direct sedative, but resembles a narcotic in its operation: thence the effects of the oil of bitter almonds and laurel-water differ considerably from those of free hydrocyanic acid.

Concentrated hydrocyanic acid cannot be employed as a medicine.‡ The same circumstance, the powerful influence of this acid on the nerves of sensation, which renders it so awfully formidable when it is taken in doses sufficient to produce its poisonous effects, renders it in the hands of the prudent and well-informed practitioner, when its dose is judiciously regulated, its administration properly timed, and its effects are carefully watched, a remedy possessed of powers which cannot be obtained from any other substance, and it is therefore extensively employed.

The use of hydrocyanic acid is indicated in diseases connected with a state of excessive or morbid sensibility, and those depending on a highly irritable state of the nervous system. This general statement is not solely influenced by the opinion which we maintain of its direct sedative power, and were the assertion that it produces at first a transient excitement capable of demonstration, it would not affect in any degree the administration of the acid; for as this excitement is said to be of a very transitory nature, it need not be taken into account in estimating the sedative powers of the remedy. In idiopathic fever, hydrocyanic acid has been rarely if ever employed: it has, however, been supposed to act beneficially in hectic, moderating the force of the circulation and suspending the night-sweats which always accompany this symptomatic fever;§ but, in reference to phthisis, the eulogy bestowed by some practitioners on this acid has not been merited. Neither, with the exception, perhaps, of phrenitis, is it calculated for the relief of the diseases classed by nosologists under the title Phlegmasiæ: even in phrenitis we have had no experience of its utility, but knowing that the inflammation of the membranes of the brain morbidly augments the general sensibility, as illustrated by the impatience of light and of sound, we are disposed to recommend its employment as an adjuvant to other remedies in this state of the brain. In pleurisy it has been found beneficial in moderating the cough, one source of exasperation of the inflammation of the serous membrane; but beyond this it has no pretensions to be regarded as a remedy in this disease.

In the exanthemata, except as an external application, hydrocyanic acid holds forth no prospect of benefit. In the state in which it is found in the bitter almond, it was employed as an external sedative so early as the time of Celsus in several external diseases; his formula in a painful pustular disease, which he describes as peculiar to infants, is the following: "lapidis, quem pyriten vocant, partes octo, cum quinquaginta amaris nucibus miscetur, adjiciunturque olei cyathi tres." (De Medicina, lib. v. c. 28, § 16.) But even as an external application, the volatile oil of bitter almonds requires to be used with much caution, and Coullen has recorded the case of a child killed by the leaves of the prunus *lauro-cerasus*, applied to a sore on the neck. (Researches, &c.) The free acid has been recommended by the author of this article in the proportion of f.ʒiii to f.ʒvi of bitter almond emulsion, as a lotion in impetigo or running tetter. In such cases also, when the irritability is very considerable, it may be combined with the acetate of lead according to the following formula:

R. Acid. hydrocyan. f.ʒiv.
Acet. plumbi, gr. xvi.
Alcoholis, f.ʒi.
Aquæ destillatæ f.ʒviiiss. M.

This lotion not only soothes the irritability of the diseased surface, but also disposes the skin to renew its healthy action, and is productive of the greatest comfort to the patient: it has been found very useful in prurigo *inveterata*, in the various forms of psoriasis, and several other skin diseases attended with itching and tingling.

In passive hemorrhages no advantage can be expected from hydrocyanic acid; but in active forms of the disorder, much confidence may be placed on the internal use of it. In hemoptysis, by rapidly augmenting the dose from three minims (the medium dose) to twelve minims, or until the pulse begin to afford indications of the deleterious influence of the medicine, we have seen the most happy results in the absence of any organic affection. In phthisis, as we have said, the powers of hydrocyanic acid have been much overrated; nevertheless as a palliative it is not without its value. In small doses frequently repeated, it diminishes the hardness and frequency of the cough, and lessens the general hectic tendency: but more is not to be expected from it in this respect than from some of the narcotics. It has, however, one advantage over narcotics, namely, that, besides moderating the cough, it frequently favours sleep

* Hydrocyanic acid is found in the leaves and kernels of almost all the plants of the natural order Amygdaleæ, and in the pips of some of the Pomaceæ and Aurantiaceæ; it is formed when copaiba is distilled with diluted nitric acid.

† When the volatile oil of bitter almonds is redistilled, the first portion which comes over smells strongly of hydrocyanic acid, and affords indications of its presence when tested; but it smells very faintly of the peach-blossom: the second portion exhales a more powerful odour of the peach-blossom than the first, but less of that of the hydrocyanic acid. The first portion operates as a powerful direct sedative in the same manner as free hydrocyanic acid; the second, besides operating primarily as an excitant, produces violent convulsions when it poisons. What remains in the retort, if the distillation have been carried far enough, crystallizes on exposure to the air, and absorbing oxygen, acquires all the properties of an acid: this is completely inert on the living system. Vogel has suggested that these changes depend on the process, and he supports his opinion by the fact that a quantity of bitter almonds, which, if made into an emulsion, may be swallowed with impunity, when distilled would yield a product more than sufficient to destroy the life of one individual.

‡ For an account of its poisonous influence on the animal system, as well as that of the diluted acid, the oil of bitter almonds, and laurel-water, with the modes of detecting these poisons and of counteracting their effects, we must refer our readers to the article Toxicology.

§ Historical and practical Treatise on the Internal Use of the Hydrocyanic Acid, &c. By A. B. Granville, M. D. &c. p. 59, 1820.

without exciting those sweats which are too often augmented when opium is employed. At the same time, as its tendency is to lower the powers of the system, it is in the early stages only of this disease that it can be regarded as likely to prove beneficial even as a palliative. Its employment in phthisis, in the combined state in which it is found in laurel-water, is, indeed, of no recent date, most of the old works on consumption enumerating laurel-water amongst the means to be employed for soothing the cough. From some experiments made by M. Jorg, at Leipsig, we might infer that it would prove injurious in the early stage of the disease, as well as in every inflammatory affection. This physician exhibited the cherry laurel-water in doses progressively increased from five to twenty-five, and finally to one hundred and twelve minims. He states that the symptoms were those of concentrated action of the brain, a sensation of weight in the head, drowsiness and torpor of the intellectual functions, lassitude, retardation of the pulse, and headach, preceded by a dull pungent pain of the head, chiefly in the region of the optic nerve. It also was attended with symptoms not unlike those of bronchitis. M. Jorg refers these symptoms to plethora of the cerebral vessels, but they may depend on paralysis of the brain itself. These observations are at variance with our own experience. We have found the laurel-water and also free hydrocyanic acid almost specific in that affection of the trachea which has been termed phthisis trachealis, and which is often as fatal as tubercular phthisis. The natural combination of hydrocyanic acid in the bitter almond emulsion is also an excellent vehicle for the administration of the compound powder of ipecacuanha in the above-mentioned disease.

In affections of the mucous membrane, hydrocyanic acid is a much less equivocal remedy than in the diseases already mentioned. In chronic catarrh, and under certain circumstances in dysentery, sufficient proofs of its efficacy have been recorded. In the latter disease, when given at the same time with full doses of calomel, to the extent of four or five minims for a dose, in the bitter almond emulsion, and repeated at short intervals, it allays irritation and improves the secretions and excretions of the intestinal canal. On the same principle its power of allaying irritability, and thereby favouring a slower and consequently more healthy secretion of the gastric juice, the author of this article was induced to recommend its employment as a sedative in dyspepsia. (See Granville's Historical and Practical Treatise on the Internal Use of the Hydrocyanic Acid. First Edition, 1819.) Dr. Elliotson prosecuted this suggestion, and laid the results of a very extended trial of its powers in St. Thomas's Hospital before the profession. (Numerous Cases illustrative of the Efficacy of Hydrocyanic or Prussic Acid in Affections of the Stomach, &c. 8vo. 1820.) In dyspeptic affections it may be combined with the decoction of Iceland liverwort, infusion of calumba, or the extract of sarsaparilla; or it may be administered in water, from three to five minims for a dose, with the addition of f.ʒi of tincture of calumba or of any simple bitter. In pyrosis it affords relief on the same principle, by allaying the morbid irritability of the stomach.

It is in spasmodic affections, however, as may be readily conceived, that the sedative powers of the hydrocyanic acid are most conspicuous. In spasmodic asthma, even when the pulse is small, irregular, and often not easily distinguished, we have seen it act almost instantaneously, relieving the oppressed state of the pulmonary circulation, and restoring the free action of the respiratory organ. In hooping-cough, also, this acid displays the most striking influence when early resorted to and judiciously administered. After emptying the stomach with an emetic, and purging briskly, it may be immediately administered three or four times a day, in doses of one or two minims, according to the age of the patient, in f.ʒiss of the bitter almond emulsion, sweetened with a few drops of syrup of tolu. It is seldom necessary to change the prescription, except to increase the dose of the acid, until the cough ceases, which generally occurs in less than a month or six weeks after commencing the use of the remedy. It is requisite to confine the patients to a graduated temperature, and to restrict them to a milk and vegetable diet.

[The writer has often used hydrocyanic acid in hooping-cough, and endeavoured to observe its effects carefully; but the results have not been such as to enable him to place much reliance upon it. It certainly has not answered, in his hands, in the very cases mentioned by Dr. Thomson, half as well as narcotics employed so as to produce a sedative influence.]

In epilepsy, chorea, hysteria, and tetanus, the results of the trials of hydrocyanic acid have been of a description which do not admit of any decisive opinion of its value in these diseases. In hydrophobia it has been tried both in this country and on the continent; in few instances it appeared to allay the violence of the paroxysms; (see Transactions of the Medico-Chirurgical Society of London, vol. xiii. p. 298;) but, as may be supposed, the effect was transitory, and in no instance has it warded off the fatal termination of the attack.

The essential oil of bitter almonds has been proposed as a substitute for hydrocyanic acid, on the plea that the strength of the medicine can be more certainly determined, and that it is less likely to suffer decomposition than the free acid from the influence of air, light, and variations of temperature. Twelve minims of the volatile oil of bitter almonds, dissolved in a fluidrachm of olive oil, and formed into an emulsion with mucilage, are regarded as equivalent to four minims of the ordinary medicinal hydrocyanic acid. An objection, however, to the use of this oil is the excitant property of the volatile oil with which the hydrocyanic acid that it contains, is mixed; it also produces an uncomfortable effect on individuals of a peculiar idiosyncrasy. Some people cannot eat even a single bitter almond without suffering severely from nettle-rash, attended with vomiting and vertigo; a circumstance, as we have already stated, depending on something in the kernels independent of the hydrocyanic acid, which is further demonstrated by the fact that the sweet almond sometimes causes the same inconvenience, although no hydrocyanic acid has been detected in it.

A more useful substitute for the hydrocyanic

acid than the volatile oil of the bitter almond, is the *cyanide of potassium*, which, although it does not hold a place in any of the British pharmacopœias, yet possesses sedative properties equal to those of the free hydrocyanic acid. In solution it is a hydrocyanate; but in this change it loses none of its sedative properties. One part of the cyanide and eight parts of water form a solution which may be administered in the same doses as the hydrocyanic acid; and in this state it has been successfully employed in neuralgic affections by Dr. Buttigny and Dr. Lombard of Geneva. They have also used in the same disease an ointment compounded of five grains of the cyanide and one ounce of lard. The cyanide has also proved useful in rheumatism.*

In closing our account of this powerful sedative, candour obliges us to notice some experiments and facts which have been published on the opposite side of the question, with regard to the mode in which its influence on the nervous system is effected. The author of this article supports the opinion that it operates directly on the nervous system, whilst Magendie, Orfila, and others contend that it is previously absorbed. The only experiments we shall notice are those of Dr. Krimer of Aix-la-Chapelle, who found that when it is applied directly to the neurilema of the nerves, or to the surface of the brain and spinal cord, it displays no activity. He also supposes that he has ascertained that it does not kill, even when applied to the tongue, until it is evaporated by the heat of the mouth, and is absorbed into the pulmonary circulation; destroying life first by diminishing the action of the heart and arteries, and then by extinguishing the energy of the spinal cord. Dr. Krimer found that when the arteries and veins of a part are tied and the nerves left free, if the acid be applied to a wound it produces no effect; but the instant the ligatures are removed, it displays its power: on the other hand, also, death occurs when the nerves are divided if it be introduced into the vessels. When all the vessels of the stomach, says Dr. Krimer, are tied, although the nerves remain entire, hydrocyanic acid when introduced into the stomach does not produce its usual effect; but it operates immediately when placed on the tongue, and in thirty-six minutes it can be detected in the blood by reagents: such is the case, also, when it is inhaled, without the vapour coming in contact with the nerves of the tongue.

Notwithstanding the apparent conclusiveness of these experiments, we cannot accord with the inferences deduced from them. For instance, we cannot conceive how the acid can be taken into the pulmonary circulation, and yet not act on the nerves in its vicinity; and an assumption is made respecting pulmonary absorption, which requires to be proved. On these accounts, and from having witnessed the instantaneous effect of this acid when taken in large doses, we see no reasons sufficient to alter our formerly expressed opinion regarding its mode of action.

Tobacco is another sedative of great power. The experiments of Mr. [Sir B.] Brodie have rendered it probable that there are two efficient principles in tobacco; one an *empyreumatic volatile oil*, which operates directly on the brain and the nerves of sensation, or on the sensibility of the system; the other a saline substance, (*nicotina*,) which appears to influence chiefly the motor nerves, confining its sphere of action particularly to the heart, which it renders insensible to its natural stimulus, the blood, and thereby causing death. In whatever manner this volatile oil is procured, its effects are so powerful on the animal economy, that, when it is applied to an abraded surface, or introduced into the rectum, it causes almost instant death.† When tobacco is infused in boiling water, this volatile oil is partially taken up by the liquid, and produces the sedative effects which always more or less result from the exhibition of tobacco enemata; but the greater part of the influence of the tobacco clyster is due to the nicotina, which, in the tobacco, is probably combined with some acid that increases its solubility. The sedative influence of nicotina is such that the action of the heart ceases even before that of the diaphragm,—an effect directly the opposite of that which occurs from the administration of hydrocyanic acid. The influence of both the components of tobacco is evidently directly sedative, without even the most transient stimulant effect, whether the infusion be introduced into the stomach or into the rectum.

It is remarkable, with the knowledge which the profession possesses of the sedative influence of the tobacco clyster, that it should ever have been employed in cases of suspended animation: it is indicated and has been successfully used in cases of incarcerated hernia. If one drachm of the dried plant infused in a pint of boiling water and strained, be thrown into the rectum, great muscular debility, partial insensibility, and sometimes cold clammy sweats almost immediately supervene; relaxation of the spasms follows, during which the gut is replaced. But occasionally the aid thus afforded to the taxis is not unattended with hazard; and in certain states of the system of some individuals which are not obvious, but greatly influence the action of the remedy, it is evident that it must not be inconsiderately resorted to, nor indeed at all whilst the least chance of any other means proving useful remains.‡ When it does not succeed, and the operation must be performed, the patients do not recover so well as those who have not been subjected to its use. The sedative influence of tobacco has also been taken advantage of, in smoking the plant for the relief of spasmodic asthma, violent tooth-ache, and some painful affections of the face.

[*Digitalis*, classed by Dr. Thomson under NARCOTICS, (q. v.) is more worthy of a place among sedatives. It is an important agent with

* A method of obtaining this cyanide in a state of great purity has been lately discovered by Mr. R. Lamins.

† This oil is gradually deposited in the wooden stems of the pipes of the Hottentots, who employ it for destroying serpents. Mr. Barrow mentions having witnessed its effects when applied to the tongue of a poisonous snake; the reptile stretched itself out, became stiff, and died in an instant.

‡ When the tobacco clyster produces deleterious effects, they should be immediately obviated by throwing into the rectum a strong infusion of nut-galls, or any other substance containing a large proportion of tannin and gallic acid, so as to combine with the nicotina, and by destroying its solubility, to render it inert. Brandy, ammonia, and other stimulants, should also be administered by the mouth, and an artificial respiration maintained for some time, or until the sedative influence of the medicine begins to disappear.

the contra-stimulant school. *Colchicum, veratria, album, veratrum, viride, cimicifuga*, and perhaps *ergota* might likewise be considered, with propriety, under this head, as their main action is one of sedation.]

The *hydrosulphuret of ammonia*, although less frequently employed than either hydrocyanic acid or tobacco, is a most powerful sedative, depressing the action of the heart and arteries by operating directly on the nervous system. In very moderate doses, namely five minims in a tumbler of water, it causes nausea and vomiting; and, when the dose is increased, drowsiness and vertigo supervene. It was employed and strongly recommended by Mr. Cruickshanks in diabetes mellitus, for destroying the ravenous appetite and morbid action of the digestive organs which always accompany that disease; but it has been very little used.

Two gaseous compounds of hydrogen, *sulphuretted hydrogen* and *carburetted hydrogen gas*, exert a powerful sedative influence on the animal economy, which proves rapidly fatal to animal life, if breathed, even when largely diluted with air. The former is noticed here rather with the view of alluding to the share which it has in causing the depression that always occurs in those febrile affections in which it is extricated largely in the intestinal canal, than to refer to its therapeutical properties, although its employment in phthisis has been suggested. There is undoubtedly a copious evolution of it in all low fevers, and its direct sedative influence on the intestinal nerves is the chief cause of the collapse which attends these diseases; to obviate this, is therefore, of much consequence, and the influence of chlorine in decomposing this gas by forming muriatic acid in combining with the hydrogen whilst the sulphur is deposited, points out an easy and effectual method of doing so. Either the aqueous solution of chlorine, or of the chloride of soda, should be administered in these cases. The presence of the gas is detected by the extremely offensive odour of the fæces; and still more decidedly by holding slips of paper covered with carbonate of lead over the vessels containing them. If sulphuretted hydrogen be exhaled, the carbonate will be immediately blackened.

The second of the above-mentioned gases, *carburetted hydrogen*, has been employed for medicinal purposes, as a sedative in phthisis; but its use requires much caution, as even when diluted with twenty or thirty times its bulk of common air, it cannot be respired for more than a minute or two without causing nausea, dizziness, and other symptoms of dangerous nervous depression. Although so destructive to animal life that it cannot be taken into the lungs undiluted without producing instantaneous death, yet to no gas does the system become so soon habituated; consequently the degree of dilution which is at first requisite, may be gradually reduced with impunity. The trials, however, which have been made of it as a remedy in phthisis are as yet far from sufficient to determine accurately its influence in that disease.

2. The *indirect* sedatives operate on the nervous system through the medium of the blood, either by altering the properties of that fluid so as to unfit it for affording the requisite stimulus to the brain and nervous centre, or by extracting it in quantity sufficient to bring the brain into a similar state from defect of stimulus, or, as it were, from inanition.

The first of the sedative agents belonging to this division of the class which requires to be noticed, is *carbonic acid gas*. The influence of this gas in causing suffocation when it is attempted to be breathed undiluted, as it never enters the lungs, but causes a constriction of the muscles of the glottis, so that no air can enter the lungs, and no change take place in the blood passing through them, is supposed to be negative; thence the question, whether this gas is positively or negatively sedative? But although this gas is never admitted into the lungs in attempts to respire it, and therefore may be regarded as negatively sedative, yet there are facts which demonstrate its positive sedative properties. Thus, if the body of an animal be immersed in an atmosphere of carbonic acid gas, whilst atmospherical air is freely admitted to the lungs, sedative symptoms occur, such as weight in the head, dimness of sight, singing in the ears, vertigo, &c.; and that it even exerts a local influence on the nerves, was demonstrated by an experiment of Dr. Priestley, who, having excited pain in a blistered hand by immersing it in oxygen, relieved the pain instantly by plunging the hand into a jar of carbonic acid gas. It is also a well-known fact that the pain of a cancerous ulcer is allayed by directing upon it a stream of carbonic acid gas which has passed through water; and it is to the presence of this gas in the carrot and other fermenting poultices, that they are indebted for their sedative properties. On these accounts, although we have arranged carbonic acid gas among the *indirect* sedatives, yet it in some measure belongs also to the former division of *direct* sedatives.

Carbonic acid gas was at one time much employed as a sedative in phthisis: Dr. Percival introduced it as an antiseptic, and from the result of thirty cases concluded that it abates the hectic and improves the expectoration; (Percival's Essays, vol. ii. p. 308;) and Dr. Withering, who also looked upon it merely as an antiseptic, found that similar effects resulted from its administration. Favourable opinions of it were given by Dr. Dobson, (Medical Commentary on fixed Air. London, 1779,) Dr. Hulme, Dr. Beddoes, and Dr. Fenwick of Durham: on the contrary, the experiments of Dr. Muehry, (Inaugural Dissert. Gott. 1797,) who gave it a fair trial in five cases without material benefit, and our own experience, have led us to place little confidence in it, even as a sedative. When it is employed, it should be largely diluted with common air; the best proportions are four parts of the air to one part of the gas.

The only other indirect sedative which requires to be noticed is *bloodletting*. It is scarcely necessary to remark that a certain quantity of the circulating fluid is required to be present in the blood-vessels, in order to support the energy of the brain and nervous centres; and, therefore, that when this proportion is diminished, the result is a sedative effect on the system. In man the average quantity of blood in proportion to the weight of the body, in a healthy adult subject, is as *one*

to *five*; when a greater relative proportion exists, a diseased state of the body, plethora, takes place; when a smaller, the body becomes emaciated. If blood be suddenly abstracted from the vessels, a series of phenomena occur which demonstrate a diminished state of vitality; and if the quantity taken away be greater than a certain proportion of the whole, then death almost immediately ensues. But these effects do not depend altogether upon the quantity of blood contained in the vessels or abstracted from them, but partly upon other circumstances, which ought always to be kept in view when bloodletting is intended to operate as a sedative.

If these phenomena depend on the state of the vascular system in health, it is evident that a powerful effect must result, in disease, from the abstraction of blood, whether this be effected by opening a vein, by cupping, or by leeches. The immediate depression of the vital powers which follows this abstraction must have been early rendered obvious, from the effects of hemorrhages arising from the accidental rupture of vessels; and thence artificial means were adopted to diminish excitement by opening a vein. The syncope which succeeds is much regulated by the habit of the patient, the nature of the disease, and the manner in which the blood is abstracted; but as a particular inquiry into the morbid effects of bloodletting and the methods of obviating these are given in detail in other parts of this work, we think it unnecessary to enter into minute details, referring the reader to the articles Bloodletting, Fever, Inflammation, and Plethora.

A. T. Thomson.

[Under the head of sedatives may be included a set of therapeutical agents, now much used, in Italy more especially, but also adopted in France and in Great Britain,—rarely in this country;—agents which, by removing excitation, might be termed *sedatives*, but which, by their propounders, have been called *contra-stimulants*, and the theory which suggests them, the *theory of contro-stimulus* or *contra-stimulus*,—the *new medical doctrine of Italy*,—*La nuova Dottrina*, &c.

Prior to the termination of the last century, the doctrines of Brown were universally embraced in Italy, and they continued in vogue until Rasori, on the occasion of a petechial fever making its appearance in Genoa, subjected the prevalent views to considerable modification; and, as in most similar cases, ended by embracing views diametrically opposite. Rasori maintained that most diseases, to which mankind are liable, are owing either to an augmentation of excitability, or to an excess of stimulus; and he conceived that there are certain medicinal agents which possess a peculiar debilitant power, and which act upon the excitability of the frame in a manner directly opposed to that in which stimulus acts upon it. To this power he gave the name *contro-stimulus*.

The mode in which the different contra-stimulants have acquired their reputation, appears to have been as simple as it must frequently have been fallacious. Every agent which succeeded in removing a sthenic disease, could do so only, it was presumed, by diminishing the excitability, or removing the stimulus. Accordingly, it was a contra-stimulant. Substances were therefore classed together, which bore no relation to each other, either in their immediate properties, or in their secondary effects—as regarded the physiological phenomena they induced. We find, in the lists, emollients—as milk and gum; astringents—as acetate of lead; tonics—as gentian, simarouba, iron, and, according to some, even cinchona; excitants—as turpentine, squill, and arnica; emetics—as tartrate of antimony and potassa, and ipecacuanha; narcotics—as stramonium and belladonna; acrid poisons—as arsenic, nux vomica, cantharides; and a host of other animal, vegetable, and mineral substances, which had no kind of analogy to each other. It has been properly observed, that this manner of considering the effects of medicines tends essentially to bring together the most dissimilar substances, as well as to separate such as are closely allied, and, consequently, to confound all.

In the case of this theory, however, as of every other, the practice built upon it has added valuable facts to therapeutics; and not the least of these is the knowledge, that tartrate of antimony and potassa may be administered in large doses in inflammatory affections, not only with impunity, but with marked advantage. This potent emetic may be given to the extent of ten or twenty grains or more, in divided doses, during the day, without either producing vomiting or purging; or, if the first doses prove emetic, a tolerance is soon acquired, and the subsequent doses may be followed by no marked effect, except the diminution of the febrile symptoms. At other times, the urinary and cutaneous depurations appear to be largely augmented, and rapid emaciation succeeds to its administration. The contra-stimulant physicians maintain, that the exaltation of the vital manifestations in febrile and inflammatory diseases, enables the system to bear the large doses of this and other contra-stimulants, and they say that the tolerance vanishes with the disorder that communicated it; but this assertion is not confirmed by experience. There is certainly a greater resistance to the action of these agents, as there is to bloodletting, when all is exaltation, but the power of resistance does not cease, although it is diminished, when the exaltation ceases. Some individuals, too, never possess the necessary tolerance; so that with them the tartrate of antimony and potassa does not produce its contra-stimulant effects; and it would seem that there are, also, what the French term *medical constitutions* or *epidemic conditions*, which forbid its employment. Thus, according to Bricheteau, (Clinique Médicale de l'Hôpital Neckar, Paris, 1835; or the writer's translation in the *Amer. Med. Lib.* Philad. 1838,) although it was so successfully used in 1831, it could not be beneficially administered at the end of 1832, and the beginning of 1833. Not until the autumn of this last year, could it be resumed advantageously. On one occasion it was given in the hospital, by an *Elève de garde*, during the choleric epidemy. The most violent symptoms supervened, and the patient died of cholera morbus, no sign of which existed before the tartrate was taken.

Of the different phlegmasiæ, acute rheumatism and pneumonia are those that are considered to

have been most successfully combated by this agent, in a large dose. (See art. Inflammation, vol. ii, p. 795.) "Emetic tartar," says M. Bricheteau, "should generally be preceded by bloodletting; and commonly it is advisable not to have recourse to the former, unless the latter is insufficient, except in cases in which bloodletting is contra-indicated or impossible, owing to some special circumstances,—as happened to me once in the case of a rickety individual, who had no veins proper for phlebotomy. The medical constitution of the season is, also, occasionally opposed to the abstraction of blood: in such cases, the tartrate of antimony and potassa is a valuable agent. Recourse may, likewise, be had unhesitatingly to tartar-emetic at the very first, when the patient is exhausted by age or other causes, and appears to be too weak to bear the abstraction of blood; or in cases where a positive refusal is given to the proposition for phlebotomy." "This agent," he adds, "must also be of great advantage and of convenient employment in country situations, where the physician can rarely pay his visits at an early period. It may be practicable, by this method, and with the aid of an intelligent person, to regulate the treatment of a case of pneumonia or of rheumatism for several days after having premised a copious abstraction of blood, if it be considered desirable." The fact, however, referred to by Bricheteau—that it is not every one who presents the necessary tolerance—would render this agent by no means as easy of application by the *laity* as he presumes.

Granting—and it would seem it must be granted—that the tartrate of antimony and potassa is a sedative agent, it becomes interesting to inquire into the mode in which such agency is exerted. It is, as is well known, one of our best suppurants, when we are desirous of establishing a centre of fluxion on some part of the cutaneous surface, with the view of removing an internal disease. Experience, too, has sufficiently shown that, when given in large doses, it produces pustulation in the mouth and fauces, if not lower down in the alimentary tube. In a case which occurred under the author's care in the Baltimore Infirmary, this effect of the antimonial was signally evidenced. Bricheteau—who has administered it largely as a contra-stimulant—says its local action is exerted more particularly on the mouth, tongue, and pharynx, where false membranes and pustules are occasioned by it; but these lesions, he thinks, are by no means common. The œsophagus, he says, never participates in them, and they are more frequent in the intestinal canal than in the stomach: and in the former, the lower part of the small intestines, and the commencement of the large, exhibit themselves more sensible to the action of the antimony than other portions of the tube; but it cannot be said that sufficient opportunities have occurred for testing the effects of the remedy, and for separating the morbid appearances which have presented themselves, and which may have proceeded from other causes. Bricheteau is of opinion, that the lesions which may be referred, with the greatest probability, to the use of the tartrate of antimony and potassa,—although he admits they are frequently owing to other inappreciable causes,—are, injection or infiltration of the submucous tissue of the intestines, and softening of the mucous membrane. In the mouth, considerable inflammation—either pustular or ulcerous—is sometimes observed, which speedily disappears after the discontinuance of the antimony.

The contra-stimulant virtues of tartrate of antimony and potassa may, then, be dependent upon its revulsive properties; this revulsion being produced in the lining membrane of the alimentary canal; so that when it is accomplished, the excited actions, going on elsewhere, may become diminished, and more or less nervous and vascular concentration takes place towards the seat of the artificial revulsion. Rasori thought that the remedy lessens stimulation, or augmented excitability, directly: Laënnec maintained that it invigorates the action of the absorbents; whilst Vaidy,—a French practitioner, who embraced the precepts of the followers of the "*Nuova Dottrina*,"—is of opinion, that its influence extends immediately to the circulation of the blood, restoring its harmony, and subduing the febrile excitement. Bégin (*Traité de Thérapeutique*, Paris, 1825) asserts that none of these hypotheses can stand the test of attentive inquiry, and that they are not founded on well-observed facts. "They are all in contradiction to experiments made on living animals, which prove that tartar-emetic, whilst it stimulates, and tends to inflame the mucous coat of the alimentary canal, from the cardia to the lower portion of the rectum, irritates the nervous system, and produces more or less inflammatory engorgement of the lungs:" and he adds—"this remedy acts chiefly as a revulsive in the treatment of pneumonia, and we shall have occasion to develop this truth, when treating of the revulsions produced on the gastro-intestinal system."

Robley Dunglison.]

SEX, DOUBTFUL, [*Sexual Ambiguity.*]—Among the freaks of nature, there is none which has given rise to more erroneous ideas or more barbarous practices than those varieties in the formation of the organs of generation, which have given origin to the term *hermaphrodite*. This word, derived from Ἑρμῆς, Mercury, and Ἀφροδίτη, Venus, conveys the notion of an individual partaking of both sexes, and capable of both begetting and conceiving. The ancients believed in the possibility of such a combination in the human body; and enactments existed, both in Greece and Rome, ordering the destruction of infants born with confusion of the sexual organs. At Athens all the unfortunate beings considered to be hermaphrodites were thrown into the sea, and at Rome into the Tiber. In modern times it is admitted that no such phenomenon ever existed in the human species as a perfect hermaphrodite; although there are numerous instances of preternatural structure which gives the appearance of a double sex. In the lower orders of organized bodies, hermaphrodism is common; thus in vegetables it is so prevalent as to have led some to suppose it to be an attribute of the order; and the more nearly the other classes of beings approach the vegetable, the more common is this combination of sex among them. Of this zoophytes, mollusca, acephali, and gasteropodes are examples.

In these animals two kinds of hermaphrodism exist: in some it is absolute, that is, the animal is capable of impregnating itself, as in some of the bivalves, as oysters and mussels; but in others, as the univalves, this power is not possessed, but a union of two individuals is necessary, both, however, becoming impregnated at the same time.

We look in vain for any such admixture in the higher orders of animals, though some extraordinary approaches towards it are recorded. According to Sir. E. Home (Phil. Trans. 1799,) and J. Hunter (Anim. Econ.,) such combination is most frequently met with in neat cattle, the individuals so circumstanced being known by the name of free martins. In these, however, the testes and ovaria are always too imperfect to perform their functions. Instances are not wanting in the human species in which, either from malformation of the genital organs in one or other of the sexes, or from a real attempt at mixture of the two in the same individual, considerable difficulty arises in deciding on the proper sex. This is the point to which the present article is more particularly directed, and it should be recollected that it is one of material importance; for upon the opinion pronounced by medical examiners may depend the employment in life of an individual, the right of inheritance to property, and the judicial decisions concerning impotence and sterility.

[In an able article by Dr. J. Y. Simpson, (Hermaphroditism, in *Cyclopædia of Anatomy and Physiology*, ii. 685, Lond. 1839,) hermaphroditic malformations, considered as a class, are divided into two orders—*spurious* and *true*,—the spurious comprehending such malformations of the genital organs of one sex as make these organs approximate in appearance and form to those of the opposite sexual type; and the true comprising all cases in which there is an actual admixture or blending together, upon the same individual of more or fewer of both the male and female organs. The following is Dr. Simpson's classification:

CLASSIFICATION OF HERMAPHRODITIC MALFORMATIONS.

- Hermaphroditism.
  - Spurious.
    - In the Female....
      - From excessive development of the clitoris, &c.
      - From prolapsus of the uterus.
    - In the male.....
      - From extroversion of the urinary bladder.
      - From adhesion of the penis to the scrotum.
      - From hypospadic fissure of the urethra, &c.
  - True.
    - Lateral.....
      - Testes on the right and ovary on the left side.
      - Testes on the left and ovary on the right side.
    - Transverse .....
      - External sexual organs female; internal male.
      - External sexual organs male; internal female.
    - Vertical or Double
      - Ovaries and an imperfect uterus with male vesiculæ seminales, and rudiments of vasa deferentia.
      - Testicles, vasa deferentia, and vesiculæ seminales, with an imperfect female uterus and its appendages.
      - Ovaries and testicles coexisting on one or both sides, &c.]

Sir E. Home (Loc. cit,) considers that all the monstrous productions hitherto noticed and described as hermaphrodites may be reduced to one of the four following classes:—1. malformations of the male; 2. malformations of the female; 3. males with such a deficiency in their organs that they have not the character and general properties of the male, and may be called neuters; 4. where there exists a real mixture of the organs of both sexes, although not sufficiently complete to constitute the double organ.

Malformation of the Urinary and ...ive Organs of the Male.—Cases of ...lly depend upon imperfection of the ...ra; there is no deficiency of the ...ition of foreign parts, but the ... from the scrotum being split a... ...h half containing a testicle, an... ...be labia majora of the female. ... these parallel folds of skin ver... ...ulva, and the similarity is he... stance of the urethra being ... in these cases, and opening in ... which having a red and tender appea... easily mistaken for the vagina. In consequence of the urethra terminating at the perineum, the penis is imperforate; and thus, if it be of small size, it may be supposed to be the clitoris. It is this malformation of the male organs which more than any other has given origin to mistakes respecting the mixture of the sexes. The case of the negro described by Cheselden (Anat. of the Human Body, p. 314,) was of this kind. In him the scrotum was divided into two separate bags, with a deep slit between them, representing the labia majora and commencement of the vagina. Over these hung down the penis; the imperfection of the scrotum extended to the canal of the urethra,—a circumstance appropriately compared to the fissure of the hare-lip being continued through the bony palate. The penis was united by its under surface, through its whole length, to the folds of skin containing the testicles, resembling an enlarged clitoris, to which resemblance the absence of the urethra contributed. The urethra opened with a large aperture in the perineum, between the divisions of the scrotum, and from its size was mistaken for a vagina. Cheselden describes another case similar to the preceding, which he met with in the person of an European.

Persons afflicted with such malformation as we have described have not only been taken for females but have been married as such. Adélaide Preville was married, and lived the last ten years of her life in Paris, and died in the Hôtel Dieu ... that city. Giraud discovered by examination ... body after death that it was of the mascu... except a false vagina, which co... ...ac placed between the rectum a... ...al presented no resemblance ... ...ecueil périad. de la Soc. de Méd. Paris.) ...here is a very remarkable case related by Marc, (Dict. des Sciences Méd. t. xxi. p. 91 et Jour. de Méd. Chirurg. et Pharm. Paris, Feb. 1806,) in which an individual after having passed for a female for many years, was at length discovered to belong to the male sex, and was restored

by public ordinance to his proper station. On the 19th of January, 1792, the curé of the parish of Ber certified the birth of a girl, and gave her the name of Marie Marguerite. This child arrived at the age of 14 without having particularly attracted the attention of the parents. It shared the bed of a younger sister, and grew up among other young persons with whom it was associated by education, exercise, and childish amusements. At this time Marie complained of pain in the right groin, where a tumour soon manifested itself. The village surgeon took it for a hernia, and applied a truss. This instrument gave too much pain to be borne, and was soon laid aside. The tumour descended and the pains ceased. Some months afterwards, the left groin was affected in a similar manner, and on the supposition of the tumour in it being also a hernia, a double truss was put on, which was as speedily thrown off as the former. At 16 years of age an offer of marriage was made, but refused by the parents as an unsuitable match for their daughter. Three years afterwards another proposal was made and broken off after having been accepted of. Nevertheless, as Marie advanced in age, the graces of her person began to disappear; her clothes did not fit as well as before; her air and carriage had something extraordinary; from day to day her tastes changed and became more masculine; indoor occupations seemed to interest her less, and she preferred field-work to her former duties. These masculine dispositions, and the report of the surgeon that Marie had been hurt in such a manner as to prevent her ever marrying, did not prevent a third lover from aspiring to her hand. This match was much desired by the friends on both sides; but the parents of Marie, knowing that she was not formed as other women, and recollecting that she had never menstruated, did not wish to deceive the son of an old friend, and determined on having a medical examination of their daughter. Worbe was requested to perform this office. The surprise of all was great indeed when he declared Marie to be a man. She (or he) shed tears at the announcement, and was for some months before she could be reconciled to the idea of not being a woman. At last he took the resolution of petitioning the authorities to alter the registry, and declare him of the male sex. A commission was accordingly appointed consisting of three medical men, to inquire into the circumstances of the case, who reported that on examination they found the scrotum divided through its whole extent, each division containing a rounded body, which they recognised as true testicles. Between these parts a fleshy prolongation was observed, having a cleft at its extremity, but imperforate, covered by a process of skin, which was in reality the prepuce. The penis was but little developed; and beneath it, at about an inch and a half from the margin of the anus, an opening was discovered, caused by the abrupt termination of the urethra in the perineum. As to the rest of the body they found nothing remarkable, except a considerable development of the breasts, resulting, as they imagined, from the form of clothing usually worn. They therefore gave it as their opinion that Marie belonged to the male sex; and the authorities declared it to be so, and ordered that the registry of birth and baptism should be altered. Dr. Worbe states that in 1816, this individual was 23 years of age, hair and eyebrows auburn, a light beard appearing on the upper lip and chin, the sound of the voice masculine, height four feet eleven inches French measure, skin very white, constitution robust, and the limbs round but muscular. The form of the pelvis did not differ from that of a male, the knees were not inclined inwards, and the hands and feet were large and strong. A year had not elapsed from the time of his metamorphosis when he was considered as one of the best farmers in the canton. On being questioned with respect to what he felt when sleeping with females, whether he had not desires different from those of others, and if curiosity had not prompted him to discover what opportunity permitted him so easily to observe, he answered, blushing, "quelquefois, mais je n'osais pas."

Dr. Schweikard (Hufeland's Journal, t. xvii. No. 18,) has published the history of an individual who up to the age of manhood was esteemed to belong to the female sex. He had been baptized as a girl, and regarded as such, until to the astonishment of all he demanded permission to marry a girl then pregnant by him. He submitted to an examination, when it was found that the penis was situated lower than ordinary, not quite two inches long, and a little less bulky than usual. The imperforate glans offered a slight curve towards the lower part; the inferior surface of the corpora cavernosa was deprived of urethra, but presented a channel or groove along its middle line. Behind and under the corpora cavernosa, between their root and the anterior superior part of the scrotum, a prominent oval opening was remarked; this was the orifice of the urethra, through which the urine flowed, and in consequence of its vicinity to the penis, the stream was conducted along the under surface of that organ so as to appear to issue from its orifice. The scrotum, situated below this opening, contained the right testicle only, that of the left being probably retained in the abdomen. In all other respects the physical constitution of this individual was perfectly masculine. According to his account, the desire for women and the secretion of semen were observed at puberty. He had frequently performed coition, and had, besides a child born before marriage, two other children well formed, born in wedlock. This case was evidently only an instance of hypospadias, of which malformation we have already spoken in the article Impotence; and it is a further confirmation of the opinion there advanced, that persons labouring under it are not to be considered as incompetent to procreation. It is most probable that the semen during the act of coition was conducted along the penis, as the urine is stated to have been, at least so far as to enter the vagina. A case similar to that just mentioned is detailed by Dr. Wageler. (Annales de Méd. Politique de Kopp. v. 129.)

The malformation of which we have now spoken is that which most frequently causes mistakes in the male, but by a careful examination of the individual the obscurity must be easily removed. There are other degrees of imperfection

which are sometimes observed, but can never lead to much confusion. One of these consists in a close application of the penis to the anterior surface of the scrotum, by a continuation of the skin of the latter over the former. In such a case the penis is bound down in its unnatural situation, and the urine passes downwards; the erection of the organ cannot take place; it may become turgid, but never erect, and intromission is of course impossible. A case of this description occurred to Mr. Brand, (Vide Brewster's Edinburgh Encyclop. art. *Hermaphrodites*, and Beck's Med. Jur. by Darwall, p. 45,) in the person of a child seven years of age, who had been baptized and brought up as a girl; he found a malformation of the male sexual organs consisting of the presence of such an unnatural integument. By a slight incision he liberated the restricted part, and proved to the parents that they had mistaken a boy for a girl.

Another form of lusus which has given rise to mistake of sex, is that in which the urinary bladder, or rather the rudiment of it, opens directly above the pubis, through a deficiency of the abdominal muscles and integuments at that part. In these cases the bladder can scarcely be said to exist; all that appears of it is a red fungous mass protruding through the integuments, consisting of the mucous lining of the viscus, with the uterus opening on it together with the vesiculæ seminales and vasa deferentia. The penis is always very short, scarcely exceeding two inches, and, from deficiency of the urethra, imperforate. The testicles are generally well formed, but are sometimes retained in the abdomen. Persons with this malformation are observed to vary in their sexual appetites; some being totally deficient in sexual desire, others exhibiting it in a trifling degree, while others have it strong. It may readily be supposed that persons constructed in this manner are impotent; but it sometimes happens that the vasa deferentia open in a small tubercle at the root of the penis, in which case it is possible that impregnation may be effected by the individual. It is only by such a disposition of parts we can explain the pregnancy of a young girl in Linlithgow in Scotland, stated to have resulted from her sleeping with a young person, who from a malformation, such as we have described, was supposed to be a female. (Vide Piscottie's History of Scotland, p. 104.) It is plain that if the seminal ducts opened externally above the pubis, such an event could not have taken place.

2. Malformation of the Female Generative Organs.—There are two sorts of malformation in women which may lead to error in judging of the sex. The first consists in excessive dimensions of the clitoris. Although hypertrophy of this organ occurs most frequently in warm countries, it has also been observed in cold. Sir E. Home doubts that it ever takes place in these latitudes, and also is of opinion that even in those situations where it is most frequently observed, the enlargement never proceeds to such a length as to lead to any serious doubt. There are, however, some instances on record in which the increase in size was such as to cause the clitoris to resemble and be mistaken for the male organ. Columbus notices an instance in which it was the size of a finger. Haller observed one case in which he states that it was seven inches in length; and it has been said to reach the extent of twelve inches. (Dict. des Sciences Méd. art. *Clitoris*.) However, notwithstanding any excessive dimensions of the clitoris, an attentive observer will readily discover the difference between the genital organs of a female with such a development, and those of a male. Thus, for instance, in a celebrated hermaphrodite exhibited in Paris and London in 1777, named Marie Auge, the clitoris was found to resemble perfectly the male organ, but it was unprovided with a urethra, and imperforate: it was situated above the other parts of generation, which presented no peculiarity, except an unusual contraction of the vagina. Schneider met with an instance in a child of two years old still more likely to mislead; he examined it after death, and found neither labia majora nor minora, nor the usual cleft between them; the clitoris was an inch and a half long, resembling a penis, with a well-formed glans and prepuce, but it was imperforate, a small spot occupying the situation at which the male urethra terminates. Some lines below this organ there was an opening, by which the urine was transmitted; but this passage seemed also destined to perform the functions of a vagina, for it led directly to the uterus, and was of a length proportionate to the age of the subject; the vaginal rugæ were distinct, and at the upper part of the orifice a small opening was observed which led to the bladder, and was in fact the orifice of the true urethra. In Sir E. Home's (Loc. cit.) paper on hermaphrodites he gives an account of a Mandingo negress whose clitoris was two inches long, and of the thickness of an ordinary thumb: at first view the extremity seemed formed like a glans, but on more minute examination it was found imperforate, and not so round as a true glans, but more pointed; the clitoris was capable of erection, during which state its size increased to three inches. The other parts of generation were well formed, the urethra was situated just beneath the clitoris, which obstructed the flow of urine so much as to compel her to raise it when about to evacuate the bladder. Her person was very masculine, the mammæ were little developed, the voice was rough, and the countenance resembled that of a man. Beclard (Jour. de Med. Chir. et Phar. Mars, 1815,) has given a very detailed account of a female who was exhibited in Paris, in 1814, as an hermaphrodite, from which we extract the following. Marie Madeline Lefort was the name of the individual; she was then sixteen years of age, and in the general form of her body resembled a male; the voice was masculine, a beard appeared on the upper lip and chin, the breasts were developed, and the limbs were slightly hairy. The external genitals presented a rounded mons veneris, covered with hair, but the symphisis pubis was elongated as in the male; beneath it protruded a conoid-shaped body, twenty-seven centimetres in length, when flaccid, but more when erect; this was surmounted by an imperforate glans, covered for three-fourths of its extent by a prepuce. Inferiorily this enlarged clitoris was furnished with a canal, which, however, did not run the whole length, but was pierced in the middle line with five small holes,

capable of admitting a small probe. Beneath and behind the clitoris, there was a sulcus, bordered on each side by a narrow and short labium, which on being handled gave no sensation of containing any body like a testicle. This sulcus or fissure was very superficial, being blocked up by a dense membrane, but which gave, when pressed by the finger near the anus, the idea that it was spread over a cavity. At the anterior superior part, near the clitoris, this membrane was pierced by a round opening, which readily admitted a moderate-sized catheter. The external abdominal rings were very small, and gave no indication of containing testicles. The urine was passed partly through the opening in the membrane described, and partly through the small cribriform openings in the canal extending along the under surface of the clitoris. This was taken from her own account, as she found it impossible to void urine in the presence of the examiners. The bladder could not be reached by a catheter introduced through the large opening, but the instrument could be easily passed upwards and backwards, and in this manner it glided along the posterior surface of the membrane closing the vagina, which, being felt between the point of the instrument and the finger, seemed about twice as thick as the skin. She had menstruated regularly from the age of eight years, and on one occasion when Beclard examined her during menstruation, he observed the fluid to pass through the opening already described, and the catheter then introduced was withdrawn full of menstrual blood. She considered herself a woman, and preferred the society of men, and was persuaded that a trifling operation would render her fit for matrimony. This individual belonged decidedly to the female sex; she had many and the most essential of the female organs of generation, the vagina and uterus, the latter organ moreover performing its natural function with regularity; and those characters of the male which she exhibited were only of a secondary class, such as the proportions of the limbs and body, shoulders and pelvis, the size of the larynx, tone of voice, development of hair, and the prolongation of the urethra beyond the symphisis pubis: this, however, was not complete, for the canal did not extend to the extremity of the mimic penis.

The second kind of malformation of the female generative organs likely to mislead as to the sex of the individual, is a protrusion of the internal parts. The uterus when prolapsed has at times assumed so close a resemblance to the penis that it has actually been mistaken for it by medical men of the highest character. The following case came under the observation of Sir E. Home, who has given the particulars in his paper on hermaphrodites. "A French woman had a prolapsus uteri at an early age, which increased as she grew up. The cervix uteri was uncommonly narrow, and at the time I saw her (when she was about twenty-five years old) projected several inches beyond the external opening of the vagina: the surface of the internal parts, from constant exposure, had lost its natural appearance, and resembled the external skin of the penis; the orifice of the os tincæ was mistaken for the orifice of the urethra. This woman was shown as a curiosity in London, and in the course of a few weeks made four hundred pounds. I was induced by curiosity to visit her, and on the first inspection discovered the deception, which, although very complete to a common observer, must have been readily detected by any person intimately acquainted with anatomy. To render herself still more an object of curiosity, she pretended to have the powers of a male: as soon as the deception was found out, she was obliged to go away." There is in the Philosophical Transactions the history of an hermaphrodite which seems to be exactly similar to this, as is fully proved by the menses flowing regularly through the orifice of the supposed penis. The French physicians were, however, so perfectly convinced of her manhood, that they made her change her dress and learn a trade. To this she readily submitted, and the account says she could perform very well the functions of a man, but not those of the other sex.

3. Males with such a deficiency in their organs that they have not the character and general properties of the male, and may be called Neuters.

This form of hermaphrodism usually takes place in individuals originally intended for the male sex, and is nothing more than the effect produced by atrophy, or absence of the testicles,—a circumstance to which is frequently joined a defective development of the penis. The genital organs do not appear to grow with the rest of the body, but continue in the same state as at birth. In many the characters of both sexes seem mixed; in others there is a slight predominance of one or the other, discoverable chiefly by moral circumstances, such as the kind of life, habits and pursuits of the individual. An instance of this kind of deformity occurred to Hufeland at Koningsberg. An individual named Marie Dorothée Duriée, aged twenty-three years, was examined by him and Mursinna, who both declared the sex to be female, while Stark and Martens were of opinion that the same person belonged to the male sex.

A marine soldier, aged twenty-three years, in the year 1779 was admitted a patient into the Royal Naval Hospital at Plymouth, under the care of Sir E. Home. He had been there only a few days when a suspicion arose of his being a woman, which induced Sir E. Home to examine into the circumstances. He proved to have no beard, his breasts were fully as large as those of a woman at that age; he was inclined to be corpulent; his skin uncommonly soft for a man; his hands fat and short; his thighs and legs very much like those of a woman; the quantity of fat upon the os pubis resembled the mons veneris; the penis was unusually small as well as short, and not liable to erections; the testicles were not larger in size than we commonly find them in the fœtal state; and he had never felt any passion for women. In this case the testicles had been imperfectly formed, and the constitution was deprived of the influence which it naturally receives from them. The two following cases show a still greater degree of imperfection in the male organs; they are mentioned by Sir E. Home.

A woman near Modbury, in Devonshire, the wife of a day-labourer, had three children; the first was considered to be an hermaphrodite; the

second was a perfectly-formed girl; and the third an hermaphrodite similar to the first. In the year 1779 the eldest was thirteen years of age, and of a most uncommon bulk, which seemed to be almost wholly composed of fat; he was four feet high; his breasts as large as those of a fat woman; mons veneris loaded with fat; no penis; a prepuce one-sixth of an inch long, and under it the meatus urinarius, but no vagina. There was an imperfect scrotum with a smooth surface, without a rapha in the middle, but in its place an indented line; it contained two testicles of the size they are met with in the fœtus. The younger one was six years old, uncommonly fat and large for his age: the external parts of generation differed in nothing from those just described except in the prepuce being an inch long. Both were nearly idiots. The immense accumulation of fat, and the uncommon size of these children, accords with the disposition to become fat so commonly met with in the free martin.

4. Where there exists a real mixture of the Organs of both Sexes, although not sufficiently complete to constitute the Double Organ.—Cases of this description which most nearly approach the absolute hermaphrodite are less common than those we have mentioned. A remarkable instance is mentioned in Dr. Baillie's Morbid Anatomy, (3d edit. p. 410.) The person was twenty-four years of age, and bore the name and dress of a woman, had the breasts of a female, and no beard, and yet had a very masculine appearance. The clitoris and meatus urinarius had the natural appearance, but there were no nymphæ, and the labia pudendi were unusually pendulous, resembling a split scrotum, and contained a testicle each. The vagina was found to terminate in a cul-de-sac, two inches from the external surface of the labia. She had no partiality for either sex, and had never menstruated.

The Memoirs of the Academy of Dijon contain the following case, communicated by M. Maret. (*Mahon*, t. i. p. 190, and Beck by Darwall, p. 43.) Hubert J. Pierre died at the hospital in October 1767, aged 17 years. Particular circumstances had led to a suspicion of his sex, and these induced an examination after death. His general appearance was more delicate than that of the male, and there was no down on his chin or upper lip. The breasts were of the middle size, and had each a large areola. The bust resembled a female's, but the lower part of the body had not that enlargement about the hips which is usually observed at his age. On examining the sexual organs, a body four inches in length and of proportionate thickness, resembling the penis, was found at the symphisis pubis. It was furnished with a prepuce to cover the glans, and at its extremity, where the urethra usually opens, was an indentation. On raising this penis, it was observed to cover a large fissure, the sides of which resembled the labia of a female. At the left side of this opening there was a small round body like a testicle, but none on the right. However, if the abdomen was pressed, a similar body descended through the ring. When the labia were pushed aside, spongy bodies resembling the nymphæ were seen, and between these and at their upper part the urethra opened as in a female, while below these was a very narrow aperture covered with a semilunar membrane. A small excrescence, placed laterally, and having the appearance of a caruncula myrtiformis, completed the similarity of this fissure to the orifice of the vagina. On further examination the penis was found to be imperforate; the testicle of the left side had its spermatic vessels and vas deferens which led to the vesiculæ seminales. By making an incision into the semilunar membrane, a canal one inch in length and half an inch in diameter was seen, situated between the rectum and bladder. Its identity with a vagina was, however, destroyed by finding at its lower part the verumontanum and the seminal orifices, from which, by pressure, a fluid, resembling semen in all its properties, flowed. The most remarkable discovery was, however, yet to be made. The supposed vagina, together with the bladder and testicles, was removed. An incision was made down to the body noticed on the right side. It was contained in a sac, filled with a limpid and red-coloured liquor. From its upper part on the right side, a Fallopian tube passed off, which was prepared to embrace an ovarium placed near it. It seemed thus proved that the body in question was a uterus, though a very small and imperfect one, and on blowing into it, air passed through the tube.

In April 1807, an individual was exhibited at Lisbon, uniting the organs of both sexes in the highest degree of perfection that has probably been ever seen. This person was twenty-eight years of age, and possessed of the male organs, a penis, or what represented one, capable of erection, covered by a prepuce, and pierced for a third of its length by a canal, and testicles. The air and appearance were masculine, the colour dark, and a light beard covered the chin. The female organs were labia, vulva, and vagina, well formed, but very small; the larynx and voice were feminine, and so were all the dispositions; she menstruated regularly, and was twice pregnant, but was prematurely delivered each time, once at three, the other at five months. (Dict. des Sc. Méd., art. *Hermaphrodite.*) This, if the account respecting the testicles be correct, is the nearest approach to a true hermaphrodite with which we are acquainted in the human subject.

In the Memoirs of the Royal Academy of Sciences of Paris (An. 1720) there is a very accurate description by M. Petit, of a similar mixture of organs. The person had wholly the character of a man, but was of a delicate constitution; he was a soldier, and died of his wounds. The appearance of the penis is passed over; but the scrotum not containing testicles drew M. Petit's attention, and in the dissection he found testicles in the situation of the ovaria, attached to two processes, continued from an imperfect vagina, but having vasa deferentia, which passed in the usual manner to the vesiculæ seminales; the vagina communicated with the urethra between the neck of the bladder and of the prostate gland.

[A number of cases in which there was a mixture of the organs of the two sexes are now on record. (Simpson, *op. cit.* See also, Guy, *Principles of Forensic Medicine*, p. 36. Lond. 1843; and the writer's *Human Physiology*, 5th edit. ii. 351. Philad. 1844.)]

With respect to the formation of such monsters as we have spoken of, Sir E. Home was of opinion that the only mode in which it can be explained is by supposing the ovum, previous to impregnation, to have no distinction of sex, but to be so formed as to be equally fitted to become a male or a female fœtus; and that it is the process of impregnation which marks the distinction, and conduces to produce either testicles or ovaria out of the same materials. The following circumstances are in favour of this opinion. The testicles and ovaria are formed originally in the same situation, although the testicles even before the fœtus has advanced to the eighth month, are to change their situation to a part at a considerable distance. The clitoris in fœtuses under four months is so large as to be often mistaken for a penis, and serves to explain an erroneous opinion at one time maintained in France, that the greater number of miscarriages between three and four months have been remarked to be males; which mistake arose from the above circumstance. The clitoris originally appears, therefore, equally fitted to be a clitoris or a penis, as it may be influenced by the ovarium or testicle. In considering this subject, it is curious to observe the number of secondary parts, which appear so contrived that they may be equally adapted to the organs of the male or female. In those quadrupeds whose females have mammæ inguinales, the males have also teats in the same situation; so that the same bag which contains the testicles of the male is adapted to the mammæ of the female. In the human species, which has the mammæ pectorales, the scrotum of the male serves the purpose of forming the labia pudendi of the female, and the prepuce makes the nymphæ. The male has pectoral nipples as well as the female; and in many infants, milk, or a fluid analogous to it, is secreted, which proves the existence of a glandular structure under the nipple. This view of the subject throws some light on those cases where the testicles are substituted for the ovaria; since, whenever the impregnation fails in stamping the ovum with a perfect impression of either sex, the part formed will neither be an ovarium nor a testicle, sometimes bearing a greater resemblance to one, sometimes to the other; and may, according to circumstances, either remain in the natural situation of the ovaria, or pass into the situation proper to the testicle, whether it is the scrotum of the male or the labia pudendi of the female. [On the causes of hermaphroditic malformation, see J. St. Hilaire, *Hist. des Anomalies de l'Organiz.* ii. 58; and Simpson, *op. cit.*]

Means of ascertaining the true sex of a supposed Hermaphrodite. — We say supposed, because, as has been already stated, we do not acknowledge the existence of a true hermaphrodite in the human species. Some cases no doubt have occurred in which it was very difficult to assign the proper sex; but even the most perfect of these complications of the genital organs did not give the individual in whom they existed the power of double copulation. Thus in the case of Hubert Pierre it is not easy to decide to which sex he really belonged: again, we must admit that great difficulty existed in coming to a conclusion when we find such men as Hufeland, Mursinna, Stack, Martens, and Metyger disagreeing. From these and other cases that might be quoted, we must agree that cases do occur in which the greatest difficulty must be felt, and the greatest caution should be used in forming an opinion. These cases of great difficulty all belong to the last class of malformations: in the other classes the solution is not so difficult. In proceeding to make an examination for the purpose of ascertaining the sex of an individual, the greatest care should be taken not to mistake appearances, and these should be all accurately noted down. The different openings that present themselves should be all explored with appropriate instruments, (taking care not to inflict any wound or cause pain,) in order that their direction may be ascertained. An accurate inspection of the whole body should be made, to elicit any predominance of the constitutional characters of either sex that may exist. These examinations should not be made hurriedly, but should continue for a length of time, and be frequently repeated, before a positive opinion is given; for the tastes, habits, and propensities of the individual must be taken into account, as well as the physical conformation in doubtful cases. It is of importance to be informed whether a discharge of blood has ever escaped from any of the openings, and if repeated, whether it has been periodical; as that circumstance alone will be sufficient to decide us in coming to a conclusion. In the case of young children, it is best to wait until the parts become more fully developed, as it has happened that instances of confusion of sex when young have at the age of puberty taken a decided leaning to one or the other sex. Above all, it is necessary to be most cautious in believing all that is stated by the individual or the friends, as, from interested motives, they may misrepresent facts in such a way as to lead us into error.

T. E. Beatty.

SMALL-POX. — The most approved authors concur in the belief that the disease known to us by the name of *small-pox* or *variola*, was not described by any of the writers of antiquity. From their silence, therefore, respecting a disorder so fatal, and possessing such very peculiar characters, we may reasonably presume that its origin was subsequent to their times, and that the world had existed some thousand years before it was visited with this dreadful pestilence. Etymology comes here in aid of history. The first authentic passage in which the words *variola* and *pocca* occur is to be found in the Bertinian Chronicle of the date 961. (Moore's History of Small-pox, p. 87.) There being no term for the disease in the Greek or Roman authors, variola was coined in the middle ages from the Latin *varus*, a pimple, or *varius*, spotted, and for several succeeding centuries was applied to designate measles as well as small-pox. From variola are derived the Italian vaiuolo, and the French vérole. The term *poc* is of Saxon origin, and signifies a bag or pouch. The Anglo-Saxons early adopted this word, which was variously spelt, and became pock, pocks, and pox. The epithet *small* in England, and *petite* in France, were added in the fifteenth century.

From very early times attempts have been made to prove the antiquity of small-pox, and even in

our days this doctrine has found supporters. Dr. Baron, of Gloucester, the latest writer on the subject, entertains the opinion that small-pox is to be traced in the earliest writings of the Hebrews and Greeks; that it was seen by Hippocrates, and commented upon by Galen. According to this author, the account of the plague of Athens, as given by Thucydides, "presents as accurate an account of the leading symptoms of variola as could possibly be expected from any historian not medical." (Life of Jenner, p. 177.) In this opinion Dr. Baron is countenanced by Salmasius, Hahn, and more recently by Dr. Willan, in a posthumous dissertation "On the Antiquity of Small-pox." Rhazes, an Arabian physician, and the first acknowledged writer on this disease, laboured to prove that Galen had seen it, but with all his enthusiasm for his master, he acknowledged and was surprised at the unwonted brevity and inaccuracy of his description. This alone may be considered as decisive of the question; but we may further state that Friend and Mead, authors of the highest repute, after devoting great attention to the subject, agreed that there was no foundation for such a notion. We shall be fully justified, therefore, in adhering to the generally received opinion that small-pox is a disease of modern origin.

The first notices of a disorder which exhibits the well-marked features of small-pox, are to be found in the historical writings of Procopius (De Bello Gothico, lib. ii.), who flourished during the reign of Justinian the First. The obscurity of its origin, the difficulty of its cure, the universality of its devastations, and above all, the complete immunity from second attacks which are mentioned as characteristic of this epidemic, bespeak it to have been truly small-pox. It began A. D. 544, at Pelusium in Egypt, from whence it spread to Constantinople. This corresponds closely with the era commonly assigned in medical books to the first appearance of small-pox, viz. A. D. 569, the year of the birth of Mahomet. In that year an Abyssinian army, under Abrahah the viceroy, appeared before Mecca, and was unexpectedly compelled to raise the siege. Several circumstances concur to render it probable that the sudden retreat of the army was owing to the breaking out of small-pox, and the dreadful mortality which it occasioned. Bruce, in his travels (Travels to discover the Source of the Nile, vol. i. p. 514), met with a manuscript account of this war, which confirms this story, and strengthens the opinion that small-pox first appeared in Egypt and Arabia about the middle of the sixth century.

A further question has been raised and keenly agitated, whether the small-pox really began in Egypt, or was conveyed to the shores of the Red Sea from India. Attempts have been made to establish the existence of this disease in China and Hindostan at very remote periods. Mr. Moore, in his history of small-pox, advocates this opinion. He finds in the mythology, the religious institutions, the sacred and historical records, the medical works, and uniform tradition of those countries, abundant proofs that small-pox existed there at a period antecedent even to Hippocrates. (Moore's History of Small-pox, p. 35.) He then enters into an investigation of the circumstances which may have prevented the spread of the infection from Asia to Europe and Africa. It must be acknowledged, however, that the facts on which Mr. Moore relies in support of this opinion rest on very questionable authority; and as the opinion itself has not met with many supporters, it is not necessary in a practical work like the present to bestow on it more particular examination.

The small-pox, and with it the measles, certainly burst forth in Arabia under circumstances most fatally favourable to their dissemination. It was in the year 622, when Mahomet began to collect the wandering tribes of Arabs whom he led forth, inflamed with religious zeal, against the neighbouring nations. To the devastations of war were now added the ravages of a new and most intractable disorder. But if we owe the introduction of small-pox to the Arabian armies, it is to the physicians of the same nation that we are indebted for the earliest accounts of it. Rhazes, an Arabian physician, who practised at Bagdad about the beginning of the tenth century, is the first author who treats expressly of small-pox. He quotes, however, several of his predecessors, of whom the most ancient is Ahron, a physician of Alexandria, who is supposed to have flourished about the year 622, the era of the Hegira, when Mahomet first went forth as a conqueror and a prophet. The treatise of Rhazes "De Variolis et Morbillis," deserves especial mention for the accurate description which is given of the several kinds of small-pox. His theory of the disease, however, is childish and scarcely intelligible, and his treatment lamentably deficient. He abounds, indeed, with directions for the management of every symptom, and more especially for that of the pustules in their several stages, which is very complicated, consisting of fomentations, fumigations, dry powders, ointments, and other applications chiefly intended to prevent pitting. In most of those instances his prescriptions are harmless, but this merit does not belong to his recommendation of free bloodletting and of the most powerful narcotics in all stages, and even in the confluent forms of the disease. Avicenna, another Arabian physician, gives also a very full and excellent account of the symptoms of small-pox, and he improves upon the treatment suggested by Rhazes, by restricting bleeding to plethoric habits, and to the three first days of the disease. Both Rhazes and Avicenna concur in the opinion that measles and small-pox are only modifications of the same disorder. Avicenna considered measles as a sort of bilious small-pox.

Hali Abbas, a third Arabian author on small-pox, deserves to be mentioned as having made an approach to the doctrine of contagious origin. The theory of small-pox adopted by him, as by all the Arabian physicians, was founded on the commotion and putrefaction of the humours of the body; but Hali observed that one of the accidental causes which excited the movement of the distempered humours to the skin was being in the same place with persons affected with the small-pox, or breathing air contaminated with the pestilential vapour of small-pox pustules. All the Arabian authors believed in the occasional occurrence of small-pox twice in the same person.

The successes of the Saracen arms in Spain and Sicily, during the eighth century, contributed

doubtless to the gradual extension of small-pox through the different countries of Europe, but on this subject very little is known. We read that on several occasions a pestilence of fire raged, the body dissolving away as if burnt, with an intolerable fœtor of the putrid flesh. It is reasonable to suppose that some at least of these epidemics were the small-pox: others may have been the true Egyptian plague with buboes.

The researches of antiquarians lead to the belief that small-pox reached England early in the tenth century (907). There is preserved in the British Museum a curious Anglo-Saxon manuscript, supposed to have been written in that century, containing an exorcism or supplication against the small-pox. (Moore's History of Small-pox, p. 94.) Nicasius was the saint especially addressed on these occasions. All that we read serves to show how great were the terrors inspired by the small-pox in every period of its career.

The discovery of America by Columbus, which so wonderfully extended the boundaries of human knowledge, was the occasion also of scenes of desolation at which the heart sickens. Among all the calamities incident to that event none can surpass the introduction of small-pox into that continent, which took place in 1517, twenty-five years after its discovery. It is stated, on the authority of the Spanish historians, that in a very short time after the infection reached Mexico, three millions and a half of people were destroyed by it in that kingdom alone. Among the victims was the emperor, the brother and successor of the brave but unfortunate Montezuma. (Robertson's History of America, vol. iv. b. viii.)

From the revival of learning to the present period, no subject has attracted the attention of physicians, both speculative and practical, more than small-pox. Every medical writer has treated of it, and some have devoted themselves exclusively to its study. It would be vain, therefore, to attempt more than a brief allusion to those who have distinguished themselves in this department of medical inquiry.

The humoral doctrines which prevailed in the schools during the sixteenth century led to the universal adoption of the hot or alexipharmic mode of treating pestilential and malignant diseases, including small-pox. Sennertus gives the following account of the practice pursued in his time (1628). The great object was to expel the noxious humour by perspiration, to accomplish which various decoctions of warm seeds are directed, containing mithridate, bezoar, and other drugs, denominated alexipharmic and sudorific. "While using these, every attention is to be paid, especially in winter, to prevent the admission of cold air. The patient is therefore to be tended in a warm chamber, and carefully covered up, lest by closing the pores of the skin the efforts of nature should be impeded, the humours driven upon internal organs, and matters which ought to be expelled retained within the body, to the imminent danger of the patient, and the certainty of increasing restlessness, fever, and other symptoms." (De Variolis et Morbillis, t. vi.)

Such had long been, and such was the state in which Sydenham in 1667 found the theory and practice of small-pox. Bad as that practice was, it yet had the support of all the learning and all the prejudices of the age. It required, therefore, talent and boldness successfully to oppose it. Sydenham began by separating for ever small-pox from measles, with which, from the days of Rhazes, it had been so strangely yet so obstinately associated. He divided small-pox into two kinds, the distinct and confluent, traced with the greatest accuracy the usual course of both, and added many important remarks to the detail of symptoms given by others, particularly with reference to prognosis. Of the intimate nature or essence of small-pox he professed his ignorance in common with the rest of mankind, but adds immediately afterwards his suspicion that it consists of a specific inflammation of the blood and other humours, and that the inflamed particles, when duly digested and concocted, are expelled from the body in the form of little abscesses. The chief merit of Sydenham consists in his criticisms on the prevailing treatment of small-pox. These, though worded with the most scrupulous care, and an anxious wish to avoid hurting the feelings of his professional brethren, yet exposed him to much obloquy, and he was calumniated as an innovator and a homicide. He introduced what is now called the cooling regimen, including fresh air, light bed-coverings, and abstinence from wine and all cordial and sweating medicines. The remedies on which he chiefly relied were moderate bleedings, acidulated drinks, and opiates. His principal faults consisted in the timid employment of purgatives, and his fondness for blisters.

Boerhaave, who was born when Sydenham was at the height of his fame (1668,) entertained the highest admiration of him, and was contented to adopt almost without alteration the description and treatment of small-pox given in his works. But Boerhaave has the great merit of first putting prominently forward *contagion* as its direct exciting cause. He acknowledges "that as the first man who suffered from small-pox must necessarily have received it without contagion, so may it still be occasionally engendered by causes of which we are ignorant. Nevertheless, as a general law it may be stated that the contagion once generated multiplies itself without any assignable limit, as the smallest spark may spread the widest conflagration." (Van Swieten's Commentaries, vol. v. p. 18.)

The theory and treatment of natural small-pox, placed thus, by the combined labours of Sydenham and Boerhaave, upon their proper footing, underwent no important changes during the last century; the attention of authors was then directed almost exclusively to the new discovery of inoculation, of which we shall treat more fully in a subsequent page.

We now proceed to give a description of small-pox, and have to remark, in the first place, how singularly diversified are the appearances which it presents. A variety of causes contribute to this, but none more remarkably than the previous habit or condition of the body with reference to the contagion of small-pox. It will be useful, therefore, to begin by considering the disease under three different aspects:—

First, as it occurs, casually and for the first time, to those who have undergone no preparatory process. This is called the casual or *natural* small-pox.

Secondly, as it occurs to those who in early life have undergone the process of vaccination. This is called the mitigated or *modified* small-pox.

Thirdly, as it occurs to those who have been inoculated with the variolous virus: the *inoculated* small-pox.

Natural Small-pox.

This disease is characterized by a long train of phenomena, some of which are peculiar to it, while others are common to it with other acute disorders. From very early times it was observed that these admit of a division into three *stages*. Such an arrangement is strictly natural, and admits of no improvement. These are, the stages of incubation, maturation, and decline; and they will require separate investigation.

I. **Stage of Incubation.** — Under this head is included the whole period that elapses from the reception of the variolous germ, or virus, into the human body, until the appearance of eruption. Rayear (Treatise on Diseases of the Skin, translated by W. B. Dickinson, p. 108, London, 1833) subdivides it into the two stages of incubation and invasion, the former comprising the interval between the reception of the germ and the *sickening*; the latter extending from the sickening to the appearance of eruption. In very many cases, however, this distinction cannot be made, the two periods running into each other by insensible degrees.

The reception of the variolous poison into the human body casually by the mode of *infection*, (that is, through the medium of respiration,) takes place in most instances imperceptibly and without symptoms. Occasionally, however, the patient experiences at the moment of imbibing the germ of disease some unpleasant sensation, such as a disagreeable odour, or a feeling of giddiness, or sickness at stomach, or, what is perhaps more common still, an inward sense of alarm or fright. The duration of this stage is subject to some variety. Fourteen days may be stated as the average period that elapses from exposure to contagion to the appearance of eruption. The extremes may be set down as one week and three weeks. This interval is passed differently in different cases. Sometimes the patient, during the whole or greater part of this period, has been weak, languid, low-spirited, and inactive, with impaired digestion and unquiet nights. He has felt poorly, without any assignable cause. In the greater number of instances, however, no uneasiness whatever is experienced until the eleventh or twelth day after exposure to contagion, when an unexpected and perhaps severe rigor announces the commencement of the initiatory, or, as it is sometimes called, the *eruptive* fever. This is accompanied in some cases with severe pain or weakness of the back, so that the patient has dropped down; in other cases with acute pain of the epigastrium, aggravated on pressure, and hence sometimes mistaken for gastritis; with nausea, vomiting, giddiness or headach. Children are often very drowsy at this period. The nervous system sometimes participates in a more marked manner. There is extreme prostration of strength. The patient staggers in his walk, and the expression of countenance is anxious and haggard: children have an epileptic fit: adults become delirious. These more urgent symptoms generally indicate the approach of a severe form of the disease. Of this there can be no doubt, when, in addition to the symptoms already enumerated, we observe such as denote that the fluids of the body are implicated in the mischief which is going on—that is to say, when petechiæ appear in different parts, or large patches of subcutaneous ecchymosis, with hemorrhage from the nose, mouth, stomach, bowels, or uterus. Under these circumstances death has been known to take place prior to any unequivocal appearances on the skin. Here the real nature of the disease must always remain in some degree doubtful, but it can often be inferred by tracing carefully the history of the case. It will be found to have succeeded exposure to small-pox contagion within the reasonable limit of time, or it may in its turn have communicated contagion to others. Several well-marked instances have occurred, rendering it almost certain that contagious emanations are thrown off from the lungs and skin even at this early period of the disease.

The duration of the initiatory or eruptive fever of small-pox has been a fruitful source of discussion among authors. Prior to the time of Sydenham the object of physicians was to shorten the period as much as possible, and to promote an early eruption, which they attempted to effect by powerful diaphoretics. Sydenham, on the other hand, maintained that the more tardy the eruption the lighter was the subsequent disease. This observation is not borne out by the results of our own experience; and it is not improbable that Sydenham's judgment might have been in some degree warped by his anxiety to dissuade from that heating regimen of whose injurious effects he was so well convinced. The fact appears to be that the period of the initiatory fever is most remarkably uniform. The eruption in a vast majority of cases shows itself at the end of forty-eight hours from the occurrence of rigor or headach, whether the subsequent disease be mild or malignant, confluent or distinct: in other words, one complete day intervenes. Sometimes, from accidental circumstances, (such as great weakness of constitution,) this period is protracted to seventy-two hours, but never, so far as we have observed, is it shortened. This may be looked upon as a remarkable law of the variolous disease, and a most important means of distinguishing small-pox from other exanthemata, particularly scarlatina, lichen, and measles. In the two former disorders, the duration of the premonitory symptoms is less than in small-pox; in measles it is greater.

II. **Stage of Maturation.**—The eruption of small-pox shows itself in the first instance in almost all cases on the face and wrists, and thence gradually extends over the rest of the body. In a very few cases only has it been first observed on the inferior extremities. It consists of minute papulæ sensibly elevated above the general surface of the skin. In some instances the eruption is fully developed over the whole body in the course of twenty-four hours. In other cases, two and even three days elapse before the process is

completed on the legs and feet. When the papulæ are few in number, and separate from each other, the disease is called *distinct*; when the eruption is close set and profuse, *confluent*. To the intermediate varieties the old authors gave the name of *contiguous* or *coherent*, but the term *semiconfluent* is preferable. We apply it to designate those cases where the eruption is confluent in one part and distinct in another, as well as those where the papulæ are numerous without actually running into each other.

Arrangement and structure of the pock.—This branch of the subject has excited much attention at various times, and in particular was investigated diligently by Cotugno, (better known under his Latin name of Cotunnius,) an Italian physician, in the year 1771. (De Sedibus Variolarum. Vienna, 1771.) When the papulæ are few in number, they will not be found indiscriminately diffused over the body, but arranged in groups of three or five, and assuming a crescentic or semicircular form. When two groups coalesce, a complete circle of papulæ may sometimes be observed. The papulæ have their seat in the true skin; and upon the third or fourth day from their first appearance are converted into vesicles, containing a thin transparent lymph. These vesicles are very curiously organized, being divided into six or eight cells tied together in the centre, which for several days is depressed. This central depression, or *umbilicated* form of vesicle (as it is sometimes called), is very characteristic of small-pox. It is exhibited only in one other disease—cow-pox. The specific matter or poison of small-pox is secreted by the parietes of the minute cells, and the progress of inflammation in the papula is denoted by the inflammatory circle (called areola) which about the fourth day begins to surround it. As the colour of this areola changes to a bright crimson, the lymph in the vesicle is converted into a thick opaque matter, of a white or straw colour. This distends the cells, and gradually increasing in quantity, breaks down the central band, in consequence of which the pustule *acuminates*. In favourable cases this process is usually completed in seven, or at furthest in eight days: occasionally it occupies only five or six days.

During the maturation of the pustules there is always some degree of fever present, varying, of course, in violence, with the quantity of eruption, the habit of the patient, and the circumstances in which he may happen to be placed. If the habit of body be good, the season mild, the apartment cool, the diet duly restricted, and the mind free from anxiety, there will be very little fever, even though several hundred pustules are in the process of maturation. There is generally more or less tenderness of the skin present. Occasionally this tenderness is excessive, and productive of the greatest distress.

Confluent form of small-pox.—When the eruption is very copious over the whole or greater part of the body, this, its regular or normal progress, undergoes several important modifications, which are next to be described. In some cases, indeed, the confluent small-pox runs the same course as the mildest forms of the distinct disease. The vesicles are small, and each is surrounded by a minute areola, while the constitutional excitement is moderate. Such a form of small-pox may be characterized as the *confluent superficial*. The most familiar instances of it are presented when the disease is taken after vaccination, but it is sometimes witnessed among persons wholly unprotected.

Analysis of the symptoms of confluent small-pox.—1. The first peculiarity of confluent small-pox, as generally met with, is, that from a very early period it involves not only the cutis vera, but the subjacent cellular membrane in extensive and often violent inflammation. The eye-lids are swollen, and by the fifth day the patient is unable to see. The scalp is tense and tender. The parotid glands participate in the increased action of the surrounding cellular membrane, and salivation takes place, with great turgescence of the cheeks. The limbs are tumid, and an erythematous redness often occupies such parts as are free from variolous papulæ. In the most aggravated cases, buboes form in the groin, often with intense pain. The skin being almost wholly occupied with vesicles, there is no areola. The pustules do not acuminate, but appear flat and doughy, and upon the face especially they coalesce into one large sore, which discharges a copious thin ichor. The constitutional symptoms accompanying this kind of small-pox are very severe. The pulse is rapid, with extreme debility, restlessness, and total want of sleep.

2. The second peculiarity of the confluent small-pox is, that the eruption occupies not only the skin but the mucous expansions of the mouth, nose, pharynx, larynx and trachea to below its bifurcation. The tongue is also occupied with vesicles. The precise structure of the mucous vesicle has not been determined with the same accuracy as that of the cutaneous vesicle; but it runs a course in all respects similar. This complication of mucous inflammation adds immeasurably to the danger of the disease, besides that it modifies some of the other symptoms. Heat of the mouth, pain of the throat, difficulty of swallowing, hoarseness, dyspnœa, and more or less mucous expectoration, are the first symptoms that it occasions. These increase in severity until the eighth day, from which time a copious secretion takes place from all the structures so affected. In a large proportion of cases the swelling occasioned by the inflammation so narrows the opening of the larynx, and the effused matter so blocks up the air-passages, that suffocation is produced. Before this takes place, however, the respiration has been impeded to such a degree as materially to interfere with the due oxygenation of the blood. Hence arises a long and frightful train of symptoms, among which we may particularly enumerate gradually increasing dyspnœa, coldness and paleness of the extremities, lividity of the areola, especially in parts distant from the centre of circulation, a swelled and purple tongue, great restlessness, and a low muttering delirium.

Cases of the confluent form of small-pox are sometimes met with, which are altogether devoid of mucous complication, but they are very rare. The extent of mucous and of cutaneous inflammation, however, are not always and necessarily proportioned to each other. A case may be very

confluent on the surface, with but few vesicles in the throat.

3. A third circumstance influencing materially the character of the symptoms in the confluent variety of small-pox, is the early and deep implication of the brain and nervous system. This fortunately is but a rare occurrence. The chief symptom by which it is characterized is early and violent delirium, (the delirium *ferox* of old authors,) attended in many cases with such a strong disposition to self-destruction that the utmost care should always be taken to guard against the possibility of accident. Variolous delirium is accompanied with redness of the conjunctiva, contraction of the pupil, and a wild expression of countenance. It generally shows itself at the very commencement of the initiatory fever, but is sometimes delayed until the second or third day from the appearance of the eruption. Excessive restlessness, anxiety, and despondency may be viewed as lighter evidences of the same specific affection of the brain. Nothing indicates its absence so certainly as a calm and collected manner, with a succession of quiet nights, and a confident hope of recovery. Variolous delirium is always most violent in the early periods of the disorder. When the areola begins to form, still more when external inflammation is fully developed, delirium for the most part ceases. Cases of confluent small-pox complicated with delirium are extremely dangerous. A large proportion of them terminate unfavourably, sometimes by affection of the head, (coma,) sometimes by acute inflammation of some other internal part, especially the pleura, brought on or determined by the general derangement of the nervous system. We have stated, as a general rule, that the peculiar affection of the brain and nervous system now adverted to, is associated with a full confluent form of eruption, but occasionally it is found to accompany, and of course very materially to aggravate the danger of distinct and semi-confluent cases.

4. The fourth circumstance which characterizes and modifies the phenomena of the confluent forms of small-pox, is the implication of the *fluids* of the body,—in other words, the concurrence of that state of the blood called by the old writers *dissolved* or putrescent. To these, the most aggravated of all cases, the terms *malignant* or petechial small-pox are generally applied. They are thus distinguished. From the earliest period of the disease, petechiæ are observed in different parts of the skin. Sometimes the extent of subcutaneous ecchymosis is immense. As the vesicles advance to maturation, they fill, not with pus, but with a thin ichor tinged with blood. Hemorrhages break forth from all the mucous structures of the body. The gums bleed often very profusely. There is epistaxis, spitting of blood, vomiting of blood, and the passage of blood by stool. Females suffer from violent menorrhagia, and abortion never fails to occur to such as are pregnant. There is bloody urine in some cases. All this occasionally happens without delirium, or any other well-marked evidence of cerebral affection. More commonly, however, these conditions, viz. disturbed brain and dissolved fluids, are found associated together. From this appalling variety of small-pox, recovery is scarcely ever met with. Death usually takes place between the fifth and seventh days of the eruption.

Complications.—Such are the ordinary phenomena of the natural small-pox in its distinct and confluent forms, when it occurs to persons previously in good health and of sound constitution. But it must be remembered that this disorder may attack those who may be labouring, at the time of seizure, under some other disease, such as pneumonia, hooping-cough, hepatitis, or consumption; and further, that these and other disorders may come on, unexpectedly, at any period, early or late, during the progress of small-pox. An infinite variety of *accidental* symptoms may thus be superadded to those regular symptoms now enumerated. Besides which, small-pox may occur to persons of a weak habit, or in constitutions exceedingly exhausted, and unable to cope with a disease of such severity. It may occur, for instance, to those who have but recently recovered from a severe typhous or scarlet fever. Under these circumstances, we observe a very tardy eruption; collapse without advance of eruption; or in cases somewhat more favourable, an abundant formation of large blebs, containing a thin ichor, with a very tedious and hazardous period of convalescence. To this latter form of the disease the old writers gave the name of the watery or bladder pock.

III. **Stage of Decline.**—If the maturating stage of small-pox exhibits great diversity of symptoms, so also, even in a more eminent degree, does the stage of decline. The mildness and rapid progress to recovery which some cases present, contrast strongly with the severity, obduracy, and varied dangers of others.

In the distinct and mild form of small-pox the pustules burst and discharge their contents on the sixth, seventh, or eighth day. A scab succeeds, cicatrization commences, and in vigorous constitutions is completed in about eight or ten days. In the very mildest cases of all, which approach to the character of chicken-pox, there is very little discharge of matter, but the pustules harden, and the small portion of pus which they do contain is apparently absorbed. This variety of the disease has been called the dry or horny pock, and it is the most common form in which small-pox shows itself after previous vaccination.

In cases of greater severity, as well in the truly confluent as in those which we have distinguished as the semi-confluent variety, where the eruption is copius, but where the vesicles do not actually coalesce except in a few places, the decline of the disorder is attended with some remarkable phenomena, of which the most important are pitting and secondary fever. Cicatrization is tedious and ultimately effected with such a loss of substance in the true skin as occasions pits and scars, which continue during the remainder of life. From the great vascularity of the face, there is always greater confluence and a higher degree of inflammation there than in other parts. Hence, pitting is chiefly met with in the face, disfiguring and often completely altering the countenance of the sufferer.

Secondary fever.—The febrile symptoms subside entirely in all cases where the pustules have maturated kindly over the whole body; but in all

severe cases, that is to say, where the cellular membrane and glands which it envelopes have become involved with the skin in inflammation, the fever, so far from subsiding on the ninth or tenth day, when the maturative stage has closed, is aggravated. The surface of the skin at this time becomes hot and dry, the tongue white, the pustules hard and scaly, the pulse increases in frequency, the patient is tormented with a great, sometimes inextinguishable thirst. Secondary fever is now said to have set in, and the variety of symptoms observed during its progress almost baffles description. The following attempt to enumerate some of the leading phenomena of secondary fever will serve at least to point out the character of this very singular condition.

1. In a large proportion of cases, secondary fever is accompanied with some form of inflammatory action on the surface. An efflorescence identical with that of scarlatina occupies the trunk and extremities. Trails of erythematous redness appear in several parts, or a genuine erysipelas attacks the head, trunk, or limbs. In other cases the cutaneous and cellular inflammation is more circumscribed, leading to the formation of abscesses, often of great extent, of boils and carbuncles, and ulceration of those parts which are especially liable to pressure, such as the elbows, hips, and sacrum. In those situations sloughing sores are often met with, which from their extent and depth bring life into danger. In some cases the scalp is the part which receives the violence of the fever. Abscesses form there, or a diffuse cellular inflammation takes place, which is followed by purulent infiltration. Lastly, in a few instances the whole surface is occupied with pustules of *ecthyma cachecticum*, accompanied with fever of the hectic kind, which is with great difficulty subdued.

2. Secondary fever is accompanied in a certain proportion of cases with ophthalmia. The subject of variolous ophthalmia is one of great extent and importance. In the early periods of the disease it is not uncommon to observe a considerable degree of conjunctival inflammation, and sometimes a pustule forms at the edge of the cornea; but it is reserved for the decline of the disease to exhibit the aggravated form of this affection. In some desperate cases an intense form of ophthalmia sets in about the tenth day, which rapidly involves all the structures of the eye, and in the course of a few days destroys its entire organization. In other cases the sloughing is confined to a portion of the cornea, and this is followed by a staphylomatous protrusion of the iris. It is rare to observe more than one eye involved in this very destructive form of inflammation, but still in all countries, and from the earliest periods at which we read of this disease, a large proportion of the blind have been found to owe their misfortune to the secondary fever of small-pox.

3. Another frequent occurrence in the progress of secondary fever is gangrenous inflammation of the genitals. This shows itself in the first instance on the scrotum or prepuce, runs on rapidly to mortification, and in almost all instances ends in the loss of life.

4. The destructive effects of secondary fever, however, are by no means confined to the surface of the body. It frequently happens that without any obvious cause some internal organ receives the violence of the febrile shock. Acute inflammation is set up, and the result is in almost all cases suppuration. The *pleura* is the part peculiarly disposed to suffer under these circumstances. Variolous pleurisy comes on about the eleventh or twelfth day of eruption, for the most part very suddenly, and proceeds rapidly to empyema. We have seen it prove fatal in thirty-six hours. In general, the pleuritic symptoms are violent and well marked. The pain of side is excruciating, and the shortness of breath equally unequivocal; but sometimes there is a latent form of pleurisy. The patient dies without making any complaint of the side, and on dissection one of the cavities of the thorax is found gorged with a sero-purulent fluid. In all cases of secondary fever, a strict attention to the respiratory organs, with such aid as the stethoscope can afford, should never be omitted. In a few cases the substance of the lungs is the seat of an intense form of inflammation, tending to abscess. Children are sometimes attacked with symptoms indicating laryngitis or croup.

5. Affections of the abdominal viscera are very uncommon. Inflammation of the liver and of the mucous membrane of the bowels have been noticed, but they are among the rarest forms of internal disease observable in the progress of small-pox.

6. The brain sometimes suffers during the presence of secondary fever. Phrenitis with delirium occurs in children; and in adults of plethoric habit a state of coma or lethargy is not unusual. But what is most worthy of attention in this respect, is that singular state of the nervous system which accompanies the destruction of large portions of skin, and which is so well known to surgeons as a consequence of extensive burns and scalds. It is characterized by severe and repeated rigors, succeeded by general tremors, low delirium, a weak and rapid pulse, a dry brown tongue, and collapse of the features terminating in death.

7. The evils attending secondary fever are aggravated by the concurrence of the strumous habit. Nothing develops it more certainly than protracted small-pox. Accordingly, in scrofulous constitutions we see secondary fever complicated with strumous ophthalmia, characterized as well by its complete intolerance of light and abundant secretion of tears as by its obstinate resistance to every kind of remedial treatment. Irritable ulcers form under the lower eyelid, and around the knee, ankle, and elbow-joints, and are found very difficult to heal. Glandular enlargements of the neck take place, which sometimes suppurate, but oftener continue indolent and of stony hardness. Children frequently suffer from otitis.

8. To all this must be added the danger of contracting during the stage of decline, common fever of the typhoid or erysipelatous kind. At the Small-pox Hospital, it is not uncommon to find even the milder cases attacked during apparent convalescence, with fever, irritable stomach, sore throat and erysipelas of the face or extremities. This *superadded* disease has in many instances brought life into hazard, and in some has proved fatal. The great peculiarity of it is the concur-

rence of severe inflammation of the tonsils and subjacent cellular membrane with erysipelas of the head, neck, or back. It appears to have its origin in that vitiation of the air which is almost inseparable from the very nature of an hospital, and which any accumulation of malignant cases, more especially in a disease like small-pox, must necessarily tend to augment. This form of disease might be appropriately designated *hospital fever*. When it has once shown itself, there is abundant reason for believing that such a fever, whether exhibiting anginose or erysipelatous symptoms or their combination, is truly contagious.

Prognosis. — The following are the chief grounds on which the prognosis in small-pox should rest.

1. Confluence is always unfavourable, because it necessarily occasions a large drain on the system; but if the pustules acuminate well, and the areola on the extremities be of a good, that is, crimson, colour, a reasonable ground of hope exists. Confluence on the face is more to be dreaded than in any other part. When the vesicles on the trunk of the body are flat, when the eruption on the face is white and pasty, when the extremities appear of a clarety or livid colour, little or no hope of recovery can be entertained.

2. With reference to prognosis, great attention is due to the state of the larynx. Hoarseness, with copious spitting, occurring at an early period is very unfavourable, as indicating the extent of mischief in that important organ. On the other hand, a natural tone of the voice is a favourable sign, and with a good constitution gives a fair ground of hope, even though the eruption be full and confluent.

3. Quiet nights, composure of mind, a collected manner, and confident hope of recovery are good omens, because they indicate the comparative freedom of the brain and nervous system from all serious complication. Patients who from an early period of the disease are restless, delirious, moaning, and desponding, rarely recover. There is not a worse symptom in children than grinding of the teeth: very few recover in whom it is observed.

4. In estimating the danger of confluent and semi-confluent cases, the age of the patient merits particular attention. Persons above forty years of age seldom recover from any of the severer forms of small-pox. Infants also are in danger even from a moderate quantity of eruption. In both cases the reparative process is attended with great exhaustion of nervous power, the result of which is that the brain, larynx, or some other important organ loses its tone, takes on acute inflammation, and by its disorganization life is destroyed. The most favourable age for taking small-pox is from the seventh to the fifteenth year, when the powers of life are in the greatest vigour, with the least chance of plethora.

5. The habit of body is likewise to be taken into account. In the middle periods of life the danger of small-pox is much increased by its concurrence with a *plethoric* habit. Great weakness of constitution is equally a source of danger. Of the additional risk which a strumous habit entails, we have already had occasion to treat.

6. Every thing indicating a dissolved or putrescent state of the fluids is of course most unfavourable, such as petechiæ, menorrhagia, and epistaxis. Recovery from the petechial or malignant form of small-pox, indeed, is so rare as scarcely to enter into calculation.

Mortality of Small-pox. — It is commonly stated that one-fourth of those who are attacked by small-pox in the natural way perish. The records of the Small-pox Hospital indicate a somewhat higher proportion. The deaths during the last fifty years at that institution have averaged thirty per cent., the extremes being eighteen and forty-one per cent. The days of greatest mortality, or critical days, as they are called by the old authors, have been much commented upon, and in all ages it has been observed that the eighth (counting from the day of eruption) is the day of greatest danger. The following table, extracted from the register of the Small-pox Hospital for the years 1828 and 1829, illustrates this fact, while it shows at the same time that small-pox proves fatal at various periods, from the third to the thirty-eighth days of eruption. From this table it also appears that nearly two-thirds of the total number of deaths take place during the second week of eruption.

Table of the critical days in Small-pox, showing the period of eruption, at which 168 *cases proved fatal. (From the Records of the Small-pox Hospital for* 1828 *and* 1829.)

	There died on the	cases.	
1st week.	3d day of eruption	1	
	4th	5	
	5th	10	32
	6th	5	
	7th	11	
2d week.	8th	27	
	9th	15	
	10th	14	
	11th	16	99
	12th	11	
	13th	11	
	14th	5	
3d week.	15th	7	
	16th	5	
	17th	3	
	18th	3	21
	19th	1	
	20th	2	
4th week and after.	22d	3	
	23d	1	
	24th	3	
	25th	1	
	27th	1	
	28th	1	16
	29th	1	
	31st	1	
	32d	1	
	35th	1	
	38th	2	
	Total	168	

[Prior to the introduction of vaccination, according to Dr. Gregory, (Tweedie's *Library of Practical Medicine*, 2d Amer. edit. ii. 324, Philad, 1842,) the deaths by small-pox were, to the total deaths in town and country, in the ratio of 16 to 100, or about one-sixth. Of those attacked, the mortality is usually stated at 1 in 4. This,

according to Dr. Stewardson, was the mortality at the Small-pox Hospital of Philadelphia during the years 1840, '41, and '42,—a much smaller proportion than in the epidemic of 1823 and 1824, described by Drs. J. K. Mitchell and J. Bell, (*North American Med. and Surg. Journal*, vol. ii. 1826,) in which more than one-half the unprotected cases died. In an epidemic small-pox, which visited Malta and Gogo in 1830 and 1831, the mortality amongst those not vaccinated was, according to Dr. John Davy, 1 in 4.7. (*Notes and Observations on the Ionian Islands, &c.*, Lond. 1842.)

The numerical method has not, however, been extensively and rigorously applied to this subject. The mortality seems to vary in different places; thus, from primary small-pox in London it has been estimated by Dr. George Gregory at 36 per cent.; whilst in Germany, according to Heim, it was only 20 per cent. From accurate statistical accounts, taken by the Registrar-General of England, it would appear that, in 1837, there were only five diseases more fatal in England; and that the deaths by it throughout England and Wales amounted to about 12,000 annually. Since then, the number has fluctuated from 16,268 in 1838, to 9,131 in 1839. (Mr. W. Farr, in *Third Report of Registrar-General*, 1841.)

At times, during special epidemic influences, the mortality from small-pox is terrific.]

Causes of death in Small-pox.—It may not be irrelevant to recapitulate the several causes of death in small-pox. 1. Prior to the maturation of the pustules, that is, between the second and seventh days of eruption, patients die of malignant fever; of that peculiar condition of the fluids and nervous system to which the name of *acute malignancy* may properly be given. 2. Between the eighth and thirteenth days of eruption, the chief cause of death is to be found in affection of the throat, and consequent *suffocation*. 3. In the state of secondary fever, that is, between the fourteenth and twenty-first days of the eruption, death may take place in three ways—either by violent febrile excitement with effusion on the brain; or by sloughing, gangrene, and destruction of large portions of the surface; or lastly, by supervening pleurisy, peripneumony, or laryngitis. 4. At a still later period, that is, after the third week from the appearance of eruption, death may take place from mere exhaustion, or from erysipelas and superadded fever.

Morbid Appearances.—It has been remarked from the earliest periods that the internal organs do not suffer in small-pox so extensively or so frequently as might be expected. In a large proportion of cases, the condition of the surface is the sole cause of death. In the throat, however, some very characteristic appearances present themselves, provided death has taken place between the seventh and twelfth days of the eruption. The pharynx, larynx, and trachea are then found covered with a copious, viscid, puriform, or purulent secretion of a grey or brownish colour, thrown out by the numerous vesicles which had formed upon the mucous membrane of those organs. The mucous membrane itself appears thickened, pulpy, and in the worst cases black and sloughy.

There is no point wherein pathologists have more widely differed than in this, whether the specific inflammation of small-pox invades the internal parts? The phenomenon has been asserted as a matter of fact by some, while others have, with equal confidence, denied it. Cotunnius (De Sedibus Variolarum, passim) made a vast number of dissections with a special view to ascertain whether any of the viscera were the seat of variolous pustules. His conclusion is, that they are exclusively confined to the skin, and those mucous membranes which are in direct contact with the external air. There can be no doubt that this opinion of Cotunnius is strictly correct. Inflammation may originate from accidental causes in any internal organ during the progress of small-pox, and its effects will be seen after death; but these are not to be confounded with, or mistaken for, the specific effects of small-pox on the skin, and mucous expansion of the throat and chest.

When death has taken place in the third week from the appearance of eruption, the pleura will sometimes be found inflamed, and coated with layers of coagulable lymph, while in the corresponding cavity of the thorax, purulent matter or a sero-purulent fluid will be collected, often in enormous quantity, compressing by its bulk the lung of that side into a small space. Occasionally a portion of the lung itself is found infiltrated with pus.

In some cases, where great determination of blood to the head has been indicated during life by swelling of the head and face, delirium, headach, and high fever, the blood-vessels of the brain and its meninges are found turgid, with more or less of effusion into the ventricles.

Nothing is more worthy of notice than the freedom of the abdominal viscera from all traces of disease in those who die of small-pox. Among the numerous dissections made at the Small-pox Hospital, we have never been able to detect variolous pustules on the mucous membrane of the intestinal canal. Ulceration of the bowels indeed sometimes takes place in children during the violence of the secondary fever, but differing in no respect from that which occurs in other and more familiar forms of hectic fever.

[See, on this subject, Dr. Petzholdt, in *Brit. and For. Med. Rev.* v. 479.]

Pathology.—For more than a thousand years after the first appearance of small-pox, this disease was considered by physicians to have its origin, like other fevers, either first, in some state of the atmosphere, or secondly, in some vitiated condition of the humours of the body. A large portion of the community at the present day are of the same opinion, and confidently believe that the small-pox is, to use their own expression, bred in the blood. The pathologists of the last century, however, from the time of Boerhaave, reasoning from the very peculiar train of symptoms observed in small-pox, and from the comparatively recent date at which it became known, adopted the notion that this disease is in all cases the product of a specific poison or contagion, received into the blood from without. Such is still the general opinion of the best informed physicians. It cannot indeed be denied, that great difficulties are experienced in tracing the source of contagion in numberless cases, and that the doctrine of *spontaneous* origin admits of being

supported by some ingenious and plausible arguments; but the weight of evidence is decidedly in favour of the invariable origin of small-pox by *contagion*. How the variolous poison was first generated is wholly unknown. A tradition has been handed down by the Arabian physicians (See Baron's Life of Jenner, p. 522,) that it was originally derived from the camel, but no substantial reasons for such an opinion have ever been advanced.

The peculiar miasm or morbid matter of small-pox is receivable into the human body in three modes: first, by the lungs through the medium of the respiration: this is called the mode of *infection*. Secondly, by application of the matter to the unbroken surface of the skin or mucous membrane of the nose. This is properly denominated *contagion*, although the terms infection and contagion are generally made synonymous. Thirdly, by application of matter to the wounded surface, which is the mode of *inoculation*.

The diffusion of small-pox by the air in the mode of infection, as thus defined, presents many interesting peculiarities. It takes place much more energetically in certain states of the air than in others. Occasionally the atmosphere appears to be altogether incapable of disseminating the poison. That peculiar, or as it is sometimes called, *epidemic*, constitution of the air which is so favourable to the propagation of small-pox is not at all understood. It is neither appreciable by the thermometer, the hygrometer, nor the barometer. Small-pox spreads sometimes in a dry and warm, sometimes in a cold and moist state of atmosphere. The phenomenon may possibly depend upon some electrical state of the air, which has hitherto eluded the researches of philosophers, but which time and closer observation may perhaps eventually succeed in discovering. It has been supposed that the peculiar condition of the atmosphere predisposing to the dissemination of the variolous germ recurs every five or seven years, but no adequate grounds for this opinion appear to exist. Dr. Haygarth (Inquiry how to prevent the Small-pox, p. 78, 1801,) has taken great pains to ascertain the sphere of contagious influence in the case of small-pox — in other words, the distance to which the contagion extends beyond the person of the individual affected. He inclined to the opinion that it was very limited, not exceeding a few feet. There is reason to believe, however, that some fallacy exists in the experiments made to determine this point, and that the distance at which the poison ceases to be energetic is much greater, varying, however, according to the condition of the atmosphere.

Effluvia capable of communicating small-pox are generally considered to be given off by the lungs as well as by the skin, and at every period of the disease from the earliest to the latest. Drs. Haygarth and Heberden maintained (Ibid. p. 47 and 216,) that prior to the appearance of eruption, and even for the first two or three days after, a patient is seldom if ever found to communicate infection. We have already, however, expressed our belief, founded on facts within our own knowledge, that even prior to the occurrence of eruption, while the body is labouring under the premonitory fever, the secretions are infectious. It is admitted by all that the contagious property hangs about the body as long as any scabs remain, which may be said to contain the poison in a concentrated form. Again, it has been well ascertained (see cases detailed by Mr. Hawkins, in the London Medical Gazette, vol. iii. p. 282,) that for some considerable period after death the matter of the pustules continues energetic, and that a confluent case will so taint the air as to spread the disease, by infection, for at least ten or twelve days after death.

All mankind, with few exceptions, are susceptible of the variolous poison at some period of their lives. It has been received by the fœtus in utero, by the infant immediately after birth, and by the adult up to the most advanced period of human life. As a general law, it may be stated that the susceptibility of small-pox is equally great at all ages, but it often happens that a particular individual shall resist infection at one period of his life and receive it at another. Some constitutions imbibe this morbid germ mildly, others with great alarm. In such cases the nervous system may truly be said to be *poisoned* by it. A full and plethoric habit predisposes to a confluent and malignant form of the disease. Huxham has well remarked that the ebullition of the fluids consequent on the circulation of the poison in such persons is, *cæteris paribus*, most severe and dangerous. (On Fevers, p. 126 et seq.) Hence the great mortality of the disease in that class of adults who indulge in full living, with a large allowance of ale and porter. At the same time it must be remembered that the opposite state of body, extreme weakness, is equally unfavourable for the quiet reception and safe elimination of the variolous poison.

The *quantity* of eruption is sensibly influenced by the state of the surface at the period of its development. Great heat of the apartment, the warm bath, the use of strong diaphoretics, abundance of bed-clothes, and the local irritation of blisters, all favour confluence. It might be expected that cold would possess some power in diminishing the number of papulæ. It must be confessed, however, that though by injudicious measures we may often aggravate the quantity of eruption, we possess few or no means of lessening it. The character of the disease is not with any certainty influenced by the source whence the infection was derived. The mildest form of what is called varioloid eruption will communicate to another the most confluent and malignant disorder.

Variolous effluvia are very volatile. A free ventilation, therefore, is the most effectual means which we possess of diminishing the danger of contagion. The clothes and bedding of a small-pox patient, if closely wrapped up, will retain and give out the disease to others at great distances of time; while medical men who visit small-pox patients and subsequently go into the open air, seldom if ever communicate the disorder. Dr. Haygarth is of opinion that they never do. Be this as it may, variolous effluvia are rendered comparatively innocuous by dilution.

A few persons pass through a long life, apparently insensible to, or unsusceptible of, the

small-pox virus. It is a curious and important circumstance that, so far as is yet known, such constitutions exhibit a like inaptitude to receive and nourish the vaccine disease. (See London Medical Gazette, vol. viii. p. 494.)

Recurrent Small-pox.—Few facts in medicine are better ascertained than that once undergoing small-pox gives to the individual through life complete immunity from future attacks. Exceptions to this law, however, have undoubtedly occurred. They have been noticed in all ages, and stand recorded in the writings of almost all authors who have treated of small-pox. (See Medico-Chirurgical Transactions, vol. ii. p. 31. Also Edin. Med. and Surg. Journal, vol. iv. p. 460.) They are, nevertheless, comparatively rare occurrences, and many persons practising extensively, have never seen even a single case of the kind. There is no instance recorded of a patient being received twice into the Small-pox Hospital. Second attacks of small-pox, when they do occur, are generally, so far as our own experience extends, different in their character from the first: when the first attack, that is to say, has been severe and unequivocal, the second has been light and trivial, and *vice versâ*. Sir Gilbert Blane remarks, (Blane's Select Dissertations, p. 209,) that "almost all the well-authenticated cases of second small-pox have been of those persons who in the first instance had undergone it in its most severe and dangerous form." This would seem to connect the occurrence of small-pox with a peculiar proneness in such a constitution to suffer under the variolous germ. Others, again, have attempted to explain this phenomenon on the supposition that the first attack did not perfectly saturate the system. Instances of death from recurrent small-pox are not common, but they are to be found recorded in authors of undoubted veracity. It has been alleged that second attacks of small-pox are more frequent after the inoculated than after the casual disease; but Baron Dimsdale, a high authority on such matters, denies this. A predisposition to receive small-pox more than once has been stated to exist in certain families.

Concurrence of Small-pox with other Exanthemata.—Among the peculiarities of the contagion of small-pox, the possibility of its simultaneous occurrence with other exanthematous diseases deserves mention. Several cases have been recorded wherein measles and small-pox have appeared together,* and both diseases have run their regular course uninfluencing each other. Such cases, however, are very rare. It has occurred to us to see at the Small-pox Hospital several unequivocal cases of the simultaneous existence of small-pox and scarlatina anginosa. Small-pox and cow-pox may sometimes be seen together, each running its natural course, but in general, under such circumstances, one or other disease is modified. This subject will be more fully discussed when treating of vaccination.

Communication of Small-pox to the fœtus in utero.—A number of facts illustrating this very curious subject have been collected together by Dr. George Pearson. (Duncan's Medical Commentaries, vol. xix. p. 213.) From them it appears that the small-pox does not often extend from the mother to the fœtus; that whenever it is so taken, it is fatal in almost all cases to the fœtus; that inoculating a pregnant woman generally destroys the life of the fœtus, and, lastly, that the disease in the fœtus and mother is scarcely ever in the same degree of intensity. Dr. Jenner has published two cases (Medico-Chirurgical Transactions, vol. i. p. 269) in which the fœtus in utero took the disease from the mother, without the mother being herself affected, though exposed, of course, to the contagion. Mead entertained the fanciful notion, that if a pregnant woman underwent small-pox without aborting, the child would remain through life unsusceptible of small-pox.

Treatment.—1. It is seldom that opportunities offer of treating this disease in its initiatory stage, for its existence is generally unsuspected until the eruption manifests itself. The eruptive fever of small-pox, therefore, supposing its nature unknown, would be managed like other forms of inflammatory fever. Blood would be taken from the arm, when the pain of the epigastrium or of the head were urgent. Saline medicines in a state of effervescence would be given to lessen the feverish excitement and to allay the irritable state of the stomach. Coldness of the extremities would be met by hot bottles to the feet, sinapisms, and the pediluvium. When from concurrent circumstances, especially a known exposure to contagion, the real nature of the disease should be ascertained or very strongly suspected, the plan of treatment would not be materially different from this. Bloodletting would not then be repeated under a confident expectation that the appearance of eruption would speedily relieve the symptoms. Leeches to the temples would be advisable, provided the headach continued urgent. The bowels should be relieved by injections and the milder kinds of aperients. All drastic purgatives should be then avoided. The saline diaphoretics might be advantageously directed, with the addition of an opiate at night, in cases accompanied by much delirium. Bleeding from the arm is not found to afford relief to that specific affection of the brain and nervous system which ushers in a certain proportion of the severe cases, and accompanies their maturative stage for the first three or four days. Leeches cold lotions to the head, aperients, and an anodyne at night, offer a better prospect of relief. The antiphlogistic regimen is to be pursued in all its details.

2. During the period of maturation the following plan of treatment is to be recommended. When the stomach remains irritable with a tardiness of eruption on the extremities, a blister may be applied to the epigastrium, and frequent pediluvia administered, made more stimulating by the addition of mustard-powder. Pain of the fauces with difficulty of swallowing is benefited by the application of leeches to the throat, followed by fomentations made of camomile-flowers or poppy-heads. The bowels are to be duly regulated by aperient draughts, consisting of senna and salts, castor oil, or jalap with cream of tartar, in sufficient doses to insure one motion daily, or two motions, if the degree of fever requires it. The

* Dr. Russell in Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. i. p. 90.—Mr. Delagarde in Medico-Chirurgical Transactions, vol. xiii. p. 163.

action of the kidneys in like manner is to be encouraged by frequent doses of the citrate of potash, the liquor ammoniæ acetatis, or any similar mild diuretic. An opiate consisting either of laudanum, of the liquor opii sedativus, or of Dover's powder, may be given at bedtime, if there be any considerable degree of restlessness or of irritation of the skin.

When the surface is tender and painful to the touch, with much heat, cooling lotions may be applied with considerable advantage. Under all circumstances the diet is to be regulated as in other cases of inflammatory fever. Lemonade may be given for common drink, and Sydenham's strong recommendation of small-beer may be unhesitatingly adopted.

Symptoms indicating local inflammation must be met by appropriate means. When cough and copious expectoration of a puriform mucus occur, and give evidence that inflammatory action has spread to the smaller branches of the bronchi, blood should be taken from the arm to the extent of twelve ounces, and repeated according to the exigencies of the case, bearing always in mind the drain upon the system which an extensive pustulation will ultimately occasion. When headach, a flushed face, redness of the eye, and activity of the carotid and temporal arteries denote the presence or probable approach of phrenitic inflammation, particularly in persons of plethoric habit, blood must be taken from the arm freely. In the same habit of body it is sometimes advisable to take blood from the arm to moderate the violence of inflammatory action upon the surface, and to lessen the danger during the state of secondary fever. In all these cases the blood will be found buffy, and generally in a high degree. Ophthalmia occurring during the maturative stage is generally relieved by leeches to the temples, a strong purgative of calomel and rhubarb, and lotions containing Goulard and the extract of poppies. In all cases of small-pox it is desirable to keep the chamber darkened to guard as far as possible against this occurrence, and for the same purpose, as well as for the general comfort of the patient, the hair should be taken off at an early period of the disease.

3. The treatment of small-pox during the stage of decline and secondary fever is to be regulated on the following principles. When the disease is mild, a few doses of purgative medicine are useful, to keep down feverish excitement, and to carry off foul secretions, or, in the language of the vulgar, to get rid of the dregs of the disorder. Where the disease has been more severe, and secondary fever has set in, the excitement is to be allayed by occasional doses of antimonial powder with calomel, followed by an active aperient. The propriety of purging during the secondary fever of small-pox was for a long period the subject of keen controversy, but the question was satisfactorily settled in its favour. Calomel and rhubarb, senna and salts, and castor oil are the forms of purgative which will generally be found to answer best.

Bleeding from the arm is seldom advisable in the course of secondary fever, unless accidental and superadded symptoms, such as pleurisy or coma, occur to render it necessary. When the face continues swollen, with tendency to delirium and a very dry skin, leeches should be applied to the temples. In those aggravated cases accompanied with the destructive form of ophthalmia already described, little can be done for the assistance of the patient. The loss of blood which the intensity of the symptoms indicates would be followed by great and rapid exhaustion. To save the patient's life, therefore, the eye must sometimes be sacrificed.

The period of secondary fever is frequently accompanied with symptoms of debility, which call for the employment of tonic and cordial remedies. If there be a cold surface, a trembling hand, and dry tongue, wine should be administered, together with cordial draughts, consisting of camphor julep, ether, and the subcarbonate of ammonia. When the pustulation is profuse over the whole body, and the consequent drain upon the system great, beef-tea should be given freely, with a liberal allowance of porter, wine, or brandy. In this condition of the surface, it is extremely useful to absorb the matter by frequently and largely sprinkling the body with some simple dry powder, such as hair-powder, dried flour, the powder of starch, or of calamine. Starch-powder is the best. When sloughy and gangrenous sores have taken place upon the hips or extremities, reliance must chiefly be placed on the administration of wine and brandy, assisted by cordial draughts containing quinine, camphor, the aromatic confection, and laudanum.

Particular symptoms must be met, as they arise, by appropriate remedies. Pains of legs are best relieved by warm fomentations made of the decoction of poppy-heads. Extreme debility and night-sweats call for the administration of bark and acid. An ecthymatous state of the surface, with languor and loss of appetite, will sometimes yield, and cicatrization advance, under the use of sarsaparilla and small doses of the pilula hydrargyri. In many cases, however, this troublesome sequela of the disease will not give way except to change of air, the beneficial influence of which is very manifest in the convalescence from all the severer forms of small-pox. Erysipelas is to be treated by purgatives of calomel and rhubarb, followed by castor oil; by lotions to the surface, applied either warm or cold according to the feelings of the patient, and the internal administration of saline diuretics, aided towards the decline of the complaint by the decoction of bark.

When small-pox has called into activity the dormant seeds of scrofula, the tonic and alterative treatment usually pursued in the management of that disorder is demanded, although the most scientific efforts of the physician will then too frequently be baffled. The abscesses and ulcers, as well indolent as irritable, which are so often left by small-pox, are to be treated according to the ordinary rules of surgery. There is no peculiar method which can be devised for the prevention of pits and scars. The masks and ointments formerly in use for that purpose, and so highly vaunted, are in reality more hurtful than beneficial. The application of a little cold cream to the hardened scabs is all that can be recommended.

The greatest attention should be paid during the latter stages of confluent small-pox to the state of the scalp. The matting together of the pustules is apt in this situation to occasion extensive

abscesses, which are very troublesome and difficult to heal. To obviate these evils, the hair should be kept close cut, the scalp, when hot, should be covered with cold lotions, and purgative medicines administered, to relieve that determination of blood to the head on which the occurrence mainly depends.

[The "ectrotic method" of treating the eruption has been much recommended of late years. (Rilliet & Barthez, *Traité Clinique et Pratique des Maladies des Enfants*, ii. 544, Paris, 1843.) It has been advised to cauterize the pustules, within the first two or three days, or even somewhat later, with the view of abridging their duration, and preventing pitting. The best mode of applying the caustic is to cut it to a fine point, and pierce the centre of each pustule with it. Mercurial plasters, composed of calomel or corrosive sublimate, are said to have the power, when applied to the skin, of so modifying its condition as to prevent the maturation of the pustules; and wetting the face frequently with spirit of hartshorn is said by Dr. Morton, (Amer. edit. of Mackintosh's *Principles of Pathology*, &c.,) to have kept down the inflammation, and prevented the pustules from becoming either large or irritable. Keeping the patient with his face covered with a linen mask smeared on the under surface with mercurial ointment, seems to have prevented pitting. (See, on this subject, Dr. Stewardson, in *Amer. Journ. of the Med. Sciences*, Jan. 1843.) Baron Larrey, however, affirms, that he has found nearly the same benefit to follow the repeated anointing of the patient's face with olive oil.

In addition to the plans already mentioned, it has been proposed, of late, to pass over the eruption a pencil dipped in a solution of nitrate of silver in the proportion of from 15 to 45 grains to the ounce of distilled water. It would seem to be necessary, that the plan should be adopted before the fourth day, or before the eruption assumes the pustular form. Frictions with sulphur ointment, made of from a drachm and a half to two drachms to an ounce of lard—the first proportion for varioloid,—the second for cases of confluent small-pox—over the face and the other parts that are covered with pustules, have been followed by equally favourable results.

Light has certainly an effect in favouring the development of the pustules: hence, the patient has been kept with advantage in a dark room. With the view also of preventing the contact of light, the face has been masked with advantage; and, according to Baron Larrey, the Egyptians and Arabians are accustomed to cover the exposed parts of the body—as the face, hands, and feet—with gold-leaf, as soon as the eruption makes its appearance.]

Modified Small-pox.

Small-pox taken casually by those who have undergone no preparatory process of any kind, is sometimes of an exceedingly mild character. The pustules, though perhaps very numerous and close set, do not run into each other, but maturate separately, and *turn*, as it is called, on the fifth day. The eruption feels hard to the touch, and is of the kind commonly denominated seedy or horny. In the works of the oldest authors on small-pox, a description of the variety called *horn-pock* or stone-pock may be found. (Van Swieten's Commentaries, vol. v. p. 10.) It is a fair presumption that such natural mildness of disorder is attributable to some fortunate peculiarity in the constitution of the patient.

When small-pox occurs a second time, whether after inoculation, or after the disease casually taken, the second attack is very often of a spurious or anomalous kind. The papulæ are prematurely surrounded with an imperfectly-formed areola; some are developed and pustulate; others harden and die away. The eruption is limited to the face, or, at furthest, extends only to the face and trunk. Such instances of a spurious or modified small-pox are recorded in all the old writers, and do not appear to have been of unfrequent occurrence. Their close resemblance to cases of common chicken-pox gave occasion to much ambiguity, and even dispute concerning the identity and relations of these diseases.

Since the discovery of vaccination, the milder varieties of small-pox have greatly increased in frequency, so as at the present time to be familiar to every one engaged in practice. Vaccination may be said to have multiplied prodigiously the number of constitutions that imbibe the small-pox mildly. It has generated a sort of artificial habit favourable to the peaceful reception of the variolous virus. It becomes now, therefore, an object of considerable importance to investigate carefully the phenomena of the mitigated or modified small-pox [*Varioloid.*] It is reserved for a future opportunity (see Vaccination,) to explain the circumstances under which small-pox occurs after cow-pox, and the presumed causes of such an occurrence. All that we now propose is to state the appearances which small-pox presents at some considerable interval of time after vaccination, as for instance, ten or twenty years.

In a certain limited number of such cases, even when the proofs of correct vaccination have been most undeniable, the small-pox has been found to run its regular course unaltered in its symptoms, and unmodified in any of its features. We cannot, therefore, be surprised if it has sometimes, when so occurring, proved fatal. In an infinitely larger proportion of cases, however, the small-pox, when it attacks an individual who in the early period of life has felt the full influence of vaccination, is altered or modified, as well in its primary aspect as in its subsequent development and progress. No reasonable doubt can be entertained, from the abundance of facts now before the world, that such modification is the *law* of the animal economy, and that the regular or normal progress is the *exception*.

It does not appear, however, that the modifying power of vaccination displays itself in the incubative stage. In the modified, as in the natural disease, the same interval of time elapses between the reception of the variolous germ, the first development of symptoms, and the subsequent appearance of eruption. The same pain of back attends the initiatory fever. The same constitutional disturbance, as well in kind as in degree, precedes the eruption. But though the primary fever rages uncontrolled by vaccination, its influence is often perceptibly seen at the very first appearance of the papulæ. The eruption is both

less in quantity, and more limited in extent than in the common forms of the disease. It shows itself in the face and breast, and not at all, or very scantily, on the extremities.

In many cases, indeed, this description does not apply. The eruption is profuse, and equals, both in extent of surface affected and in quantity, the worst cases of natural confluent small-pox. The modifying power, however, begins to show itself almost immediately afterwards. The feverish excitement, which with such a state of surface might be expected to run high, subsides entirely. Some of the papulæ never advance at all towards maturation, while around others an imperfect attempt to form areolæ may be observed as early as the second or third day. The course of the disease is then so rapid, that by the fifth day the pustules on the face have maturated. The pocks are horny and speedily desiccate, leaving, however, for a considerable time afterwards, tubercular elevations of the skin surrounded often by a mottled redness. During the progress of this imperfect maturation the patient is generally able to walk about. He enjoys a good appetite and sound sleep. The unsightliness of the eruption alone disturbs him. No inflammation of the cellular membrane interrupts the period of convalescence. No pits remain to attest the violence of the disorder.

We are warranted, as well by etymology as by the custom of old authors, in applying to this mild form of small-pox the term varicella; but to distinguish it from another disease which has received the same name, (the genuine or infantile chicken-pox,) we may with propriety call this the *varicella variolodes*. It resembles the true chicken-pox in the mildness of the external inflammation and the absence of all severe constitutional excitement. It differs from it, however, in its undoubted origin from the variolous germ, and in its power of communicating the most perfect small-pox to others, as well by inoculation as by infection.

In some cases, especially where the interval from the date of vaccination has been short, small-pox in the vaccinated shows itself in a form so singularly mild that the real nature of the disorder can be with difficulty ascertained. In fact, none but those who are in the constant habit of seeing such cases, of tracing them to their source, and observing the minute gradations by which the several kinds of small-pox run into each other, could recognise them. A few scattered pimples perhaps are all that exist to attest the fact; but these pimples, in their progress to maturation, will be found to exhibit (with or without the aid of the microscope) that great and undoubted criterion of variolous origin, *depression of their centres*. The diagnosis is aided by carefully inquiring into the history of the initiatory fever, and observing if forty-eight hours had elapsed between the occurrence of rigor and the development of papulæ. It is put beyond dispute by tracing the source of the disorder to some case of undoubted variola, at the distance of eight to fourteen days, or by its simultaneous occurrence with other cases in which the character of the disease is unequivocally displayed.

Such are the phenomena of small-pox as it usually presents itself in those who have undergone regular vaccination in early life. It remains to state that every intermediate degree between the thoroughly confluent and the mildest varioloid will sometimes be seen. It is seldom, however, that any severe affection of the bronchial passages is witnessed. A few vesicles may be observed on the tongue and soft palate, but they seldom extend to the larynx. Affection of the brain and nervous system is more common. Intense delirium may often be found accompanying a very modified aspect of eruption, giving rise to much anxiety and some real danger. The cause of this anomaly generally exists in the peculiar habit of the individual. He will be found to be a person of an irritable or nervous temperament, and who has probably displayed, on some former occasion, a similar occurrence under the pressure of acute disease.

Small-pox after vaccination very rarely exhibits dissolution of the fluids, hemorrhages, and the other phenomena of malignancy. Such an occurrence has been witnessed, and followed too by a fatal result, but it must be looked upon as the most rare of all observed deviations from the ordinary course of the modified disease.

Inoculated Small-pox.

Small-pox existed in the world, and had been studied by physicians for at least a thousand years, before any idea prevailed that its course could be controlled and its virulence assuaged by any artificial means. When, where, and by whom this great discovery was first made is not accurately known. It has been conjectured that it had its origin in the countries bordering on the Caspian sea, Circassia, and Georgia; but the opinion rests upon no adequate authority. Nor can we place much more reliance on the statements which have been made as to the antiquity of inoculation in China and Hindostan. Our first accounts of it are derived from Constantinople, and there, towards the close of the seventeenth century, inoculation must be considered as having had its origin.

About the year 1703, rumours of the great success of this operation attracted the attention of Dr. Emanuel Timoni, a Greek physician, who had studied and graduated at Oxford. He subsequently settled in Constantinople, and being convinced of the importance of the discovery, wrote an account of it in 1713 to his English correspondent Dr. Woodward, which in the following year was published in the Philosophical Transactions. In 1715, Dr. Pylarini, the Venetian consul at Smyrna, having also learnt the success of this Turkish practice, published an account of it at Venice. A notice of this work appeared in the Philosophical Transactions for 1716, and these favourable accounts were fully corroborated by the reports of Mr. Kennedy, (an English surgeon, who had travelled in Turkey) in his "Essay on External Remedies," published in London in 1715.

No notice, however, was taken of these important facts by any English physician, and the idea of transplanting or engrafting small-pox (as the process was called) was well-nigh forgotten in London when the celebrated letter of Lady Mary Wortley Montagu appeared, which described the practice in so lively a manner as to attract public attention. (Vol. ii. Letter 31, dated April 1, 1717.) "The small-pox," she writes, "so general and so fatal amongst us, is here entirely harmless by the

invention of *engrafting*, which is the term they give it. There is a set of old women who make it their business to perform the operation. Every year thousands undergo it, and the French ambassador observes pleasantly that they take the small-pox here by way of diversion, as they take the waters in other countries. There is no example of any one that has died in it, and you may believe I am well satisfied of the safety of the experiment, since I intend to try it on my dear little son. I am patriot enough to take pains to bring this careful invention into fashion in England." She kept her word, and to the spirit and enterprise of this lady the introduction of inoculation into this country is altogether due. It was not until her return to London that any attempt was made to profit by a discovery which had been announced for five years; and her own daughter was reserved to be the first example of inoculation in England. This event occurred in April 1721, and as its success was complete, Dr. Keith, who had been witness to the experiment, submitted his child to the same process, and with a like happy result. Several months elapsed, but the medical profession in London still remained sceptical; some, because the practice originated with ignorant old women, and others from inability to understand the rationale of the process.

The next step was to obtain a pardon from King George I. for six condemned criminals, on condition of their submitting, by way of experiment, to inoculation. This was effected through the agency of the Princess of Wales, who was anxious to follow Lady Mary's example, and to secure her own children by the new process. These and some other trials having been deemed satisfactory, the Princesses Amelia and Caroline were inoculated on the 19th April, 1722, the former being then eleven and the latter nine years of age. Both of them passed through the small-pox favourably; but the new practice, begun under such brilliant auspices, received a severe check in the death of three persons, (one of them a child of the Earl of Sunderland,) which happened within a few days afterwards.

Contemporaneous with these experiments in London were those performed at Boston in North America, by Dr. Boylston, on the authority of Timoni and Pylarini. 244 persons were inoculated by him in Boston and its neighbourhood between June, 1721, and January, 1722, of which number six died. The subjects, however, were ill chosen, and the operator betrayed both ignorance and rashness. Dr. Boylston, however, deserves credit for having been the first to remark that the period of incubation is shorter in the inoculated than in the natural small-pox, and that the former may be employed to supersede the latter.

When these occurrences at Boston became known in London, the clamour against inoculation increased. Objections were made to it both in a medical and moral point of view. By Dr. Wagstaffe it was declared to be unsafe, and by the Rev. Mr. Massey impious. Under these discouraging circumstances, it is hardly to be wondered at that the practice of inoculation advanced but slowly. Prejudice and mismanagement combined to throw obstacles in its way. It was calculated that during the first eight years only 897 persons were inoculated throughout the whole of Great Britain, of whom seventeen died.

By slow degrees the medical profession became convinced of the advantages of inoculation, but it was not until the middle of the last century that it was practised in England to any considerable extent. Several circumstances contributed about this period to bring it into repute. In the year 1746 the Small-Pox and Inoculation Hospital of London was founded, for the express purpose of extending to the poor the benefits which had hitherto been almost exclusively confined to the rich. The results of the practice in the hospital were eminently favourable to the cause of inoculation. In 1747, Dr. Mead, then in the zenith of his fame, published his work *De Variolis et Morbillis*, and in a chapter expressly treating of inoculation, adduced many cogent arguments in support of it. In 1754, the Royal College of Physicians of London put forth a strong approbation of inoculation; but the popularity which it ultimately acquired is mainly attributable to the improvements which, in 1763, the Suttons introduced in the mode of conducting the process.

Robert and Daniel Sutton were sons of Mr. Robert Sutton, surgeon, of Debenham, in Suffolk, who had acquired some celebrity as an inoculator. Both followed their father's profession. The former established himself as a professed inoculator at Bury St. Edmunds, and the latter at Ingatestone in Essex. The success which attended Daniel (the cleverest of the family) at Ingatestone was unparalleled, but he fairly earned it by the boldness and dexterity of his management. The peculiarities in his system of inoculation were chiefly the following:—he reduced the preparatory process from a month to a week; he employed very freely, during the whole period, a strong purgative powder, containing calomel and emetic tartar: he inoculated by means of a single puncture; he exposed his patients freely to the coldest air prior to and during the eruption, and prescribed cooling drinks and a spare diet. There was nothing new in the plan. Lady Mary Wortley Montagu had stated that the Turkish children were suffered to play about in the open air during the period of eruption; Sydenham taught the value of the cool regimen; and the purgative powder had been introduced from North America. The merit of the inoculator consisted in the skill with which he selected what was beneficial in the several plans already known.

The system of Daniel Sutton was ably followed up by Baron Dimsdale, who enjoyed a high reputation and extensive practice, and whose admirable treatise on inoculation (The present Method of Inoculating for the Small-Pox, by Thomas Dimsdale, M.D. seventh edition, 1779) contains every thing then known on the subject. Nor was any further improvement attempted. For twenty years the mode of practice recommended in Dimsdale's work was adhered to, and the result was, that in every succeeding year inoculation became both more popular and more successful. The close of the century, however, which saw the rise of inoculation, was destined to witness its fall. In 1798 Dr. Jenner announced the discovery of vaccination, almost immediately after which the ge-

neral practice of inoculation declined, and has never since been revived.

Theory of Inoculation.—The object of inoculation is to secure a mild form of the disease, and this result follows in a very large proportion of cases. No adequate explanation has ever been offered of the singular fact, that mildness of the disease should be occasioned by the germ being received into the system by means of the cutaneous vessels. Something, it has been said, may be attributed to the influence of the preparative process, but this explanation will not go far when we reflect that the same means applied during the incubation of the natural disorder are not productive of the same effects.

The beneficial influence of inoculation is displayed not only in moderating the quantity of eruption, but in determining the whole force of the disease upon the surface. In a very large proportion of inoculated cases, the eruption is of the distinct sort, and moreover widely scattered. An efflorescence (roseola exanthematica) frequently precedes for one or two days the development of the true variolous papulæ. Sometimes a full and confluent crop is produced, but under these circumstances it is very seldom that the mucous membrane of the pharynx and larynx become implicated to any dangerous extent. The cellular membrane, in like manner, is rarely involved in the inflammatory action, so that the disease is then properly characterized as *confluent superficial.* Secondary fever, therefore, is rarely met with in the latter stages of inoculated small-pox; and further, that affection of the fluids which constitutes the leading feature of acute malignancy is almost or altogether unknown as a consequence of inoculation. The result of all this is, that the mortality by inoculated small-pox is very small indeed, and bears no sort of proportion to that of the casual disease. The average number of deaths at the Inoculation Hospital was only three in a thousand. In the wards appropriated to the casual disease the deaths were (and continued to be) three in ten.

Practice of Inoculation.—According to the statement of Lady Mary Wortley Montagu, the old women of Constantinople "opened with a large needle one or more of the veins of the arm or leg, and put into the wound as much matter as would lie on the head of the needle, afterwards binding it up with a hollow bit of shell. This simple mode was first followed in England, but it was afterwards supposed more desirable to have large wounds, which might ensure a more plentiful discharge of matter. For this purpus incisions were made three quarters of an inch in length, and deep enough to penetrate through the skin; and some cotton charged with variolous matter was laid on them for twenty-four hours, and retained there by means of a plaster. (Woodville's History of Inoculation, p. 99.) Another mode of giving the small-pox, said to have been first practised in China, consisted in inserting crusts or cotton charged with variolous matter in the nostrils. These rude practices were very injurious to the cause of inoculation, and they have long since yielded to the simple expedient of making a *single* wound with a lancet armed with fresh variolous matter in any convenient part; and, by a sort of general consent, the arm, at the insertion of the deltoid muscle, has been selected for the purpose.

It is of little moment at what period of the disease the matter for inoculation is taken; but thin, limpid, or *crude* lymph of the fourth and fifth days is generally preferred to the purulent or well concocted matter of the eighth and ninth days. It is of as little importance whether the matter be supplied by a distinct or a confluent, a casual or an inoculated case. The Suttons preferred the crude lymph of a *primary* inoculated vesicle. Common sense would dictate the propriety of rejecting a case of extreme malignancy.

The best age for inoculation is from the third to the sixth month from birth, and again, after the period of dentition is passed. Adult persons in the middle periods of life may be inoculated with perfect safety, due attention being paid to the habit of body. Season has but little influence upon the results of inoculation, but, *cæteris paribus*, the extremes of heat and cold should be avoided. The spring season was generally preferred by the professed inoculators in England. At Constantinople the month of September was the period usually selected.

The circumstance chiefly to be dreaded in inoculated small-pox is an inflammatory state of the blood. Hence it is that the only preparatory measures of any importance are such as have for their object to repress this tendency. A dose of purgative medicine should be given prior to the observation, and two or three more during the period of *incubation.* The purgative should consist of calomel, combined either with antimonial powder, emetic tartar, or powder of jalap. The patient is to be restricted to a spare vegetable diet. He should sleep in a large airy apartment, without a fire, and during the day should be exposed freely to the cold air. The influence of cold in repressing the quantity of eruption was strikingly manifested in the practice of the Suttons, and constituted, in fact, the principal peculiarity of the Suttonian system.

Phenomena of Inoculation.—On the second day after the operation, if the part be viewed with a lens, there appears an orange-coloured stain about the incision, and the surrounding skin seems contracted. On the following day a minute papular elevation of the skin is perceptible, which on the fourth day is transformed into a vesicle with a depressed centre. The patient perceives an itching in the part. On the sixth day, some pain and stiffness are felt in the axilla, proving the absorption of the virus into the general mass of blood. Occasionally on the seventh, but oftener on the eighth day, rigors occur, accompanied sometimes with faintishness, sometimes with pain of the back, headach, or vomiting. The patient complains of a disagreeable taste in the mouth, and the breath is offensive, soon after which the eruption shows itself.

The incision in the arm, when viewed through a glass, now appears surrounded with an infinite number of small confluent papulæ, which daily increase in size. On the tenth day an areola or circle of inflammation forms around the inoculated point, now distended with matter. This areola is irregular in shape, and in its progress becomes

interspersed with numerous minute vesicles. By the fifteenth day the primary pustule has scabbed, and the eruption on the body generally has begun to maturate. By the twenty-first day, in the great majority of cases, the disease is wholly at an end. The number of papulæ dispersed over the body is subject to great variety. In some cases not more than two or three are perceived. It is important to know that an eruption is not indispensable to the success of inoculation. In some cases the full change has been produced upon the frame, and a complete insusceptibility to future attacks given, by means of the single pustule excited artificially upon the arm.

Treatment of inoculated small-pox.—In mild cases nothing is required but one or two doses of simple aperient medicine, such as the infusion of senna, with manna and Epsom salts. In cases of greater severity, we are to proceed in the manner already directed for the natural small-pox.

The objections which have been urged against inoculating for the small-pox, and which have caused the abandonment of the operation, are the following. Although in many instances the subsequent disorder be slight, still it is sometimes severe, and occasionally brings life into hazard. It often proves the exciting cause of other disorders, and more especially calls into activity the scrofulous taint. But more than all, it is urged against small-pox inoculation that it adds to the danger of the public by multiplying the foci of variolous contagion,—that it preserves one life at the risk of many. This objection to inoculation, which has been so strongly insisted on of late years by almost all writers, was long since fully appreciated. Dr. Watkinson, Dr. Schwencke, and others, in the year 1777, attempted to obviate it by showing that the diffusion of variolous contagion takes place only in certain epidemical states of the air; that when such a condition of atmosphere prevails, the disease would propagate itself quite as widely, independent of all cases artificially excited; and when it was not present, inoculation would be perfectly harmless. The argument is ingenious, and certainly calculated to show that this charge against inoculation has been overstated. It might seem easy to determine the point at once by reference to the Bills of Mortality, where a gradual augmentation of deaths, in proportion as the practice of inoculation extended, will at first sight appear. Dr. Adams, however, very justly remarks (Inquiry into the Laws of different Epidemic Diseases, by Joseph Adams, M. D. 1809, p. 144,) that this argument is more plausible than solid; for in the first place, admitting the fact to be as stated, there has been a corresponding increase in other diseases, not communicable by inoculation; and, secondly, the statements may be so put as to show a diminution rather than an increase. Thus, in the thirty years between 1741 and 1770, there died of small-pox, according to the Bills of Mortality, 63,308; whereas in the next thirty years (viz. from 1771 to 1800,) there only died 57,268.

Although, then, it would be difficult to support this objection against inoculation by a reference to statistical tables, it is obvious that it must necessarily contribute to diffuse the contagion, and so far therefore is an evil. Notwithstanding this defect, however, and others already adverted to, inoculation must still be viewed as a most valuable discovery, and a merciful provision of nature against the ravages of a dreadful pestilence.

GEORGE GREGORY.

SOFTENING OF ORGANS.—The term *softening* [*Ramollissement*] is employed to designate a diminution of the natural and healthy consistence of organs. It is only of late years that this change has been investigated and described as a special morbid condition; and whether we consider the frequency of its occurrence, the variety which it presents as to degree and extent, the serious and often fatal effects to which it gives rise, or the wide difference of its nature in the same or in different organs, it constitutes a subject of great interest and importance.

Before proceeding to describe softening of particular organs and tissues, we shall take a summary view of the opinions which are entertained regarding the nature of this lesion. Two opinions prevail regarding the nature of softening of the brain, an organ in which this change of consistence frequently occurs and often proceeds to a great extent. The first of these opinions is, that it is always a consequence of inflammation; the second, that it is a disease *sui generis*, entirely opposite in its nature to inflammation, and, consequently, that it ought to have a distinct place in the nomenclature of diseases. It is surprising that opinions so opposite should have received the exclusive support of pathologists of great merit, and whose extensive opportunities of studying the disease put them in full possession of the means of determining how far one or both of these opinions should be received as the truth.

It may not be altogether out of place to notice here what we conceive to have been the circumstances which led to the adoption of these two opinions on the nature of softening of the brain. M. Rostan, who may be regarded as the first who directed the attention of pathologists to softening of the brain, was one of the physicians of the Salpêtrière of Paris, an hospital destined exclusively for the reception of females, the greater number of whom are very old. These old women, varying from sixty to upwards of eighty years of age, were the patients in whom he observed softening of this organ. In such patients, ossification and other diseased states of the arteries of the brain which give rise to obliteration of these vessels, and consequently to cessation of nutrition in the part to which they are distributed, may be said to be a frequent occurrence. The consequence of this state of the arteries is, as we shall afterwards endeavour to show, softening of the cerebral substance. But M. Rostan having overlooked this pathological state of the arteries, and not observing in the greater number of his patients, either the phenomena which generally accompany acute inflammation of the brain during life, or some of its least equivocal effects, such as various degrees of vascularity, and the presence of pus or coagulable lymph in this organ, after death, was led to believe, and to announce it as his belief in the work which he published on softening of the brain, that the disease in question is not the consequence of inflammation, but, as

we have already said, a disease *sui generis*, resembling *gangrena senilis* more than any other disease with which we are acquainted. (Recherches sur le Ramollissement du Cerveau.) The facts brought forward by Rostan in support of this opinion are far from being conclusive. He maintains rather than proves that the disease is not the consequence of inflammation, and has not attempted to elucidate its nature, with regard to which he seems satisfied by saying that it resembles gangrena senilis, which disease is the result of cessation of nutrition from ossification of the arteries; but what is most remarkable is, that, after having made such a statement, he brings forward no evidence to show that softening of the brain is produced by a similar state of these vessels. Nay, among the great number of cases of softening of the brain, the histories of which are detailed in his work, there is not one in which ossification of the arteries of this organ is mentioned as having been observed at the autopsy. Such being the case, the opinion of M. Rostan on the nature of softening of the brain is at most but a plausible conjecture, in so far as the evidence which he has brought forward in support of it is concerned. But the fact is, these researches were imperfect; for we have had frequent opportunity of examining the state of the arteries of the brain in softening of this organ in the old women of the Salpêtrière, and in the great majority of cases we have found ossification or other morbid states of these vessels. Had this anatomical fact been stated by M. Rostan, and shown to have the same relation to softening of the brain as it has to gangrena senilis, he would have proved that there is at least one form of softening of this organ, the origin of which is independent of inflammation: —that it is the consequence of a cessation of nutrition from an interruption to the arterial circulation, a state of gangrene or local death from this cause.

The chief supporter of the opposite opinion is Lallemand of Montpellier. This able pathologist seems to have studied softening of the brain for the most part in young and middle-aged persons, and in several of his cases it occurred in consequence of external injury. Under these circumstances he had a full display of the inflammatory phenomena which precede softening of this organ. He has traced, if not in all, at least in the greater number of the cases he has related, its inflammatory origin and progress; that is to say, he has shown its connection with vascular injection of various degrees, with the presence of coagulable lymph, or with pus either infiltrated or collected in the form of an abscess. (Recherches Anatomico-Pathologiques sur l'Encéphale et Ses Dépendances. Paris, 1820.) Indeed, the researches of Lallemand on the nature of softening of the brain are so conclusive, that even Rostan himself tacitly admits, in the second edition of his work already referred to, that this lesion may occur under two forms—the inflammatory and the non-inflammatory, or that which he compares to *gangræna senilis*.

[A similar opinion has been strongly expressed of late by Durand-Fardel, (*Traité du Ramollissement du Cerveau*, Paris, 1843.)]

Dr. Abercrombie describes softening of the brain as the consequence of chronic or acute inflammation, but he thinks it may also occur from obliteration of the arteries, as supposed by Rostan. (Pathological Researches on Diseases of the Brain and the Spinal Cord. Edin. 1828.)

Softening of the mucous membrane of the digestive organs, a much more frequent occurrence than softening of the brain, has for a long time engaged the attention of pathologists. But it is more especially softening of the mucous membrane and other tunics of the stomach which has been made the subject of pathological investigation. The great extent to which softening often proceeds in this organ, and its occurrence under conditions of the most opposite kind, as relates to the state of the stomach individually or to that of the economy in general, are circumstances which have given rise to great diversity of opinion regarding the nature or softening of this organ. The following are the chief opinions which have prevailed on this point. 1st. That softening of the stomach is the consequence of irritation or inflammation. 2d. That it is produced by the operation of an acid and corrosive fluid, formed in consequence of irritation of the mucous membrane of the stomach. 3d. That it is a change effected after death by the gastric juice, this fluid having been previously modified by disease of the stomach. 4th. That it is produced after death by the dissolvent property of the gastric juice, this fluid as well as the stomach itself being in the natural state.

Of these opinions, two only appear to us to merit attention, viz. the first, which ascribes softening of the stomach to an inflammatory condition of this organ; and the fourth, which refers this change to the natural dissolvent property of the gastric juice acting on the stomach after death. We have, therefore, the same lesion said to be produced by two agents, and under circumstances of the most opposite nature. In the first case, softening of the stomach is a pathological condition—a disease; in the second, it is not a disease, it is merely a *post-mortem* lesion. But although occurring after death, softening of the stomach from the chemical action of the gastric juice requires to be particularly noticed in the present article, because of its having been described by many eminent pathologists as a diseased state. We shall, therefore, endeavour to demonstrate in another part of this article the separate existence of these two forms of softening of the stomach, and more particularly the characters by means of which the one may be distinguished from the other.

The forms of softening which we have noticed are confined to particular organs or tissues. But there are other forms of this lesion of a much more general character, and which are also very different in their nature from the former. In the first of these forms the softening occurs in almost all the textures of the body at the same time, although it may be so slight in some as hardly to be observable; whilst in others, even the hardest, it may be greatly marked. It is never observed unless in individuals in whom nutrition in general is strongly modified. The modification of nutriment which precedes the softening process is, however, very different in kind in different in-

dividuals—a difference which obviously exercises a great influence in determining the seat and severity of the disease. Thus, in children born in a state of debility and emaciation, and in those who have been long deprived of the wholesome necessaries of life, we find all the tissues and organs of the body more or less soft, and easily injured by external causes. This general diminution of cohesion is always accompanied by universal pallor, a watery, scanty, and aplastic state of the blood. Such, also, is the case in advanced stages of scrofula and scorbutus; the bones as well as the other textures being found in those who die of these diseases, soft, spongy, and infiltrated with a sero-albuminous or sero-sanguinolent fluid. In another class of patients, the softening, while it pervades to a certain extent all the tissues of the body, exists in a much greater degree in the bones, and from the superincumbent weight which they have to support, or the impulse which they receive from the action of neighbouring muscles, they lose their natural forms, and become bent or flattened to an extraordinary degree. It is this form of softening which has been termed *rachitis*, *mollities ossium*, or *osteo-malacia*. Great softening and pliancy of the bones constitute what is most frequently termed mollities ossium, whereas a degree of fragility, a want of cohesion, accompanied with softness, are more generally regarded as constituting rachitis. (See Rickets.)

There is another form of softening, or rather flaccidity, which only requires to be noticed. It is best seen in the skin and cellular tissue when these textures, after having been greatly distended by an accumulation of fluid in the abdomen, are left unsupported by the removal of the distending cause. The looseness and flaccidity of these tissues is also very conspicuous in old people: in persons who, from a state of obesity, become lean, and in persons in general who become rapidly emaciated, particularly from disease.

Lastly, softening of organs and tissues may take place from maceration and putrefaction after death. With regard to softening produced by these causes, we shall only observe that it should be kept in mind by the physician in his *post-mortem* researches, lest it should be confounded with the pathological forms of this lesion.

From these general considerations, it would appear that the several forms of softening to which the different tissues and organs of the body are subject, may be ranged under two groups, the first comprehending those forms which occur during life; the second, those which are effected after death.

I.—*Occurring during life.*

1. Softening from inflammation.
2. Softening from obliteration of arteries.
3. Softening from a modification of nutrition.

II.—*Occurring after death.*

1. Softening from the chemical action of the gastric juice.
2. Softening from maceration and putrefaction.

We shall treat of three only of these forms of softening,—viz. the first and second of the first group, and the first of the second group,—because of the two former being special pathological states, and because of the latter occurring under circumstances which have often deceived the practical pathologist, and led him to describe it as a morbid alteration of the gravest character.

I. **Softening from Inflammation.**—Before proceeding to describe inflammatory softening, it may be well to make a few remarks as to the manner in which the consistence of a tissue becomes diminished or entirely destroyed by inflammation. Two causes appear to co-operate in producing this change. The first is of a mechanical, the second of a physiological nature. Serosity or pus, when in considerable quantity, appear to effect, mechanically, a diminution of the cohesion of the tissue in which they are contained. The pressure which they exercise arrests the circulation, and it would appear, absorption also; for if this function were performed, we should have an excavation or ulcer formed instead of a mass of soft pulpy tissue. The circulation being thus arrested, nutrition ceases to be accomplished, and the molecules of the tissue are disunited and detached. If, while these changes are going on, or at some subsequent period, the function of absorption be resumed, the softened tissue is partially or wholly absorbed, and solutions of continuity of various extent are formed. The physiological cause of softening is referable to a change in the vital properties of the affected tissue. We are unable to say in what this change consists, but its effects on circulation and nutrition are sufficiently obvious, both these functions ceasing to be performed at an early period of the inflammatory process. Softening or dissolution of the affected tissue then takes place in the same manner as when produced mechanically. It is necessary to observe that the presence of serosity in a tissue from a mechanical obstacle to the return of the venous blood, as œdema of the inferior extremities from disease of the heart, does not give rise to softening; and for this reason, that it does not arrest, but only impedes the capillary circulation.

Locality of inflammatory softening.—There is no tissue in which softening may not occur as the mediate or immediate consequence of inflammation. It occurs in tissues which are never the seat of inflammation, as cartilage, tendon, fibrous tissues, &c. Thus, when inflammation exists in the immediate vicinity of these tissues, they are soon deprived of the materials of their nutrition, and, consequently, lose their natural consistence, become soft and pulpy, and even slough. The cellular tissue is by far the most frequent seat of inflammatory softening. The diminution of cohesion which follows inflammation of parenchymatous organs, is owing to softening of the interstitial cellular tissue. Slight pressure with the point of the finger lacerates or breaks down a portion of hepatized lung. Muscular tissue is also easily torn or separated into shreds in consequence of softening of the interstitial cellular texture by which its fibres are united, examples of which are sometimes met with in the heart, but more frequently in the muscles of voluntary motion.

Softening of the subcutaneous, submucous, and subserous cellular tissues, is often great in degree and extent in erysipelas phlegmonodes, enteritis, and peritonitis. The easy separation of these

coverings, particularly the serous and mucous, from the subjacent tissues after death, is always the consequence of inflammatory softening of their cellular tissue, and the degree of facility with which their separation is effected affords a ready means of determining the degree and extent of the inflammation to which this tissue had been subjected. Cases of peritonitis and meningitis occur which would escape the *post-mortem* researches of the pathologist but for this state of softening of the cellular tissue. In such cases there may be little increase of vascularity, and perhaps only a slight serous effusion, both of which may be overlooked, or, if observed, can afford no idea of the degree or extent of this morbid condition of the cellular tissue.

Softening of mucous membranes from inflammation is a frequent occurrence, and is often great in degree and extent. Softening of this tissue is more frequently met with in the digestive organs than in the respiratory, urinary, or generative organs. It is not, however, either so frequent or extensive in the mucous membrane of the digestive organs as has been supposed, for the reasons to which we have already alluded, and which we shall afterwards explain. Softening of the osseous tissue is seldom observed as a consequence of inflammation, unless in surgical diseases. It is, however, a change which always follows inflammation of this tissue, and is frequently so considerable that the hardest bones become as soft as cartilage or muscle.

Softening of the blood-vessels as a consequence of inflammation does not take place till after the destruction of their cellular sheath from the same cause. Softening of this sheath is a serious accident in surgical diseases of the arteries requiring the application of the ligature.

It has often been said that softening of the spleen, which is sometimes so great that this organ is transformed into a uniform pulpy mass, is the consequence of inflammation. We are, however, of the opinion of those who ascribe this state of softness of the spleen to a morbid condition of the blood with which it is filled, this fluid being in a state of extreme fluidity.

Inflammatory softening is no where so conspicuous, either as regards its physical characters, or the functional derangement to which it gives rise, as in the brain and spinal cord. Obvious functional derangement, as the direct consequence of inflammatory softening, is indeed not observed, unless when the brain or spinal cord is the seat of this lesion. We shall therefore commence with the medical pathology of inflammatory softening as it occurs in these organs.

Physical characters of inflammatory softening of the brain and spinal chord.—The *degree* of softening of the cerebral substance may vary from a slight diminution of the natural consistence of the part affected to that of cream or even of thin milk. The first stage of softening of this substance is often so slight, that it is hardly perceptible to the touch, and may, even when considerable, if not accompanied by some peculiarity of colour, be altogether overlooked. In the first case a gentle stream of water allowed to fall upon the cerebral substance, is the best means of determining whether a portion of it has lost its natural consistence; and in the second case, the only way of detecting the presence of softening unaccompanied by any obvious change of form or colour of the affected part, is to submit the whole of the cerebral substance to a careful inspection, by removing it piecemeal in the form of thin slices.

In the first stage the cerebral substance is not yet broken down; it has only lost a certain degree of its cohesion, for it is still continuous with that by which it is surrounded. In the second stage the diminution of consistence is so great that it may be recognised at first sight, owing to the change of form by which it is accompanied. The cerebral substance is so soft that it sinks by its own weight beneath the level of the cut surface; and prominent parts, such as the thalami, corpora striata, and convolutions, become more or less flattened. In the third stage, a solution of continuity has been effected by the separation of the softened cerebral substance. It is now of the consistence of cream or milk, contained in an excavation of variable extent, situated in the substance of the brain, or confined between the membranes and convolutions of this organ.

The *colour* of inflammatory softening of the cerebral substance presents considerable variety. The principal varieties of colour depend on the quantity of blood contained in the affected part, on changes which this fluid undergoes some time after its accumulation or effusion, and on the presence of serosity and pus. Redness and vascularity are, in general, greater in the first than in the second stage, but the degree and extent of either greatly depend on the quantity of blood in the cerebral vascular system. In some cases a gradual increase of redness and vascularity can be traced to a considerable extent beyond the softened part; in others, these changes are limited to the immediate vicinity of the latter. The vascularity of the softened cerebral substance has frequently a hemorrhagic character. When this substance is divided, it presents a number of red points, streaks, or patches, produced by the blood accumulated in the veins, or effusion of this fluid. In some cases the effused blood is small in quantity compared with the extent of the softening; in others it pervades the whole of the softened substance, and presents the same appearance as hemorrhagic apoplexy. The redness, vascularity, and hemorrhagic character of inflammatory softening, are never so conspicuous as when this lesion occupies the brown substance, as that of the corpora striata, thalami, and convolutions. Inflammatory softening of the cerebral substance is not always accompanied by those changes of colour which we have just described. The affected part may have preserved its natural colour, or it may be much paler than natural. Thus the septum lucidum may be converted into a mere pulp, without its colour being perceptibly altered; and the same degree of softening may take place in the brown or cortical substance, which has become so pale as hardly to be distinguished from the medullary substance in its vicinity. Pale softening in either of these situations, viz. in the medullary or cortical substance of the brain, is a frequent occurrence in hydrocephalus, and it is also this variety of softening which is sometimes met with in those fevers in which the brain is primarily or secondarily affected. Mons. Recamier described this pale softening of the brain in his

clinical lectures at the Hotel Dieu of Paris, long before Rostan, Lallemand, or Abercrombie published on softening of this organ. This author regarded the pale softening as a primary condition of nervous or malignant fevers, and therefore he called it *ramollissement ou dégénérescence ataxique; foyer ataxique*. In such cases of softening of the medullary or cortical substance, we always find the brain in general pale, its vascular system containing but a small quantity of blood, and its membranes infiltrated with serosity. It is, in fact, owing to the pressure which the effused serosity exercises on the blood-vessels, that the anæmic condition of the brain in general, and of the softened portion of it in particular, is to be attributed.

When the redness which accompanies softening arises from the presence of effused blood, it may always be regarded as evidence that the softening is of recent occurrence. But there are other modifications of colour which accompany softening of the cerebral substance, and which for various reasons require particular notice. They indicate that the disease has existed for a considerable time — several weeks, or two or three months. The principal modifications of colour consist of brown, yellow, and orange colours, either separately or combined, and occupy either the softened substance, the part of the brain contiguous to it, or both at the same time. They are not observed unless the softening has been accompanied by effusion, and originate in changes taking place in the effused blood. Such are the modifications of colour to which we allude, so frequently observed to take place in the blood effused in the subcutaneous cellular tissue in consequence of external violence. The brown colour appears first, and is very limited in extent when compared with the orange and yellow, by which it is succeeded,— circumstances which enable us to form a tolerably accurate opinion regarding the extent of the sanguineous effusion by which the softening had been accompanied. Knowing that these colours accompany cerebral softening, the pathologist will be put on his guard, and not confound this disease with hemorrhagic apoplexy, in which the same colours are present.

A pale yellow straw-coloured tinge of the softened cerebral substance arises also from the presence of pus. But this is rarely observed unless the softened substance be in contact with the membranes of the brain. The presence of serosity in the softened cerebral substance produces, as we have already observed, a diminution of the red colour alluded to; but it likewise communicates a glossy albuminous aspect to softening, which it does not present in any other circumstances.

When softening of the brain is accompanied by an increase of bulk, it is generally owing to the softened part being infiltrated with serosity.

The *situation* of softening, or those portions of the brain in which this change of consistence occurs, requires to be pointed out. Thus, it has been found in the central portions of the medullary substance and in the convolutions of the anterior, posterior, and middle lobes of the brain; in the corpora striata and thalami; in the corpus callosum, septum lucidum, and fornix; in the pons Varolii, crura cerebri and cerebelli; in the cerebellum and the surface of the lateral, third and fourth ventricles. It is much more frequent in the brown than in the medullary substance, and more so in the brown substance of the convolutions than in that of the thalami or corpora striata. Softening may occur in both substances at the same time, which is generally the case when it occupies the two latter situations. It may also occupy several portions of the brain at the same time, as the septum lucidum, fornix, and walls of the lateral ventricles; the corpora striata and thalami; one or more lobes; a portion of one or both hemispheres; the brain and cerebellum; and is rarely met with in the latter organ without its being present in the former, — circumstances which give great variety and complexity to the functional derangement by which it is accompanied.

In all the portions of the brain which we have named, the softening may be confined to a very limited spot, or pervade the greater part of their entire substance. There are examples of nearly the whole of one of the hemispheres of the brain having undergone this change of consistence; and in children, probably on account of the natural softness of this organ in them, both hemispheres have been found reduced almost to a pulpy or fluid consistence.

[Softening of the brain occurs with nearly the same frequency in both hemispheres. In 169 cases, the right hemisphere was concerned 73 times; the left, 63 times; and both hemispheres, 33 times. (Andral, *Clinique Médicale*, v. 545.) In 150 brains, the softening of the whole of the hemispheres was observed 4 times; of almost the whole of one hemisphere, 13 times; of the convolutions, 14 times; of the convolutions and other parts, 9 times; of the anterior lobes, 27 times; of the middle lobes, 37 times; of the posterior, 16 times; of the corpora striata, 28 times; of the thalami optici, 15 times; of the parietes of the ventricles, 2 times; of the peduncles, once; and in disseminated points, 5 times.

M. Durand-Fardel (*Op. cit.*) found acute softening by far most frequently in the convolutions. Of 33 cases, 31 were examples of this seat of the disease; and in 9 the convolutions were alone affected. Fifty-three cases, collected from various sources, gave the following results as regards the seat of the lesion:—

Convolutions and medullary substance,	22
Convolutions alone,	6
Medullary substance alone,	5
Corpus striatum and thalamus opticus,	6
Corpus striatum alone,	11
Thalamus opticus alone,	4
Pons varolii,	3
Crus cerebri,	1
Corpus callosum,	1
Walls of the ventricles, septum,	1
Fornix,	1
Cerebellum,	1]

Such is a general description of the physical characters of inflammatory softening of the brain. Whatever may have given rise to the inflammation of the cerebral substance or its membranes, which terminates in softening, the physical characters of this lesion are always such as we have described them. It is, however, of great practical importance to make a distinction between softening from idiopathic inflammation, and that which follows the presence of foreign bodies, such as

bony and fibrous tumours, tubercles, carcinoma, melanoma, hydatids, &c., formed in the brain or its membranes, and foreign bodies forced into it from without, which, at some period of their development, or after their introduction, excite inflammation and softening.

The description which we have just given of inflammatory softening of the brain, applies generally to the same lesion of the spinal cord. In this organ the softening may be confined to the medullary or cortical substance, or may occupy both at the same time. The whole of the cord may be softened, or only particular portions of it, as the cervical, dorsal, and lumbar,—differences of situation which are accompanied by corresponding differences in the seat of the functional derangement to which this lesion gives rise. The nature of the functional derangement, especially of sensation and motion, it is now well known depends on the situation of the softening, the former being deranged when the softening occupies the posterior surface, and the latter being affected when it occupies the anterior surface of the cord. Softening of the cord may, like softening of the brain, be the consequence of idiopathic inflammation, or of this pathological state succeeding to the presence of foreign substances, or arising from external injury.

The simultaneous occurrence of inflammatory softening in the brain,—cerebrum, cerebellum, and spinal cord, is rarely observed, unless in infants. Of thirty cases of softening of the cerebral substance observed by M. Billard in infants, in ten these three divisions of the nervous system were simultaneously affected. In these children, softening of the cord was rarely observed to occur without softening of the brain; and on the contrary, softening of the brain was frequently considerable without any similar change being present in the cord. (C. Billard, Traité des Maladies des Enfans, &c. Paris, 1828.)

Before proceeding farther in the description of inflammatory softening of the brain, we shall point out the physical characters of this lesion when produced by obliteration of the arteries, as it will be more advantageous to treat of the causes, symptomatology, diagnosis, prognosis, and treatment of both forms of the disease at the same time.

Softening of the brain from obliteration of the arteries of this organ.—This form of softening depends on the presence of osseous, cartilaginous, and fibrous substances formed in the interior of the arteries or between their coats. These accidental products may exist in the form of cylinders occupying the entire calibre of arteries of considerable size, and also the smaller branches; or they may form patches or small masses projecting internally, which obstruct the circulation of the blood. The obliterated arteries may occupy the softened cerebral substance, and can be seen ramifying through it; and when this substance is removed by pouring water upon it, the solidified vessels retain their situation, and feel sometimes as hard as fine wires. If the obliteration be confined to a limited portion of an artery whose branches terminate in the softened part of the brain, the cause of the softening may be overlooked. In the case of obliteration of minute arteries, or of a single small arterial trunk, the softening is generally limited to a space not exceeding an inch or two inches in breadth; but if several large contiguous branches be obliterated at the same time, the extent of the softening is considerably increased; and if the obliteration takes place in the carotid or one of its principal divisions within the brain, the greater part or the whole of a hemisphere may be completely softened. This form of softening is, like the inflammatory, not confined to any particular portion of the brain. Like it also, it occurs far more frequently in the brown than in the medullary substance, or in those parts most abundantly supplied with blood-vessels, as in the optic thalami, corpora striata, and cortical substance of the convolutions. If the obliteration has taken place in the minute arteries or small branches, the softening is generally confined to the brown substance; and when a large trunk or several small trunks are obliterated, both the brown and medullary substances are softened.

Softening, from obliteration, of the corpus callosum, septum lucidum, and fornix, is extremely rare, and we have only met with one example of it in the pons Varolii. We have not observed it in the spinal cord.

The degree of softening from obliteration, as well as the various colours which this change presents, are very similar to those observed in inflammatory softening. It is necessary, however, to observe that redness is seldom considerable, and vascularity and effusion of blood are generally wanting on account of the impervious state of the arteries. When it does happen that blood is effused, it is probably the consequence of rupture of the obliterated vessels, or some of the small arteries in the softened part having remained pervious, and yielding to the increased momentum of the blood.

Before concluding this part of our subject, it may be well to observe that the sanguineous effusion which succeeds to softening of the brain is sometimes so extensive that it is extremely difficult to distinguish such cases from sanguineous apoplexy. Nor should it be overlooked that softening of the brain is occasionally the cause of apoplexy, as apoplexy may be the cause of softening, although some authors have maintained that apoplexy is always preceded by softening. It is only when the softening extends considerably beyond the effused blood, or when this fluid has been thrown out in several points of the softened cerebral substance, that we can feel authorized to say that apoplexy has occurred subsequently to the softening. That apoplexy may occur without previous softening is as true as the occurrence of hemorrhage in other tissues, such as the cutaneous, mucous, and cellular, where it is not preceded by any such alteration. That hemorrhage may take place under similar circumstances in the brain is obvious from what is observed in many cases of apoplexy, in which the only change consists in the presence of effused blood. Nor are the portions of brain which have been broken down and mixed up with this fluid always softened. In those cases where death has taken place suddenly, such portions of brain are found to have lost very little of their natural consistence.

[It appears to the writer, however, to be taking too restricted a view of softening, when we refer

it either to an inflammatory process or to obliteration of arteries. It certainly remains to be proved, as M. Calmeil has remarked, (Art. *Ramollissement Cérébral*, in *Dict. de Méd.* xxvii. 220, Paris, 1843,) that white softening, with anæmia, and without purulent infiltration, has been really preceded by active hyperæmia of the softened tissue. It is clearly an altered state of nutrition of the organ, occurring under the influence of morbid causes of very different character. "To endeavour," says M. Andral, "to discover these various conditions is the great but difficult object,—an object of far more importance than that on which observers have exhausted themselves in recent times, when they have been desirous of referring every cerebral softening to some form or degree of inflammation of the nervous centres," (*Clinique Médicale*, iv. 527).

In the obscurity of the subject M. Calmeil (*op. cit.*) suggests, that the softening may be owing to the action of some kind of menstruum, which, he supposes, may be formed by the reaction of the chemical elements upon each other,—"a menstruum, which hereafter perhaps the chemists may be able to demonstrate to the pathologist!"]

To distinguish softening from obliteration from softening produced by inflammation, it is only necessary to ascertain the presence of the morbid state of the arteries which we have described.

We shall conclude the pathological anatomy of softening of the brain with a short description of the changes which occur in those cases in which this lesion does not prove fatal. It is now well known that blood effused into the substance of the brain may be absorbed, and the solution of continuity which it had occasioned become cicatrized. The softened cerebral substance may also be removed by absorption; but we have never seen a case in which its removal was followed by cicatrization.

The first change which indicates the removal of the softened cerebral substance is the formation of an excavation containing a milky, greyish, reddish, or yellowish fluid matter, with sometimes a small quantity of loose cellular tissue. By-and-bye this matter becomes fluid and limpid, and the cellular tissue is found transformed into a serous membrane which lines the surface of the excavation. This cystiform membrane is very delicate, and when the excavation which it lines is situated near the surface of the brain, it may acquire a large size. We have met with a cyst of this kind which would have contained an orange. It occupied one of the thalami and a portion of the corpus striatum on the same side, and extended to the surface of the brain, where it was covered only by the pia mater and arachnoid. It is only in the inflammatory form of softening that we have met with examples of this mode of cure. In three cases in which we have seen it, the patients, from thirty to forty years of age, could not afford us any particulars of their respective cases, but they had been paralytic of both extremities of one side from an early period of life.

Causes of softening of the cerebral substance.—The exciting causes of the two forms of softening which we have described are, as we have seen, inflammation and obliteration of the arteries of the brain. The predisposing causes of the first form of this lesion will be found enumerated under the article Brain. Those of the second form have as yet received no elucidation, further than that the ossification which gives rise to the obliteration of the arteries and softening, consists in a modification of nutrition peculiar to an advanced period of life. It is, therefore, between seventy and eighty years of age that softening from ossification and obliteration of the arteries of the brain is most frequent. The inflammatory softening occurs at every age. It has been met with in infants a few days after birth, in children, adults, and old persons.

Symptoms and progress of softening of the brain and spinal cord.—In both forms of softening of the brain it is necessary to distinguish *two periods;* the first period comprehending the symptoms which accompany or follow the existence of this lesion.

1. *Symptoms of inflammatory softening of the brain and spinal cord.*—As the symptoms of the *first period* of inflammatory softening of the *brain* must necessarily be those of inflammation of this organ, its membranes, or both, it would be superfluous to describe them here. (See Brain, Inflammation of.) It may, however, be observed that the severity of these symptoms does not always indicate a corresponding condition as to the degree and extent of the softening which they precede; nor do they present any one character which can be regarded as a sign that the inflammation on which they depend will terminate in softening. When, however, they are taken in conjunction with those of the second period, they are frequently of great value, as they afford us the means of establishing our diagnosis in cases where it would otherwise be impossible. We shall, therefore, as we proceed, allude to the more important of these the precursory symptoms of softening of the brain.

The symptoms of the *second period* of inflammatory softening of the brain are, generally speaking, of an entirely opposite character to those of the first period. Those of the first depending on the presence of irritation or a morbid stimulus, are characterized by a state of excitement; whereas those of the second being the consequence of the softening or disorganization of the cerebral substance, are necessarily marked by a state of prostration, collapsus, or paralysis. They are announced by the gradual or sudden diminution of the intellectual powers; by the occurrence of stupor or coma; by paralysis, difficulty or loss of speech, and diminution of the sensibility of the skin, eye, and ear. The relative frequency, degree, and extent of these symptoms, as well as the order of their occurrence, present considerable variety. Thus, the derangement of the *intellectual faculties*, such as their diminution, suspension, or abolition, is always present at the commencement of the second period, that is, so soon as the softening of the cerebral substance has taken place. In some cases the derangement which they manifest is at first slight, increases gradually or rapidly, and terminates in their entire abolition. In others, these faculties are, from the commencement, gravely compromised and give no signs whatever of their existence. It is not rare to meet with cases in which their derangement is marked by

remissions and exacerbations, or the occurrence of lucid intervals succeeded by profound stupor. The delirium which accompanies the first period of inflammatory softening either disappears or diminishes greatly in intensity when the second period is announced by the derangement of the intellectual faculties to which we have alluded. It diminishes with the diminution of these faculties, and ceases when their suspension or abolition is indicated by the presence of coma and complete paralysis.

An imperfect state or the entire loss of memory and speech are necessary consequences of these latter conditions of the intellectual faculties. But the absence of any derangement of these faculties is not necessarily unaccompanied by derangement of memory and speech, particularly the latter, for a patient may recover the consciousness of his existence, perceive and comprehend what is passing around him, and yet be incapable of expressing himself in words, on account of paralysis of the muscles by means of which the act of speech is accomplished. The diminution, suspension, or abolition of the intellectual functions, are always accompanied with *paralysis* of the muscles of voluntary motion, and the degree of the paralysis is, generally, in the direct ratio of the extent of the derangement manifested by these functions.

The paralysis is rarely complete at the commencement. It is generally progressive, with occasional alternations of increase and decrease, before it becomes ultimately complete. The situation and extent of the paralysis present considerable variety, and in many cases seem to correspond with the situation and extent of the softening, in the same manner as in apoplexy. The paralysis occupies one or both extremities of the same side, when the softening is limited to one of the hemispheres of the brain, and paraplegia or universal paralysis is produced when both hemispheres, the pons Varolii, &c., are the seat of this lesion. It has been said that paralysis occurs more frequently in the superior than in the inferior extremities; that the seat of the lesion in paralysis of the former is the corpus striatum, and of the latter, the optic thalamus of the opposite side of the brain.

Softening of certain parts of the brain may, however, exist without occasioning paralysis. Such cases are observed in softening of the septum lucidum, fornix, and corpus callosum.

[Still, according to M. Calmeil, (*Op. cit.*) the most precious symptom in the diagnosis of local softening of the brain is local paralysis seated in the side of the body opposite to the softened hemisphere. "Without being invariably present, the abolition or quasi-abolition of motion is so rarely absent, that, whenever the premonitory symptoms of softening are noticed, we should hasten to explore the movements of the limbs."

In 32 cases of acute softening, recorded by M. Durand-Fardel, (*Op. cit.*) paralysis was present in 23 cases. In two, it was general; in one there was simply weakened powers of motion; in 6 the paralysis was limited to the arm, and in 14 it affected one entire side.]

Paralysis of the muscles of the face, of the eye, of the tongue, and of deglutition, depends likewise on the situation of the softening. Paralysis of the bladder and rectum is a frequent consequence of softening of the brain, and gives rise, in the first place, to an accumulation of the contents of these organs, and afterwards to their involuntary escape, more particularly of the urine, from the distension of the bladder and the subsequent dilatation of its sphincter. The difficulty with which vomiting is sometimes effected in this affection of the brain is also, no doubt, owing to a similar state of the muscles which participate in the accomplishment of this act. The state of stupor of the intellectual faculties will, however, explain, in great part, why the urine and fæces are retained, and why emetics as well as purgatives frequently fail to produce their usual effects. For in this state of the brain the impressions of external objects are feebly or not at all perceived. It is under similar circumstances of the brain that the organs of hearing and of sight, which in the first or inflammatory period of softening are highly susceptible, are rendered obtuse to a degree that a strong light or loud sounds impressed on the eye and ear pass unperceived.

One of the most constant symptoms of inflammatory softening of the brain is a state of permanent *contraction* of the flexor muscles of the extremities. This state is well described by Lallemand. (Loc. cit. p. 252.) In some cases the contraction of these muscles amounts only to a slight degree of stiffness; in others it is carried to such an extent that the hand is clenched and remains pressed against the shoulder, and the heel against the hip. The spasmodic contraction of the muscles is sometimes so great that it is not possible to extend the affected limb. The muscles themselves are prominent, feel hard, and the projecting tendons resemble cords stretched beneath the skin. Acute pain is frequently the imdiate consequence of an attempt to overcome the contraction of the muscles. A prickling sensation or even lancinating pains, more marked in the superior than in the inferior extremities, sometimes precede the contraction of the muscles, which, according to Lallemand, always commences in one of the superior extremities, in which, unless it be already carried to the utmost extent, it is always greater than in the inferior extremities. It is sometimes limited to the former, or does not extend to the latter until a considerable time after.

It is of importance to note the presence of this state of the muscles of the face and eyes, as it produces changes peculiarly characteristic of paralysis from softening. We have seen that a paralysed extremity may be contracted and held in a state of permanent flexion. The same thing happens in the paralysed side of the face. The muscles of this side, spasmodically contracted, are drawn upwards and backwards, and produce that deviation in the form and situation of the mouth observed in this disease as well as in apoplexy. But the fact to be noticed in the present case is the deviation of the mouth to the paralytic side, the opposite of what is observed in apoplexy, in which disease it is drawn towards the healthy side. When, however, the spasmodic state of the muscle has ceased, the mouth immediately assumes the position which it occupies in the latter disease. As the spasmodic contraction of the muscles depends on the presence or irritation

around the softened cerebral substance, the former coincides, diminishes, increases, or disappears with the latter. Hence it is that these contractions have an intermittent character, precede the paralysis, and seldom accompany it till the fatal termination of the disease. The paralysis is not otherwise recognised during the spasmodic contraction than by the immobility of the paralysed limb, which is not under the command of the will. When the contraction ceases, the limb becomes flaccid, and remains in a state of immovable extension. If the spasmodic state of the muscles returns, the limb is again contracted, and thus the stiffness and flaccidity, the flexion and extension of the muscles, occur at irregular intervals of time. Slight convulsive motions, referable to the same cause as the contractions, viz. the presence of irritation of the brain, the degree of which is suddenly increased and diminished, accompany sometimes the contraction of the muscles, or agitate the paralysed limb.

The spasmodic contraction of the orbicular muscle of the eye is also not unfrequently very marked. When the eyelids are raised by the finger, they immediately return to their former position, and cover the entire surface of the eyeball; and when the motor muscles of this organ are affected, there is strabismus. The pupil, too, undergoes marked changes of contraction and dilatation. It is contracted only during the first period of the softening, or when this change is accompanied by irritation of the brain; and during the second period, or when there is softening without subsequent irritation, it is dilated. This state of the pupil is also intermittent, and its permanent dilatation does not occur until the paralysis is complete. It is observed by Lallemand that the pupil is contracted only in those patients in whom the muscles are spasmodically contracted; that when the disease exists only on one side of the body, it is the eye of the same side that is affected; that when the spasmodic convulsions make their appearance by successive attacks, it is during these attacks that the pupil is contracted; and lastly, that in proportion as the paralysis increases, the pupil becomes more and more dilated; and, as we have seen, that as patients are unable to use their limbs although the action of the muscles is increased, so are they incapable of perceiving external objects, although the contraction of the pupil announces an augmentation of the sensibility of the retina.

In some cases the spasmodic contractions are confined to the paralysed extremity, a circumstance which depends on the irritation being limited to the same portion or side of the brain in which the softening exists. In other cases, the paralysed and healthy extremities are both spasmodically contracted from the irritation occupying both hemispheres of the brain. Such is frequently the case when the softening occupies the convolutions of the brain, or when it is preceded by meningitis of both hemispheres. In this latter instance too, the rigidity, contraction, and convulsive movements of the muscles, precede the paralysis. Lastly, one side of the body may be in a state of complete paralysis, and the other the seat of spasm or convulsive contraction, when one hemisphere of the brain is affected with softening, and the other or its membranes in a state of inflammatory excitement.

The precedence of spasmodic contractions to paralysis is not a constant character in inflammatory softening. We have seen two marked cases of paralysis from inflammatory softening which, so far as information could be obtained from the relatives of the patients regarding the previous history of both, appeared to have taken place suddenly without any precursory symptoms, such at least as were calculated to prevent the patients from carrying on their daily occupations.

The last symptom of inflammatory softening of importance to be noticed, is pain. It is obvious that this symptom cannot depend on the state of softening of the cerebral substance. It is the consequence of irritation or morbid excitement of the brain, the disorganization of which has not yet taken place. It is therefore generally most severe when it occurs as a precursory symptom; but it frequently accompanies the first period of the disease, and presents remissions and exacerbations, variable in duration and degree. It is seldom that it exists to the same extent in the second period as in the first; on the contrary, it generally diminishes or disappears as the paralysis and the derangement of the intellectual faculties increase. The depressed state of these faculties not unfrequently prevents the patient from manifesting the existence of pain; and it is not until he is roused from the state of stupor in which he is plunged, that he gives signs of suffering by carrying the hand to that part of the head which is the seat of pain. We have already alluded to the pain which accompanies the spasmodic contraction of the muscles. It is hardly necessary to remark that pain can be present in those cases only in which the sensibility of the paralysed part remains unaffected.

Such are the modifications of function which are generally observed to accompany inflammatory softening of the brain, and which appear to be the immediate consequences of this lesion. We shall now notice briefly those which are observed in the functions of respiration, circulation, and digestion. Respiration is seldom much affected till near the termination of the disease, when it becomes embarrassed, afterwards hurried or irregular, and lastly stertorous. The pulse is sometimes frequent, full, and strong; sometimes quick, or feeble and intermittent, but more frequently it does not present any very remarkable alteration. There is in general little or no appetite; sometimes nausea or even vomiting; thirst, and, as we have already noticed, difficulty or even impossibility of swallowing. The temperature of the skin is sometimes not much increased; at other times it is considerably so; the tongue and lips become dry, fissured, and covered with a brown or black sordes. It is at this period that the respiration becomes stertorous, the pulse sinks and intermits, and announces the approaching death of the patient, which takes place in the midst of the most profound stupor, and in a state of universal paralysis and prostration.

The *progress* of inflammatory softening of the brain is generally rapid. It is seldom stationary except during the first period. The second period is marked by a progressive increase of the principal

symptoms, which, although sometimes observed for a short interval, re-appear under a worse form, and hasten towards a fatal termination. The average *duration* of the disease, or of the second period, is from five to seven days; death may supervene on the second or third day, or not until the third or fourth week, or even at a later period; but cases of the latter kind are extremely rare.

The symptoms of inflammatory softening of the *spinal cord* consist in modifications of sensation and motion, as the increase, diminution, or abolition of the former, the diminution or cessation of the latter. If the posterior portion of the cord be softened, sensation only is modified; if the anterior, motion only is modified; and when both portions are the seat of this alteration, both sensation and motion are modified. The lesion of sensation and motion, separately, does not so frequently happen as that of both; and when it does occur is seldom of long continuance, both soon becoming affected. The situation, degree, and extent of the functional derangement are determined chiefly by the seat of the softening. If the softening has taken place in the cervical region, the functions of all the organs situated inferiorly, in so far as their accomplishment depends on the integrity of the cord, are altered. Paralysis of the superior and inferior extremities of one or both sides; diminution or increase of the sensibility in the same parts; difficulty of respiration; retention or involuntary discharge of the fæces and urine, are produced, according as the softening occupies the anterior or posterior portions of the cord or both. The latter symptoms only are present when the dorsal or lumbar region of the cord is affected. Pain may or may not be present in the affected portion of the cord. It may exist as a consequence of the disease, or may not be perceived until it is developed by pressure or the direct application of heat or cold.

We formerly alluded to the simultaneous occurrence of softening of the brain and spinal cord. This complication rarely happens, however, in adults; and in the cases which we have seen, the softening of the cord being confined to the lumbar region, the general symptoms did not present any peculiarity worthy of notice. The same may be said of softening of the cerebellum, which we have never seen unaccompanied by softening of the brain.

2. *Symptoms of softening of the brain from obliteration of the arteries.*—This form of softening of the brain has, like the former, been divided into two periods. The symptoms of the *first period* consist of pain referable to a particular part of the brain. The pain may be slight or severe, of short or long duration, generally remittent or intermittent. The intellectual functions are often sensibly modified; memory is impaired, speech embarrassed; there is frequently drowsiness, an unwillingness to every exertion; sometimes numbness or stiffness of the extremities, a prickling sensation or an increase of the sensibility to such a degree that even slight pressure occasions acute pain. The functions of the organs of sense are generally impaired; sight in one or both eyes may be less acute or entirely lost, and the pupil may retain its natural dimensions or be dilated; hearing may also be more or less imperfect, and taste and smell, when altered, are less acute than natural. The state of the digestive functions does not present any remarkable alteration, except inappetence, or constipation; the latter symptom being generally accompanied with retention or a difficulty of voiding the urine.

These are the symptoms which generally occur during the first period, but they are not constant; they are seldom all equally manifest; several of them may be absent, or only one, two, or more of them may be so marked as to attract the attention of the physician, or excite the fears of the patient. The local symptoms, or those of the brain, may prevail, particularly pain, loss of memory or confusion of ideas; or it may be the general symptoms, or those which indicate derangement of the functions of those organs which we have enumerated, especially the sensation of numbness and prickling felt in the muscles of the extremities or face, and difficulty of speech. It is, however, important to note that all the symptoms of this period may be regarded as denoting a diminution rather than an increase of function, the opposite of what is observed in the first period of inflammatory softening of the brain.

The symptoms of the *second period* are generally ushered in by a sudden aggravation of those of the first period, but chiefly by the occurrence of complete paralysis and the suspension or abolition of the intellectual faculties. The extent and situation of the paralysis, the modifications of the sensibility and contractility of the affected parts, and the ulterior progress of the disease, are so similar to those observed in the second period of inflammatory softening, that a description of them would be nearly a repetition of the latter. The important exceptions which they present will be more appropriately introduced when treating of the diagnostic symptoms of both forms of softening.

The *progress* and *duration* of softening of the brain from obliteration of the arteries do not essentially differ from those of inflammatory softening. In its progress it is, perhaps, less rapid than the latter. Although it may sometimes appear stationary, it is essentially progressive. The paralysis, if not complete at the commencement, increases till it becomes so, and the recovery of speech or of the intellectual faculties seldom insures more than a short suspension of the progressive increase of this form of softening. The duration of this lesion is very various. We have seen death take place as early as the second day, and not before the fourth or sixth week.

Diagnosis of softening of the brain and of the spinal cord.—We have here to distinguish, first, the symptoms of softening of the brain produced by inflammation, from those which accompany softening from obliteration of the arteries; and, secondly, the symptoms of both these forms of softening from those of other diseases between which and the former there is a greater or less resemblance.

First, the necessity of distinguishing between the two forms of softening of the brain can arise only when this disease affects persons after the decline of life. We shall not enter minutely into the description of the distinctive characters of the two forms of softening, as the treatment required in both is essentially the same, and as the impor-

tance of an accurate diagnosis diminishes in proportion as the disease approaches to that stage or period which constitutes the lesion of which we are now treating.

We have already observed that the two forms of softening of the brain are distinguishable from each other more by the phenomena of the first than by those of the second period; by the symptoms which precede rather than by those which accompany the state of softening. Inflammatory softening is preceded by local and general excitement; there is present, from the commencement, an increased development as it were of the functions of the brain, and of those organs comprised within the sphere of its morbid activity. This state of local and general excitement does not occur in the non-inflammatory softening at the commencement. It takes place after this lesion is produced; is, in general, slight at first, and afterwards increases in severity, the opposite of what happens in the former. The delirium, the spasmodic contractions and convulsions, the contraction of the pupil, and increased sensibility of the eye and ear to their natural stimuli, which precede the former, are absent at the commencement of the latter, and do not occur until some time after the softening has taken place and is followed by irritation or inflammation of the substance of the brain or its membranes.

When the second period of softening of the brain has arrived, there are few if any symptoms which indicate the kind of softening on which they depend, if those of the first period cannot be ascertained, or, as sometimes happens, have been wanting. The spasmodic contraction or convulsive twitchings of the muscles of the extremities and contraction of the pupils are, under these circumstances, the symptoms on which most reliance is to be placed. The presence or absence of these symptoms may, as a general rule, be regarded as indicating the presence, the former of inflammatory, the latter of non-inflammatory, softening.

Secondly, the diseases the most likely to be confounded with softening of the brain are serous effusion, congestion, and apoplexy. The *serous effusion* which gives rise to symptoms resembling those of softening of the brain, occurs as a termination of meningitis. The delirium, derangement of the intellectual faculties, and febrile excitement which accompany the first stage of the latter disease, together with gradual and sometimes sudden supervention of paralysis occasioned by the effused serosity, render it, in some cases, very difficult to distinguish this termination of meningitis from inflammatory softening. There are, however, two features in particular, in the symptoms of meningitis, of considerable diagnostic value, — namely, the prevalence of convulsions during the first stage, and the general character of the paralysis in the second stage, the latter symptom being seldom confined to one extremity or one side of the body in this disease. Paralysis from this cause is not likely to be confounded with non-inflammatory softening.

The symptoms of *congestion* are, generally speaking, very characteristic of the kind of lesion on which they depend. The ringing of the ears, dimness of the sight, the sensation of a weight within the cranium, giddiness, stupor, and the turgidity of the veins of the face and neck and conjunctiva, followed by the sudden diminution or suspension of the intellectual faculties, of sensation and motion, are symptoms referable to a rapid accumulation of blood in the vascular system of the brain. And if this disease does not suddenly prove fatal, the disappearance of all these symptoms under the use of the ordinary remedies, and the rapid recovery of the patient, very soon put its nature beyond doubt.

The difficulty of distinguishing between inflammatory softening of the brain and *apoplexy* from sanguineous effusion is, in the great majority of cases, by no means great. The progressive character of the former, and the sudden invasion of the latter, constitute, in a general point of view, a marked difference between the two diseases. The state of excitement which precedes and accompanies inflammatory softening occurs in apoplexy only as a consecutive symptom, and is, perhaps, never equal in degree or extent to that observed in the former disease. The state of coma and collapse does not make its appearance till towards the termination of softening from inflammation, whereas it is the first symptom which indicates the existence of apoplexy. Inflammatory softening tends progressively to this state; whereas in apoplexy the most profound stupor may be of short duration; consciousness and the exercise of the intellectual faculties return, and, if the disease be curable, may regain the same degree of integrity which they possessed before the attack. The subsequent contraction and convulsive motions of the muscles, and the contraction of the pupil — conditions the opposite of those observed at first, namely, relaxation and dilatation, — present the same differential importance as the symptoms just alluded to. It is in those cases of apoplexy in which the stimulus of the effused blood gives rise to irritation of the cerebral substance with which it is in contact, that the difficulty of distinguishing between this disease and inflammatory softening is greatest, particularly if the inflammation which has preceded the latter has been slight, and confined to the cerebral substance.

It would be difficult to lay down even a general rule whereby to determine the distinctive characters of softening of the brain originating in obliteration of the arteries, from those of hemorrhagic apoplexy. Apoplexy is certainly, in general, more sudden in its occurrence and less frequently preceded by precursory symptoms than non-inflammatory softening. But it must not be forgotten that the former may be preceded by symptoms similar to those which precede the latter; and, *vice versâ*, the latter may occur with all the rapidity of the former, and without its being announced by any marked modification of function.

Softening of the spinal cord will not readily be confounded with apoplexy of this organ. Apoplexy is a rare affection of the cord compared with softening; and its effects, loss of sensation and motion, are sudden, from the first complete, and without being announced by any precursory symptoms. In inflammatory softening, sensation and motion are gradually lost, are preceded by excitement, generally by local pain, although it may be slight; by an increase of the sensibility and con-

tractility of the affected extremities, and sometimes by convulsions of the same parts.

Prognosis of softening of the brain and spinal cord.—We formerly observed that we had not met with a case of cure of non-inflammatory softening of the brain, and that, on the contrary, we had seen cases of the inflammatory kind in which the evidence of complete recovery was rendered obvious by the state of the brain examined some years after the attack. Rostan (Loc. cit. p. 462,) says that the cure of softening of the brain, when it has attained the second period, must be regarded as problematical, and if he alludes to the non-inflammatory form of the disease, his opinion is in accordance with our own. Lallemand (Loc. cit. p. 287,) and Abercrombie (Loc. cit. p. 158,) both agree in opinion as to the curability of inflammatory softening of the brain, or, more correctly, of the curability of inflammation of this organ when the symptoms have been of the worst kind, and those too which accompany the second period. But at the same time they remark that this favourable termination of the disease is, under such circumstances, of rare occurrence. When, therefore, the symptoms of the second period of inflammation of the brain, or those ascribed to softening of this organ, manifest themselves, our prognosis must always be unfavourable, and the more so in proportion to the rapidity of the progress of the symptoms of the second period, and the degree of coma and paralysis by which they are succeeded. The progress of softening of the spinal cord is, if possible, more unfavourable than that of the brain.

Treatment of softening of the brain and spinal cord.—It would appear from the preceding remarks that the fatal termination of this disease has seldom been prevented by any mode of treatment hitherto adopted. There are no successful cases recorded of softening from obliteration of the arteries, and in the few cases of the inflammatory form of the disease which have terminated favourably, it is more than probable that the softening was very limited in extent, and affected the superficial or less important parts of the brain. As regards the state of softening, which, in point of fact, consists in a *solution of continuity* of the cerebral substance, it must be obvious that we possess no remedial agent capable of obviating such a change. The diseased state, therefore, of which we are treating, is incurable; that is to say, the solution of continuity which it constitutes will remain, even though the patient should recover. The essential part of the treatment of softening of the brain relates, consequently, to the local morbid conditions which immediately precede this change,—namely, the diseased state of the arteries on the one hand, and inflammation of the brain on the other. This state of the arteries, like the softening to which it gives rise, is, so far as we yet know, beyond the control of remedial agents. When, therefore, it is ascertained that the softening is the consequence of this state of the arteries, the only hope that can be indulged is partial relief, and the prolongation of life for a short period beyond that at which the disease would have proved fatal had it been allowed to run its natural course. It is possible that the attack may be delayed by judicious treatment, employed when the first symptoms of cerebral derangement are perceived, such as pain in a particular part of the head, confusion of ideas, giddiness or unusual drowsiness and listlessness, together with a prickling sensation, or numbness in the muscles of the extremities, face, or tongue.

Bleeding from the temples, cupping in the nape of the neck, or small general bleedings, repeated from time to time as circumstances may require, may, by diminishing the quantity of the blood, facilitate the circulation of this fluid through the brain. But, perhaps, greater advantage would be derived by keeping the bowels freely open without inducing excitement or debility, chiefly by means of the neutral salts. The compound aloetic pill will be advantageously employed in those cases in which the disease occurs after the cessation of the catamenia, or suppression of a hemorrhoidal discharge. A diminution of the circulating fluids, as well as their equalization, will be effected likewise by promoting all the secretions, particularly the secretion of the urine and bile. The food and drink of the patient should be particularly attended to. His diet should consist of those kinds of food which are most easily digested by him, and which affords the greatest quantity of nourishment in the smallest bulk. Ardent spirits, strong wines, fermented liquors, even strong coffee or tea, and all stimulating potions should be avoided as more or less injurious. The occasional use of warm and rubefacient pediluvia, constant warmth to the feet and lower extremities, an elevated posture of the head, residence in a cool atmosphere, and tranquillity of mind, will greatly favour the operation of the other means, and afford the patient a chance of escaping the fatal termination of the disease.

It is with reluctance that we allude to any kind of treatment to be employed when softening has once taken place. Rostan recommends that the use of all debilitating means be avoided, when the softening does not present the inflammatory character, which kind of softening, we presume, is that of which we are now treating. He recommends the prompt use of rubefacients, irritating lavements, and those internal medicines which exert their influence on the large intestines; and the administration even of tonics, aromatics, and internal stimuli.

It is also by the early, prompt, and vigorous application of those means which have been found most efficacious in arresting the progress of inflammation of the brain and its membranes, that the termination of this pathological state in softening is to be prevented. As the treatment of inflammation of the brain and its membranes has been given in detail in another article, (see BRAIN AND ITS MEMBRANES, INFLAMMATION OF,) we shall, in this place, only allude to it generally. The principal are bloodletting, purgatives, and cold. The bloodletting may be either local or general, or both; and in this respect, as well as quantity, we must be regulated by the violence of the attack, the age, habits, and constitution of the patient.

Drastic purgatives have been found the most beneficial, but in their employment the physician must be guided by the state of the stomach and intestines. With these, the tartar-emetic may be

combined, or given alone in such quantity as to keep up a state of nausea, but ought never to be carried so as to produce vomiting. As a purgative, Dr. Abercrombie strongly recommends the croton oil. The same author highly extols the beneficial effects of cold applied to the head, by means of pounded ice contained in a bladder; or a stream of cold water directed against the crown of the head, and continued until the desired effect be produced: but this is so powerful a remedy that it requires to be used with much discretion.

The treatment of the second period, or that of softening from inflammation, is the same in principle as that of the former, in so far as it regards the state of excitement with which this morbid change is generally accompanied. But if the paralysis be fairly established, and, notwithstanding the depletory and sedative measures which have been employed, continues to increase, neither our own observation nor the recorded experience of others would recommend a hardy perseverance in the means, the debilitating effects of which have not been sufficient to overcome the inflammatory excitement of the first period. Bleeding and active purgatives should now be laid aside; blisters or sinapisms should be applied to the inferior extremities, the nape of the neck, and superior part of the spine; the head should be kept cool by the constant application of evaporating lotions; the bowels evacuated once or twice a day by means of castor oil or any mild aperient if it can be swallowed, or by injections; the secretion of the urine and the cutaneous perspiration should also be promoted by remedies of the least stimulating qualities. The retention of the urine is a complication which must be sedulously watched, that this fluid may be removed before it accumulates to a degree to prove injurious. Stimuli or tonics should now be employed with a view to support the strength of the patient, but they ought never to be employed to such an extent as to produce excitement, as the powers of life are already greatly exhausted by the stimulus of the disease.

Should the patient recover from this dangerous and so frequently fatal disease, every attempt to restore the functions of the paralysed limb should be deprecated in the strongest terms. There are, however, cases in which the paralysis is extremely slight, consisting in a slight degree of weakness, which disappears gradually of itself in the course of a few weeks. But in the former, the paralysis is from the commencement complete, the member remains in a state of flaccidity and immobility, from which it does not recover until after a considerable length of time, and, perhaps, never to such a degree as to be of much use to the patient. In such cases there must be a solution of continuity, which being permanent and the cause of the paralysis, the paralysis must be permanent also.

With regard to the treatment of inflammatory softening of the *spinal cord*, it is only necessary to observe that it is in every respect the same as that of softening of the brain. Topical bloodletting, however, the actual cautery or the moxa, may be employed according as the disease may be acute or chronic in its progress, and the more so that it is much more frequently the consequence of disease of the spine, which also requires this treatment, than of idiopathic inflammation.

Softening of the Mucous Membranes.—Softening of the mucous membranes may, as we have already remarked in the introductory part of this article, occur either as a *pathological* or *post-mortem* lesion. The first, being the consequence of inflammation, is met with in mucous membranes in general; but the second being the effect of the chemical action of the gastric juice, is observed only in the digestive organs. It is a remarkable fact that softening of the mucous membrane is much more frequent and infinitely more extensive in the stomach and intestines than in any other organ; a circumstance deserving of particular notice, inasmuch as it indicates some peculiarity in this portion of the mucous system considered in itself, or in its relations with external agents. It is, therefore, not surprising that softening of the mucous membrane of these organs should have attracted in a special manner the attention of pathologists, but more particularly after it was discovered that this membrane undergoes so frequently this change in various forms of fever, or when the seat of inflammation as a primary or secondary disease.

Before proceeding to describe softening of the mucous membrane of the stomach and intestines from inflammation and from the chemical action of the gastric juice, we shall make a few general observations on the natural consistence of this membrane in these organs, and the diminution of consistence which it undergoes from maceration and putrefaction. The importance and intricacy of this part of our subject render it absolutely necessary to possess an accurate acquaintance with the modifications which the mucous membrane presents in these respects.

The *natural consistence* of the mucous membrane of the digestive organs is always in proportion to its thickness. Thus it is found to be thickest in the duodenum and pyloric portion of the stomach, and in these situations it is most consistent; it is thinnest in the colon and fundus of the stomach, and there also its consistence is least. Its thickness progressively diminishes in the rectum, jejunum, and ileum, and in the same descending ratio its consistence. If where it is thickest it be cut through, it may be torn from its connection with the cellular tissue, in pieces varying from a quarter of an inch to half an inch in length. This can be done in the pyloric portion of the stomach and rectum, but not in the duodenum, on account of the mode of attachment of this membrane in this portion of the intestinal tube. At the fundus of the stomach and in the colon it can be detached in very small portions only; and in all cases of great emaciation, this membrane becomes so thin throughout the whole of the stomach and intestines, that it breaks whenever an attempt is made to raise it.

The relative degrees of the normal consistence of the mucous membrane in different portions of the digestive tube are nearly the same at every period of life. It is hardly necessary to remark that the consistence of this membrane, as well as that of the other tunics of the stomach and intestines, is much less in the infant than in the adult.

When a portion of intestine is submitted to *maceration*, the mucous membrane does not lose its consistence until after a considerable lapse of time. Billard made this experiment, and found that softening did not commence till towards the expiration of two months. (De la Membrane Muqueuse Gastro-Intestinale. Paris, 1825.) When exposed to the air, it does not begin to soften until about the commencement of the third week. But in both cases it would appear that putrefaction always precedes the softening, as the latter is not perceived until the former is announced by the peculiarity of its smell. Hence it has been suggested that as softening of the mucous membrane, from these causes, does not take place until at a period greatly beyond that at which the body is usually submitted to inspection, we ought not to regard as *post-mortem* examples of softening those which are met with in this membrane, say twenty or thirty hours after death. This, however, we shall find, is far from the truth, as we shall afterwards show that complete softening of all the tunics of the stomach and intestines may take place in a much less space of time.

With regard to the influence of putrefaction in producing softening, it would not by any means be correct to say that it does not produce this change of the mucous membrane till after the expiration of weeks or months. Such appears to be the expression of the fact as regards the influence of putrefaction in modifying the consistence of healthy mucous membrane; but when this membrane has been the seat of disease before death, and more particularly when the disease has been of such a kind as to deprive this membrane suddenly of its vital properties, a few hours will suffice for its complete decomposition. This fact is illustrated in a general point of view by those cases of sudden death in which the nervous system, the blood, or both, are the vehicles of the destructive agent or of its influence, as in death from lightning and certain poisons. In such cases all the tissues run rapidly into putrefaction.

Having made these general remarks on softening from maceration and putrefaction, we shall now confine our attention to softening of the mucous membrane from inflammation and the chemical action of the gastric juice.

Softening of the Mucous Membrane of the Stomach and Intestines from Inflammation.—It is said that the mucous membrane of the stomach is much more frequently affected with softening than that of the intestines. Now this statement is true only in so far as expressive of the occurrence of softening without reference to its nature. It is not true as regards inflammatory softening, while it is quite true if applied to softening as a chemical effect of the gastric juice. It is also said that the mucous membrane is most frequently found softened where it lines the fundus of the stomach. This circumstance does not, however, decide the locality of inflammatory softening in this organ. For it is precisely at the fundus of the stomach that the mucous membrane is almost always acted upon by the gastric juice after death. Softening of the mucous membrane from inflammation is, we should say, most frequently observed at the termination of the ileum; in the depending or fixed portions of the colon, or the cœcum, in the right and left hypochondriac regions and sigmoid flexure of this intestine. Although such are the parts in which inflammatory softening is most frequently observed, it may occur not only in any definite portion of the intestinal tube, but also throughout its whole extent, that is to say, from the cardiac orifice to the anus; but such cases are very rare. These remarks apply to inflammatory softening of the mucous membrane considered as a whole; but as this membrane is composed of distinct elements,—the mucous tissue properly so called, villosities and follicles,—this morbid alteration may take place in each of these parts separately, or in all of them at the same time. Softening of the mucous membrane in general, or of these its elements in particular, presents various degrees. In the first degree the mucous membrane, instead of possessing that degree of cohesion which permits of its being detached from the submucous tissue, breaks as soon as it is seized between the fingers or forceps; in the second degree the edge of a scalpel or the finger passed lightly over its surface converts it into a soft, somewhat opaque, creamy-looking pulp; and in the third or last degree it is so soft that it is removed by a stream of water poured upon it from the height of a few inches. In this stage portions of it are found partially or entirely destroyed, and, having been removed by the fluid contents of the stomach or intestines during life, the submucous or cellular tissue is thus found deprived of its mucous covering. It is in this manner that various forms of softening are produced, as irregular or round patches of various sizes. It is important to notice this circumstance, for when the softening is limited to the glandulæ solitariæ, particularly in the large intestines, as is frequently the case in dysentery, it might be altogether overlooked. These bodies being very small, and their entire destruction from softening being often unaccompanied by any obvious alteration of the mucous membrane itself, the seat and nature of the intestinal affection might not be ascertained were it not for the presence of a number of minute circular patches, which, when narrowly examined, are found to be the result of softening of these follicles; for it often happens that enlarged follicles are seen intermixed with the patches, and which, when a scalpel is carried over the surface of the mucous membrane, break down or are removed, and thus other patches are formed similar to the former. These circular patches, which have the submucous tissue for their basis, are often described as ulcerations of the mucous membrane; but in all cases of doubt the use of the scalpel, as noticed above, will enable us to determine their nature. Softening of the mucous membrane in the form of stripes and bands has been described with great care and precision by Louis, and has been much insisted upon as characteristic of inflammatory softening. But for reasons which we shall afterwards assign, we are disposed to ascribe a very different origin to these forms of softening of the mucous membrane of the stomach, viz. the chemical action of the gastric juice.

Softening of the mucous membranes of the digestive organs may present various degrees of redness, or it may be quite pale. The redness may

be confined to the softened part, or it may extend to the neighbouring parts at the same time, or the latter may be red and the former pale. The redness of the softened membrane may vary from a slight rose red, bright or dark red, to purple or brown,—varieties of colour, the value of which it is by no means easy to estimate, inasmuch as the quantity of blood in an inflamed tissue cannot be taken as the measure of the degree of inflammation which had caused the accumulation of this fluid. The pale inflammatory softening presents also some variety of tint which requires to be noticed. The softened mucous membrane is of a pale greyish or yellowish grey tint, being little altered from its natural colour; or it may be paler than natural, when it generally presents a milky aspect, owing to the colour of the submucous tissue being seen through it. The pale softening is very common in phthisical subjects, in tubercular disease of the mesenteric glands, as in all diseases followed by great emaciation, although the existence of this important lesion was not known to pathologists till very lately, owing to the imperfect mode of examination to which the digestive mucous membrane was subjected.

Instead of constituting the only disease of the mucous membrane, softening may be complicated with various other diseased states, such as thickening of this membrane, enlargement of its follicles, and ulceration; but its general characters do not, under these circumstances, differ from those we have just described.

Inflammatory softening has been described as affecting all the tunics of the stomach and intestines. It is said to proceed from the mucous membrane to the submucous tissue, and from the latter to the muscular coat and peritoneum, all of which it destroys in succession, and terminates in perforation of these organs. We, however, disbelieve this statement. Softening of all the coats of the stomach or intestines, carried to the extent of perforation of these organs, does not arise in inflammation. It depends on the chemical action of the gastric juice.

Much has been said of the *symptoms* of softening of the gastro-intestinal mucous membrane, but it would serve no useful purpose to give an exposition of them in this place, inasmuch as when this lesion is the consequence of inflammation, the symptoms are those of gastritis or gastro-enteritis, and which will be found detailed under these heads respectively. It need hardly be observed that there are no symptoms referable to the states of softening which we have described, considered in itself, and as a termination of inflammation of the mucous membrane.

It may, however, be reasonable to suppose that, if a person recovers from gastritis or enteritis, followed by complete softening of the mucous membrane to a considerable extent, nutrition will be considerably modified, at least in degree. But how far this actually takes place has not been ascertained; and although we find the mucous membrane in some individuals, after death, presenting a very indistinct villous structure, either generally or in particular parts, it is easy to conceive how great must be the difficulty of deciding on the nature of such an appearance, the more especially as it has not been found to be connected with any peculiar modification of function.

The description, therefore, which we have given, of softening of the digestive mucous membrane, is valuable only in so far as it becomes a *test* of the previous existence of inflammation. It is, in fact, only in this point of view that we can consider it in this place. It is a lesion of the mucous membrane which belongs exclusively to the pathologist, as it furnishes the physician with no sign of its existence. It puts him, however, in possession of the important facts to which we have alluded, viz. the frequency, extent, and consequences of inflammation in organs to which it had so long escaped his researches, thereby leaving him without the means of judging of the propriety of his practice, or of giving to it that stability and scientific character which it is more capable of receiving.

2. *Softening of the stomach and intestines from the chemical action of the gastric juice.*—The chemical dissolution of the mucous membrane and other tunics of the stomach was discovered by John Hunter, while engaged in a series of experiments on digestion. (J. Hunter, on the digestion of the stomach after death, Phil. Trans. vol. lxii. p. 444; and Observ. on certain Parts of the Animal Economy, 2d edit. p. 226.) He described it as *digestion of the walls of the stomach after death*, and as the immediate consequence of the solvent property of the gastric juice. As he had observed it only in healthy animals, and in persons who had been suddenly deprived of life by external violence, he believed that a perfect state of health, immediately before death, was absolutely necessary to its production. The opinions of Hunter on the dissolvent property of the gastric juice after death, were soon after confirmed by Spallanzani (On the Natural History of Animals and Vegetables, Dissert. 5,) and Dr. Adams, (On Morbid Poisons, &c. and London Med. Jour. vol. xxiii. p. 399); and Mr. Allan Burns (Observations on the Digestion of the Stomach after Death; Edin. Med. & Chir. Jour. vol. vi. p. 129,) contributed some important information on the subject, more particularly relating to the chemical dissolution of the stomach in individuals who had died in a state of great debility and emaciation from chronic disease, and also the occurrence of this lesion in portions of the stomach in which it had not before been observed.

Although the experiments and observations of Hunter, modified and extended by the contributions of Spallanzani, Adams, and Burns, clearly demonstrated the occurrence of softening and perforation of the walls of the stomach in certain animals, as fishes, rabbits, and dogs, and in man, in consequence of the chemical action of the gastric juice after death, British pathologists appear to have entirely overlooked the importance of the subject in relation to those morbid conditions of the stomach which bear a greater or less resemblance to the *post-mortem* effects of the gastric juice upon this organ. In France, the opinions of Hunter were at first received with doubt, afterwards turned into ridicule, and the most vague and absurd hypotheses set up in their place. French pathologists, instead of regarding the lesions pointed out by Hunter as *post-mortem* effects of the gastric juice, described them as grave

alterations of the stomach during life by the direct operation of morbific agents. Chaussier (Bulletins des Sciences Médicales du Département de l'Eure, No. 53, p. 7,) whose description of the appearances produced by the gastric juice accords with that of Hunter, ascribes the softening and perforation of the walls of the stomach to the presence of an *acrid* and *corrosive* fluid produced by a *special* irritation of this organ, and which turns its activity even against the tissue whence it is derived, as well as other tissues with which it is brought in contact. Morin (Considér. générales sur l'Erosion, Paris, 1806,) Laisné (Considér. Medico-légales sur les Erosions et Perforations spontanées de l'estomac, dans le recueil intitulé Méd. Lég. No. 104, p. 135,) and several others referred the same alterations of the stomach to the sudden development of a *high degree of local irritation*, terminating in the partial or complete destruction of the affected part of this organ, by a process similar to that of erosion or ulceration.

The researches of Jæger* in Germany revived the opinions of Hunter, and directed the attention of pathologists anew to the experimental investigation of this interesting subject. The experiments and observations of this author led him to the conclusion that the softening and perforation of the stomach occur after death, but that these changes are not the result of the chemical action of the healthy gastric juice. He believes, on the contrary, that this fluid must have been altered by disease, the nature of which he does not explain, but supposes it to consist in some peculiar change taking place in the functions of the nervous system, and a consequent modification of the secretion of the digestive organs. Dr. J. Gairdner† has arrived at the following conclusions as the result of his observations on softening and perforation of the alimentary canal, viz. that these lesions are produced after death by the action of the fluids contained in the stomach and intestines; that these lesions probably occur in some cases without previous disease of the parts in which they are found to exist; but that they also take place in consequence of a peculiar disease of the alimentary canal, whereby portions of it are rendered more easily soluble by the action of its contents.

Such are the principal opinions of those who have adopted, rejected, or modified the views of John Hunter on softening and perforation of the alimentary canal. We may now allude briefly to those of Cruveilhier and Louis, who have described these *post-mortem* lesions as pathological alterations of the stomach and intestines, and as constituting a disease not hitherto observed by pathologists. Louis‡ has detailed, with great precision and accuracy, the symptoms and *post-mortem* appearances observed by him in a considerable number of cases in which the mucous membrane of the stomach was found more or less softened or destroyed. He considers this state of the stomach as produced during life, and referable to a state of irritation of the mucous membrane, the symptoms of which, although generally conspicuous, are sometimes wanting. In Cruveilhier's (Médecine Pratique éclairée par l'Anatomie et la Physiologie Pathologique) memoir, we find this author describing the same lesion of the alimentary canal as it occurs in infants and children, and ascribing it to a high state of irritation of the mucous membrane, which, being followed by the repeated effusion of serosity, the delicate textures of the stomach and intestines become infiltrated, distended, and ultimately disorganized, thus producing, as it were mechanically, what he calls the *ramollissement gelatiniform* of the walls of this organ, and perforation.

Such is a brief outline of the several opinions which have been entertained regarding the nature of the lesion now under consideration. Impressed with the importance of the subject when considered in connection with several morbid conditions of the stomach, more especially those produced by inflammation of this organ, the author of the present article instituted a series of experiments, modified in every possible way, with a view to obtain a satisfactory solution of the following questions. (Journ. Hebdom. de Méd. Nos. 87 and 91, 1830.) Are the lesions described by various authors under the appellations of softening, erosion, perforation, gelatiniform softening, and digestion of the walls of the stomach, the same or different lesions? Are these lesions produced during life or after death? If in the latter case, are they the effects of the chemical action of the gastric juice? and what are the conditions and properties of this fluid to which they are to be ascribed? The following summary of the experiments alluded to appears to us to afford a satisfactory solution of these queries.

Softening, erosion, and perforation of the stomach and intestines from the chemical action of the gastric juice after death, in inferior animals.—When an animal, such as a rabbit or dog, in the most perfect state of health, is killed during the act of digestion, the following appearances are observed in the stomach if examined four, six, or eight hours after. In one series of cases, the mucous membrane of the most depending portion of the stomach, or this membrane, the submucous, and muscular coat, are softened or broken down into a pulpy substance. In a second series, the serous or peritoneal covering is also destroyed, or the stomach is perforated, and a quantity of digested food projects through the opening, and lies in contact with the liver, spleen, diaphragm, or intestines, one or all of which may present, to a greater or less extent, the same kind of softening as that observed in the stomach. In a third series, the diaphragm or œsophagus is perforated, and the liquid part of the digested food has passed into the cavity of the thorax, and all the parts with which it is in contact, as the pleura pulmonalis and costalis, and even the substance of the lungs, are softened or entirely dissolved. The colour of the softened parts was generally pale, sometimes of a yellowish tinge; and whenever vessels filled with blood traversed these parts, this fluid presented a brown or black colour. The

* Über die Erweichung des Magengrundes, oder die Sogennante Verdauung des Magens nach dem Tode. Hufeland's Journal, 1811; and in Lond. Med. Repos. vol. x. p. 416.

† Cases of Infantile Disease, in which Erosions and Perforations of the Alimentary Canal were found after death. Trans. of Edin. Med. Chir. Soc. vol. i. p. 311.

‡ Ramollissement avec Amincissement, et de la Destruction de la Membrane Muqueuse de l'Estomac. Archiv. Génér. de Méd. tom. v. p. 5; and, Recherches Anatomico-Pathol. sur diverses Maladies, Paris, 1826.

softened mucous membrane of the stomach, when removed by passing a scalpel over its surface, appeared like a solution of starch in hot water. It was frequently found in this state covering the submucous coat like a thin layer of jelly, and could be carried away by a stream of water, leaving a large irregular grey or pale coloured patch, formed by the denuded submucous coat. Sometimes several of these patches were observed, and presented those appearances termed erosions. These alterations of the mucous membrane were always limited to, or most marked in, the fundus or most depending portion of the stomach; they became gradually less perceptible towards the body or pyloric portion of the stomach, where they were lost in the healthy state of this membrane. The same characters were observed in the other tunics of the stomach, and the borders of the perforation were irregular, ragged, thin, pulpy, and transparent, and consisted principally of the peritoneum.

The fundus of the stomach was the part primarily and exclusively affected. It was also in this portion of the stomach that the food was found most completely digested,—a circumstance which depended on the depending position of the fundus, at least in those cases in which the food was in a state of fluidity, or the gastric juice considerable in quantity. The same may be said of those organs alluded to, those of them being most softened that were nearest the fundus of the stomach, or in the direction in which the fluid contents of this organ were made to pass, from the position given to the body of the animal after death. From these facts it will not be difficult to perceive in these changes the effects of a common cause, having its seat in the stomach, and extending its influence to other organs in the manner we have described. That this cause was the healthy gastric juice must be obvious, since this fluid was formed in animals in a perfect state of health. It was, besides, only when these animals were killed during the act of digestion, or when the stomach contained gastric juice, that any lesion of this organ was observed. We shall not at present attempt to identify the effects of the healthy gastric juice with those described by Cruveilhier, and others observed in children, as we shall afterwards have an opportunity of showing that the gelatiniform softening of the stomach and intestines met with in children is of the same nature as that we have just described.

The next fact satisfactorily determined by these experiments was the *property* of the gastric juice, by means of which the dissolution of the stomach or other organs is effected after death. On laying open the softened or perforated stomach of a healthy animal, we are at once struck with the sour smell that arises from its contents. It is precisely similar to that which we perceive on opening the stomach of a living animal containing a quantity of digested food. When litmus paper is placed in contact with this food, or the more fluid contents of the stomach, it becomes immediately red, the degree of redness, or the rapidity with which it takes place, varying with the stage of the digestive process and the fluidity of the contents of the stomach. The *acidity* of the gastric juice always accompanied the softening and perforation of the stomach in the animals subjected to our experiments; and hence we concluded that it is to this property—acidity, that the production of these changes is to be attributed; a conclusion, the accuracy of which was confirmed by introducing into the stomach of a rabbit that had just been killed, a quantity of magnesia sufficient to neutralize the acid contents of this organ. In this experiment there was no appearance of softening.

In order to show that the softening and perforation of the stomach are the immediate effects of the gastric juice, or, more correctly speaking, the *gastric acid*, and in no way dependent on any morbid state of the stomach or other organ of the body, the stomach of a healthy rabbit, containing digested food, was removed, and placed under a glass globe. It was kept moist by a little tepid water placed beneath it. In a short time the fundus became pale, afterwards soft, thin, and transparent, and at the end of four hours dissolution of all the coats of this depending portion of the stomach took place, and was followed by the escape of the food. Softening and perforation of the stomach, intestines, and urinary bladder, are produced under similar circumstances—that is to say, when the gastric acid or digested food is taken from the stomach of a healthy animal, and introduced into one or other of these organs, removed from another animal, or left *in situ*. We have repeatedly observed, and reproduced as stated above, all the varieties of softening, erosion, perforation, &c. described by the authors whose opinions we have quoted as pathological states.

Softening, erosion, and perforation of the stomach from the chemical action of the gastric juice after death, in persons suddenly deprived of life while in the enjoyment of perfect health.—It were weak and futile to argue that the *post-mortem* effects of the gastric acid, although observed to take place in inferior animals, do not prove their occurrence in man; for the gastric acid has been found to be of the same nature in all animals in which it has been examined, as in man. Moreover, all the chemical *post-mortem* effects of this acid have often been observed to occur in individuals suddenly deprived of life soon after a meal, and at the time in the enjoyment of perfect health. We have seen one case of this kind which occurred in a healthy young man who fell from a considerable height soon after breakfast, and died a few hours after. All the coats of the fundus of the stomach, except the peritoneal, were converted into a soft gelatinous pulp, resembling in every respect the same change observed in our experiments on rabbits, as well as the contents of the stomach in this case, these having been found, by means of their smell and the chemical test, to be acid. There cannot, therefore, remain the slightest doubt that softening of the walls of the stomach occurs after death from the chemical action of the healthy gastric acid in individuals suddenly deprived of life.

Softening, erosion, and perforation of the stomach, of this organ and the intestines, the œsophagus, diaphragm, &c. from the chemical action of the gastric acid after death, in persons who die of various diseases.—These lesions have been met with of every possible degree, extent, and

form, whatever may have been the nature of the disease by which they had been preceded. Thus they have been observed in the bodies of those who have died of acute and chronic diseases, whether of one or of several organs, whether the stomach and intestines have manifested any signs of disease during life or not; in the most robust as in the most feeble and emaciated, and at every period of life. Before alluding farther to the symptoms ascribed to the present form of softening of the stomach, by those who regard it as a pathological lesion, we shall point out the situation which it occupies in this organ, the degree and extent to which it proceeds, and the form and colour which it presents, in order to determine how far it resembles in these respects this change of consistence, such as we have described it to occur in animals and in man, as the consequence of the chemical action of the healthy gastric juice after death.

The *situation* of softening, as well as that of erosion and perforation of the stomach, in individuals who die from disease, is precisely the same as in our experiments, viz. the fundus of that organ. It is to this part of the stomach that these lesions are almost always either exclusively confined, or in which they are greatest in degree. Their occurrence in any other portion of the stomach may be explained by the presence of certain physical conditions of this organ, which we shall presently notice more particularly.

The *degree* of softening presents the same variety observed in our experiments. The mucous membrane or other tunics of the stomach present, in the first stage, a slight diminution of consistence, and have acquired a certain degree of transparency. When seized, they break immediately, or are crushed between the fingers into a soft pulp. In the second stage, the mucous membrane is seen lying like a quantity of albumen covering the submucous coat, and can be wiped off or removed with a bit of cloth or a stream of water. In the last stage, this membrane has entirely disappeared in several portions of the stomach, thus leaving the submucous coat denuded, and presenting the grey silvery aspect by which it is characterized.

The *extent* of the softening is very various, being either limited to a small portion of the fundus, or occupying the whole surface of the stomach. When perforation either of the stomach or œsophagus has taken place, we find, as in our experiments, softening of the liver, spleen, intestines, diaphragm, pleura, and lungs, all of which organs may be affected in the same individual, and present various degrees of dissolution.

The *form* of softening presents several important varieties. If the softening be confined to the mucous membrane of the fundus, the form which it presents is that of small or large patches. These are generally irregular, the borders of them being formed by the mucous membrane, and the bottom of each by the submucous coat. The edges of the patches, besides being irregular, are thin, soft, and somewhat transparent. If the softening has penetrated the submucous and muscular coats, the edges of these are beveled outwards, and terminate in thin irregular prolongations, which are seen to float like shreds of transparent coagulable lymph when water is poured upon them. Softening and perforation of the peritoneal coat present precisely the same characters as to form and consistence. These, then, are the varieties of form of softening observed in the fundus of the stomach, and when this lesion extends beyond the fundus, it still presents the same appearances so long as the mucous membrane is smooth or stretched out. But when this membrane is thrown into folds or forms plicæ, the softening no longer occurs in patches, but presents those remarkable appearances so minutely and accurately described by Louis, as indicating the existence of pathological alterations. The forms of the softening in this case are those of stripes or bands of various dimensions, having the situation and distribution of the plicæ. Wherever these stripes and bands exist, we find that the mucous membrane has been completely destroyed, and the submucous coat laid bare. They have thus a bluish or silvery grey aspect, while the mucous membrane which they enclose may be of its natural colour, red or otherwise modified, and appears in isolated patches of various forms and extent. It was the isolated and defined character of this form of softening which made it be considered as indisputably of a pathological nature. But the following explanation will show that it is a *post-mortem* lesion, and the consequence of the chemical action of the gastric juice. The mucous membrane possessing only in a very limited degree the power of diminishing its bulk, is always thrown into the form of plicæ when the muscular coat has contracted so as to diminish considerably the capacity of the stomach. When a quantity of gastric acid is collected on the surface of the mucous membrane in this state, it is obvious that the dissolvent property of this fluid will be exerted principally, if not exclusively, on the borders of the plicæ, their lateral surfaces being in contact with one another, or covered with mucus. Hence it follows, that when the stomach is removed from the body, emptied of its contents and spread out, the plicæ are effaced, and the stripes and bands, not before observed, make their appearance. That such is the manner in which this form of softening is produced is demonstrated by the following experiment, which we have frequently repeated. If the stomach of an animal, or of the human subject, in which the plicæ are well marked, be taken, and a quantity of gastric acid or digested food be placed over its mucous surface, we find that after a few hours the projecting borders of the plicæ are dissolved, while their lateral surfaces remain unchanged.

We have said that softening of the stomach, the erosion and perforation by which it is followed, almost always takes place in the fundus of this organ, in consequence of its depending position favouring the accumulation of the gastric acid. But there are various circumstances which, operating after death, give rise to important varieties in the situation, form, and extent of the softening of the mucous and other coats of the stomach. Great enlargement of the spleen may elevate or compress the fundus of the stomach so as to prevent the gastric acid from collecting within it, while at the same time this fluid accumulates in some other portion of the stomach, as the pyloric, which may have become the most depending part;

great distension of the transverse arch of the colon may throw the great curvature of the stomach upwards and forwards, when the fluid contents of this organ collect along the small curvature; or tumours in the liver, retro-peritoneal cellular tissue, &c. may be so situated as to produce considerable variation in the position and form of the stomach, and, consequently, in the situation of the softening.

Under all these circumstances the form of softening is likewise considerably modified. But the presence of gas in the stomach gives rise to a particular variety of form of softening which requires to be noticed. The softening terminates in a well-defined, abrupt margin, beyond which the mucous membrane is found to present (so far, at least, as the gastric acid is concerned) its natural colour and consistence. This regular and defined margin of the softening is determined by the gas acting as a foreign body, equalizing the distribution of the gastric acid, and confining its operation to a circumscribed portion of the mucous membrane. The quantity of the gastric acid generally regulates the extent of the softening of the mucous membrane. If considerable, the whole of the gastric mucous membrane may be destroyed, and it is also in cases of this kind that the cardiac orifice becomes dilated, and the gastric acid passes into the œsophagus, the cuticular lining, mucous and muscular coats of which it dissolves, and forms a communication between the cavity and this tube and that of the chest.

The *colour* of the mucous membrane in softening, erosion, and perforation of the stomach, presents several important modifications, and which depend essentially on the quantity of blood contained in this organ after death. If the quantity of this fluid be very small, or such as it is generally found to be in what is considered the healthy state of the stomach, the natural colour of the mucous membrane is not altered except where it is softened, where it is of a dull-yellow or orange-tint. This colour increases with the quantity of blood, and is accompanied with shades of brown and black, which assume a variety of forms, the description of which will be found in the article Melanosis, and also the experimental evidence which demonstrates that these changes of colour are produced by the gastric acid. An opposite state, or extreme paleness of the softened mucous membrane, is that form of *post-mortem* softening which is generally observed in infants and young children, and in emaciated, cachectic, and leucophlegmatic persons, in whom the blood is not only small in quantity, but contains a great disproportion of serum. In such individuals the whole stomach appears as if macerated; is, indeed, sometimes infiltrated with serosity, and is so completely deprived of blood that no trace of this fluid is perceived except in some of the large venous branches.

Redness of the softened mucous membrane is never observed. Its existence is incompatible with the chemical action of the gastric acid, and the red colour of the blood is instantaneously destroyed by this fluid.

Although the general characters of the chemical dissolution of the *intestines* agree in every respect with those which accompany this lesion of the stomach, there are a few circumstances which require to be noticed, in order to refute the opinion that softening of this part of the digestive apparatus is, in an especial manner, the consequence of disease. We have already stated that softening of the intestines was a frequent occurrence in those animals submitted to our experiments. The portions of intestines softened or perforated were invariably those situated in the epigastric or left hypochondriac region; and it is most important to note that complete dissolution of the coats of the intestines was sometimes observed, even when the stomach was not perforated, and, consequently, when the former were not in immediate contact with the gastric acid contained within the stomach. As the intestine occupied the superior surface of the stomach, presented no trace of disease, nor contained any acid fluid, the softening must obviously have been produced by the gastric acid having been transported from the stomach by imbibition. Hence it follows that softening, and even perforation, *from without inwards*, of the intestines, may take place after death from the chemical action of the gastric acid, and without perforation of the stomach as a previous and necessary occurrence. It is an interesting fact that in almost all the cases of softening, (gelatiniform softening,) or softening with perforation of the intestines that have been published, the large intestines, situated in the epigastric or left hypochondriac region, were exclusively the seat of one or both of these lesions. Such, also, has been the result of our own observations in all the cases of softening of the intestines which we have examined in the dead body. The locality of this lesion and its physical characters being precisely the same in man as those observed in animals, and having traced it in both to the mediate or immediate influence of the gastric acid, we must necessarily regard it in the former, as it was shown to be in the latter case, a *post-mortem* alteration. Cases of softening and perforation of the intestines, *from within outwards*, occur after death, from the presence of an acid fluid, either formed within them, or brought into them from the stomach.

From the evidence we have brought forward to prove that the softening, erosion, and perforation of the stomach and intestines, described as pathological lesions by the authors to whom we have referred, are the effects of a chemical agent—the *healthy* gastric acid—and produced after death, it would, in our opinion, be a waste of time to attempt a refutation of the several theories which have been offered on this subject. We have already remarked that all these lesions have frequently been found to occur in individuals, whatever may have been the seat or nature of the functional derangement by which they may have been preceded, whether death may have been the consequence of disease or of accidental injury. But why, it may be asked, do these lesions frequently occur, particularly in children, in whom the only symptoms observed are referable to a greater or less derangement of the functions of the stomach and intestines? This question may be met by the following. How does it happen that these lesions *do not occur* in cases in every respect the same as the former as regards the derangement of function and the organs affected?

The answer is simply this—the presence in the former, and the absence in the latter case, of the chemical cause of these lesions. Gastritis or gastro-enteritis is the disease which exists in both cases, and would never have been described as any thing else but for the presence of those *post-mortem* lesions which we have described. It is, indeed, surprising that any divergency of opinion should exist on this subject, seeing that no such changes exist in any other organ supplied with a mucous membrane; seeing, on the contrary, that inflammation produces quite a different kind of softening of the mucous membrane from that which we have described. The mucous membrane softened by inflammation, instead of being transparent, is more or less opaque, and even when it is completely disorganised, it resembles a mixture of flour and water or milk, rather than an albuminous or a gelatinous fluid. Such is, in fact, the principal character of inflammatory softening of the mucous membrane, in whatever organ it occurs; whereas the transparent gelatiniform softening is never observed except where the chemical agent is formed by which it is produced, viz. in the alimentary canal, and in some of the neighbouring organs, for the reasons which we have already given. We shall only further observe, that were the gelatiniform softening, erosion, and perforation of the stomach the consequences of inflammation, we should in every case find, either in the stomach or external to it, one or more of the products of this pathological state. But this we never find; even the perforation of the stomach, of the intestines, diaphragm, with the accompanying destruction of the spleen, liver, &c., may exist all in the same individual without any trace of serous effusion, of coagulable lymph or pus. There is no trace of peritonitis, even when the contents of the stomach, of the most stimulating quality, are lying in contact with the peritoneum. Lastly, the stomach is frequently found perforated without its contents having escaped into the cavity of the abdomen.

From all the facts brought forward on this part of our subject, the following principles may be established:—

1st. That the softening, erosion, and perforation of the walls of the stomach, attributed by the greater number of pathologists to morbid conditions of this organ, may be produced, whatever may be their form, degree, extent, or situation, by the gastric acid.

2. That no pathological condition of the stomach or of any other organ is necessary to the production of these lesions.

3d. That all of them are met with in individuals who, in the full enjoyment of health, are suddenly deprived of life; and in those who die from various diseases.

4th. That all of them are met with, after death, in healthy and diseased stomachs, which contain gastric acid.

5th. That they are produced by introducing this fluid into a healthy dead stomach.

6th. That the varieties observed in the form, degree, extent, and seat of these lesions, depend on modifications of the gastric acid, the action of which on the stomach is regulated by a certain number of physical conditions in which this organ may be placed.

7th. That softening, erosion, and perforation from the action of the gastric acid, are observed in other organs besides the stomach, viz. in the œsophagus and intestines, from the direct communication which exists between them and the former organ; and the peritoneum, liver, spleen, diaphragm, pleuræ, and lungs, in consequence of the perforation of the stomach and œsophagus.

8th. That all these lesions of the stomach, intestines, and of the other organs, are produced after death.

R. Carswell.

SOMNAMBULISM AND ANIMAL MAGNETISM.

I.—Of Proper Somnambulism.

Somnambulism or sleep-walking is one manifestation of a state of the nervous system which, in different degrees and under several forms, coexists with various general conditions of the living body. It is characterized by a suspension more or less complete of external feeling, while the imagination is in activity, but the individual is not conscious of his real state, and fancies himself to exist under different circumstances from those which actually surround him. Dreaming is one modification of this state, but it does not afford so great a variety of phenomena as somnambulism, or display so many peculiar signs of the real condition of the faculties. Many forms of delirium, catalepsy, trance or ecstacy, and some cases of madness — those, for example, in which the patient on recovery is found to have lost suddenly all recollection of what had passed during the period of his disease — belong to the same class of affections, for which we have as yet no collective term. An inquiry into the real character and pathology of somnambulism may afford us an opportunity of throwing some light on a variety of obscure phenomena which display themselves in the state of the system above described, and it will be found interesting, and, as we trust, useful in some other points of view.

There is an obvious relation between the state of the faculties in somnambulism and that which exists during dreams. It is, indeed, probable that somnambulism is dreaming in a manner so modified, that the will recovers its usual power over muscular motion, and likewise becomes endued with a peculiar control over the organs of sense and perception. This power, which gives rise to the most curious phenomena of somnambulism, is of such a kind that, while the senses are in general obscured, as in sleep, and all other objects are unperceived, the somnambulator manifests a faculty of seeing, feeling, or otherwise discovering those particular objects of which he is in pursuit, towards which his attention is by inward movement directed, or with which the internal operations of his mind bring him into relation.

The near connection between somnambulism and dreams is established by the following considerations:—

1. Sleep-walkers, after they have awakened from the slumbers which ushered in and continued after somnambulation, have sometimes remembered the circumstances or adventures of the period, and

have correctly related them as the impressions of a dream. This fact has been noticed by Sylvius and by Hoffmann : " Somniantibus et somniorum ratione obvenire hominibus somnambulorum affectum patet exipsorum evigilantium relatu, putantium se somniâsse duntaxat, quæ actu fecerunt." A striking instance of this kind is related by Horstius. A young nobleman in the citadel of Brenstein was observed by his brothers, who occupied the same room, to rise in his sleep, put on his cloak, and having opened the casement, to mount, by the help of a pulley, to the roof of the building. There he was seen to tear in pieces a magpie's nest, and wrap the young birds in his cloak. He returned to his apartment, and went to bed, having placed his cloak by him with the birds in it. In the morning he awoke, and related the adventure as having occurred in a dream, and was greatly surprised when he was led to the roof of the tower and shown the remains of the nest, as well as the magpies concealed in his cloak. A similar observation as to the occasional remembrance of the impressions made on the mind during somnambulism, was made long ago by Muratori, to whose work we shall again have occasion to refer.

2. As in dreams, so likewise in somnambulism the individual is intent on the pursuit of objects towards which his mind had been previously directed in a powerful manner, and his attention strongly roused; he is in both states impelled by habit, under the influence of which he repeats the routine of his daily observances. A somnambulator is a dreamer who is able to act his dreams.

Many facts may be cited in proof of this remark. A man (known to the writer of this article), who was accustomed to attend a weekly market, rose from his bed, saddled his horse, and actually proceeded on his journey as far as a turnpike, which being closed during the night, he was awakened by the circumstance. Another individual who had been in the habit of frequenting a public promenade, where he used to meet his acquaintances, was seen to rise from his bed at night and walk in his shirt along the same path, which extended for a mile on the brow of a hill, stopping very frequently and greeting different individuals whom he had been accustomed to see in the same place. Hoffmann relates the case of a somnambulator who dreamed that he was going to set out on a journey, rose and put on his clothes, shoes, and spurs, and then striding across the sill of an open window, began to kick with his heels and to exert his voice, supposing that he was exciting his horse to speed. Henricus ab Heer mentions another person, a student at an university in Germany, who having been very intent on the composition of some verses which he could not complete to his satisfaction, rose in his sleep, and opening his desk, sat down with great earnestness to renew his attempt. At length having succeeded, he returned to bed, after reciting his composition aloud, and setting his papers in order as before. Martinet gives the case of a man who was accustomed to rise in his sleep and pursue his business as a saddler.

M. Bertrand considers it to be a peculiar feature of somnambulism that the individual, though on waking he is generally found to have lost all recollection of what passed during his sleep, yet recalls, when the periods of this state return, the whole train of obliterated ideas. " Somnambulism," as the same writer says, " thus constitutes really a new life, returning at unequal intervals, connected together by a new species of memory." (Traité du Somnambulisme, par A. Bertrand, Paris, 1823.) We may observe that something of this kind is perceived in the instance of dreams. A person strongly impressed by a dream, on again falling asleep, experiences not unfrequently a recurrence of the same impressions, and the imagination will even take up the dream at the precise point where it was before interrupted.

These observations seem to prove that somnambulism is a modification of dreaming, and this conclusion appears so probable, that it will perhaps be admitted without hesitation; yet there are many writers of great research and ability who maintain a different opinion. Bertrand, who has investigated the circumstances connected with the history of sleep-walking with great pains and accuracy, considers the state in question to be something entirely different from dreaming. The same opinion is expressed in the most positive manner by Professor Heinroth, who says that somnambulists are to be reckoned as awake, since their perceptive power is in some respects even more acute than during the ordinary waking state; and that this condition bears no relation to dreaming, inasmuch as dreamers exist in an ideal world, whereas night-wanderers are conversant with actually existing and material objects. (Lehrbuch der Stoerungen des Seelenlebens, und ihrer Behandlung, von Professor J. C. A. Heinroth, Leipzig, 1818, B. ii. p. 270.) Both of these writers maintain an opinion which is very prevalent in France and Germany, that somnambulists have the ordinary channels of sensation entirely closed, that they neither see with their eyes nor hear with their ears, but are endowed with a peculiar mode of sensation, which, in its highest degree, constitutes what is termed *clairvoyance*. This is supposed to be diffused over the whole surface of the body, but to be especially seated in the epigastrium and fingers' ends. It is not exactly sight or hearing, but fulfils all the functions of both these modes of perception.

An opinion so improbable will be thought by some scarcely worthy of consideration. Its extensive reception, however, among a large number of continental writers, together with some other reasons which will become apparent, must prevent our passing it over as an idle speculation. The facts, also, of somnambulism are, as we have above remarked, deserving of further attention on account of their relation to a variety of obscure pathological phenomena, with which we shall have to compare them. For these reasons we deem it necessary to call the attention of our readers to some of the most remarkable of the cases of somnambulism which have been recorded in different countries, and which are occasionally appealed to as affording evidence on controverted points.

Somnambulism was known to Hippocrates and Aristotle, and to Galen by his own experience, but is briefly mentioned by them. Diogenes Laertius has recorded two cases of this affection. One

was that of a stoic philosopher, who in this state used to compose works, read, and correct them. Such actions, as M. Bertrand observes, under the ordinary circumstances would imply the possession of sight; still this writer is inclined to maintain that somnambulists have rather a new faculty which supplies the place of sight, though he admits that the supposition should not be adopted without incontestable proof. Gassendi has related in a more detailed manner several cases of somnambulism. These are extracted by Muratori in his work on The Imagination, in which are also to be found some of the most interesting facts on record connected with this and other mental phenomena.* One of Gassendi's somnambulists used to rise and dress himself in his sleep, go down to the cellar and draw wine from a cask: he appeared to see in the dark as well as in a clear day; but when he awoke either in the street or cellar, he was obliged to grope and feel his way back to his bed. He always answered his wife as if awake, but in the morning recollected nothing of what had passed. It often seemed to him as if there was not light enough, and he thought he had risen before day. He then struck fire, and lighted a candle. Another sleep-walker, a countryman of Gassendi, passed on stilts over a swollen torrent in the night, but on waking was afraid to return before daylight, or until the water had subsided. Two of the most curious and best related cases on record are those of Signor Augustin Forari and John Baptist Negretti; both of these are given by Muratori, from whom we shall take a brief extract of them.

"Signor Augustin was an Italian nobleman, dark, thin, melancholic, and cold-blooded, addicted to the study of the abstract sciences. His attacks occurred at the waning of the moon, and were stronger in autumn and winter than in the summer. An eye-witness, Vigneul Marville, gave the following description of them.

"One evening towards the end of October, we played at various games after dinner; Signor Augustin took a part in them along with the rest of the company, and afterwards retired to repose. At eleven o'clock his servant told us that his master would walk that night, and that we might come and watch him. I examined him after some time with a candle in my hand. He was lying upon his back, and sleeping with open, staring, unmoved eyes. We were told that this was a sure sign that he would walk in his sleep. I felt his hands and found them extremely cold, and his pulse beat so slowly that his blood appeared not to circulate. We played a trictrac until the spectacle began. It was about midnight, when Signor Augustin drew aside the bed-curtains with violence, arose, and put on his clothes. I went up to him and held the light under his eyes. He took no notice of it, although his eyes were open and staring. Before he put on his hat, he fastened on his sword-belt, which hung on the bed-post: the sword had been removed. Signor Augustin then went in and out of several rooms, approached the fire, warmed himself in an arm-chair, and went thence into a closet where was his wardrobe. He sought something in it, put all the things into disorder, and having set them right again locked the door and put the key into his pocket. He went to the door of the chamber, opened it, and stepped out on the staircase. When he came below, one of us made a noise by accident: he appeared frightened, and hastened his steps. His servant desired us to move softly and not to speak, or he would become out of his mind; and sometimes he ran as if he were pursued, if the least noise was made by those standing round him. He then went into a large court and to the stable, stroked his horse, bridled it, and looked for the saddle to put on it. As he did not find it in the accustomed place, he appeared confused. He then mounted his horse, and galloped to the house door. He found this shut; dismounted, and knocked with a stone which he picked up, several times at the door. After many unsuccessful efforts he remounted, and led his horse to the watering-place, which was at the other end of the court, let him drink, tied him to a post, and went quietly to the house. Upon hearing a noise which the servants made in the kitchen, he listened attentively, went to the door, and held his ear to the keyhole. After some time he went to the other side, and into a parlour in which was a billiard-table. He walked round it several times, and acted the motions of a players. He then went to a harpsichord on which he was accustomed to practise, and played a few irregular airs. After having moved about for two hours, he went to his room and threw himself upon his bed clothed as he was, and the next morning we found him in the same state; for as often as his attack came on, he slept afterwards from eight to ten hours. The servants declared that they could only put an end to his paroxysms either by tickling him under the soles of his feet, or by blowing a trumpet in his ears."

The history of Negretti was published separately by two physicians, Righellini and Pigatti, who were both eye-witnesses of the curious facts which they relate. The former corresponded with Muratori, and gave replies to his questions as to particular circumstances. Negretti was about twenty-four years old, was a sleep-walker from his eleventh year, but his attacks only occurred in the month of March, lasting at farthest till the month of April. He was a servant of Marquis Luigi Sale. On the evening of the 16th of March, 1740, after going to sleep on a bench in the kitchen, he began first to talk, then walked about, went to the dining-room and spread a table for dinner, placed himself behind a chair with a plate in his hand, as if waiting on his master. After waiting until he thought his master had dined, he uncovered the table, put away all the materials in a basket, which he locked in a cupboard. He afterwards warmed a bed, locked up the house, and prepared for his nightly rest. Being then awakened and asked if he remembered what he had been doing, he answered, no. This, however, was not always: he often recollected what he had been doing. Pigatti says that he would awake when water was thrown into his face, or when his eyes were forcibly opened. Ac-

*L. A. Muratori, della forza della Fantasia Umana, Venez. 1766. It is singular that this treatise has not been translated into either French or English. The German translation is a very valuable work, containing various notes and additions by the editor, Richertz of Göttingen.

cording to Maffei, he then remained some time faint and stupid. Righellini assured Muratori that his eyes were firmly closed during the paroxysm, and that, when a candle was put near to them, he took no notice of it. Sometimes he struck himself against the wall, and even hurt himself severely. Hence it would seem that he was directed in his movements by habit, and had no actual perception of external objects. This is confirmed by the assurance that if any body pushed him he got out of the way, and moved his arms rapidly about on every side, and that when he was in a place of which he had no distinct knowledge, he felt with his hands all the objects about him, and displayed much inaccuracy in his proceedings; but in places to which he had been accustomed, he was under no confusion, but went through his business very cleverly. Pigatti shut a door through which he had just passed: he struck himself against it on returning. The writer last mentioned was confident that Negretti could not see. He sometimes carried about with him a candle, as if to give him light in his employment; but on a bottle being substituted, took it and carried it, fancying that it was a candle. He once said during his sleep that he must go and hold a light to his master in his coach. Righellini followed him closely, and remarked that he stood still at the corners of the streets with his torch in his hand not lighted, and waited a while in order that the coach which he supposed to be following might pass through the place where light was required. On the 18th of March he went through nearly the same process as before, in laying a table, &c. and then went to the kitchen and sat down to supper. Signor Righellini observed him in company with many other cavalieri very curious to see him eat. At once he said, as recollecting himself, 'How can I so forget? To-day is Friday, and I must not dine." He then locked up every thing and went to bed. On another occasion he ate several cakes of bread and some salad, which he had just before demanded of the cook. He then went with a lighted candle into the cellar and drew wine, which he drank. All these acts he performed as usual, and carried a tray upon which were wine-glasses and knives, turning it obliquely on passing through a narrow doorway, but avoiding any accident.

Our limits prevent us from extracting the further details which relate to the history of this night-wanderer. The preceding relations, to which we shall incidentally add a few other particulars from the same sources, furnish a body of facts sufficient for displaying, as far as these individual cases are concerned, the state of the faculties in somnambulism. In the analysis of these we shall now attempt to discover some general principle which may serve as a clue to the variety of analogous phenomena on record. To begin with the inferior senses. Pigatti says that Negretti sat down to eat a bowl of salad which he had prepared. It was taken from him, and some strongly seasoned cabbage put in its place; this he eat without perceiving the difference, as he did also some pudding which was presently substituted. At another time, having asked for wine, he drank water which was given to him. He sniffed ground coffee instead of snuff, which he had demanded. Other sleep-walkers are well known to have detected similar deceptions, as it will appear from a case hereafter to be related. The difference appears to be in the degree of attention: a more lively perception as to the qualities of the object desired existed in one case than in the other, the mind being more directed to particular sensations in the one case, and more distracted or diverted from them in the other.

The sense of hearing presents similar variations. In general, somnambulists do not hear persons who talk aloud in their presence. It has often been observed that very loud noises are unperceived by them,—that a trumpet must be sounded in their ears before their attention can be forcibly withdrawn from reverie to the perception of the real world, and to the waking state. At other times they converse and hear the lowest sounds. Signor Augustin repeatedly listened and heard slight noises at a distance. The difference seems here to depend upon the same principle as in the preceding instances which refer to smell and taste. When attention is by a voluntary act directed to the particular operations of sense, the perceptive faculty of the sleeper is perfect, even remarkably acute. But when his mind is distracted, his reverie presenting different objects, even loud sounds are imperceptible to him. Perhaps from the same consideration we shall obtain a clue to unravel the perplexing varieties of phenomena connected with the state of vision in some cases which will be presently mentioned. Negretti, as it seems, had his eyes shut and saw not. Habit guided him in places with which he was familiar, and in other places he frequently showed the want of accurate perception, and assisted himself by feeling and groping about. Etmuller observed that sleep-walkers go about "oculis clausis," but he adds that some have acted "oculis conniventibus." Haller says decidedly, that they get out of their beds fast asleep, their eyes being either firmly closed or otherwise sightless, since a strong light is unperceived, though held near. (Elem. Physiol. tom. v. p. 626.) The fact is doubtless, yet why may we not avail ourselves of the analogy presented by the sense of hearing, and allow the insensibility to light under the ordinary circumstances of sleep-walking to be compatible with the use of the same faculty in other instances where we can find no other explanation of the phenomena? Such cases will presently come under our notice. Negretti and Augustin did not see, and Richertz well observes that the want of vision seems to have been supplied by various means. Habit, as we have observed, is the principal guide. The sense of feeling, when under the guidance of attention, and even that of hearing in similar circumstances, appear to be remarkably acute. Then as to the hypothesis to which in the sequel we shall have further to advert, viz. that somnambulists have a new kind of sight independent of the eyes;—although we are not called upon to disprove such a position, yet many facts may be found in the history above related which would enable us to do so. The defect was not supplied in such a degree and manner as the hypothesis implies. Negretti stood behind his master's chair supposing him to be at dinner; he fancied that the torch which he held to guide

his coach was lighted, when it was not. In a variety of cases he displayed the total want of any sensation analogous to sight; he stumbled when he walked in places to which he had not been accustomed, felt his way on various sides, struck himself against a wall. In attempting to pass through a closed door, he hurt himself. Other histories of somnambulists supply parallel remarks. Galen mentions of himself that he once walked about a whole night in his sleep till he was awakened by striking himself against a stone which happened to be in his way. (De Motu Musculorum, lib. ii. cap. 5.)

There are facts which prove that even the sense of feeling, which is the principal guiding faculty in somnambulism, is limited in its sphere of action, and exists under a modification similar to that which affects the other perceptive powers, and which, according to the opinion above stated, explains the anomalies of their operation. Negretti seems not to have distinguished accurately even objects of feeling *when they were not particularly the objects of attention*. When struck a blow by a stick on the leg, he fancied that a dog had touched him, and scolded it. Being again struck, he threw a bit of bread, calling the hound by name. A muff was thrown at him, which he again took for the dog. (*Muratori*, ubi supra, p. 323.)

In other instances somnambulists have been known to write, and even to correct their compositions, and to do other acts which could not possibly be performed without sight.

Castelli, a sleep-walker, whose case is one of the most remarkable, was a pupil of Porati, an Italian apothecary. His history has been published by Francesco Soave, a physician, who personally observed him. He was found one night in the act of translating from Italian into French, and looked for words in a dictionary as usual, being asleep. His candle being extinguished, he found himself to be in the dark, groped for the candle, and went to light it again at the kitchen fire. Bertrand thinks that Castelli did not really experience the want of light, because the room was, as we are informed, actually illumined at the time by other candles. This is a most improbable supposition, and seems irreconcilable with the fact just related, that he perceived his candle to become extinguished. There are, indeed, many circumstances related of this somnambulist which prove to our entire conviction that he not only saw, but had his other organs of sense in a state capable of perception whenever his attention was excited, and he wished to avail himself of their operation. He used to leave his bed, go down to the shop and weigh out medicines to supposed customers, to whom he talked. When any one conversed with him on a subject on which his mind was bent, he gave rational answers. He had been reading Macquer's Chemistry, and somebody altered his marks to try if he would notice it. This puzzled him, and he said, "Bel piacere di sempre togliermi i segni." He found his place and read aloud, but his voice growing fainter, his master told him to raise it, which he did. Yet he perceived none of the persons standing round him, and "though he heard," says Soave, "any conversation which was in conformity with the train of his ideas, he heard nothing of the discourse which those persons held on other subjects." His eyes seemed to be very sensible to objects relating to his thoughts, but appeared to have no life in them, and so fixed were they, that when he read he was observed not to move his eyes but his whole head, from one side of the page to the other.*

Facts which appear even still more strongly to evince the possession of accurate sight, are related in a very curious case of somnambulism, which was published in the French Encyclopædia. The account has been copied by Bertrand, who endeavours to turn aside the evidence afforded by it, or to reconcile it with his own hypothesis. We shall conclude this part of our inquiry with an abstract of the most remarkable facts contained in the narrative, and request our readers to bear in mind the explanation of the phenomena which we have proposed.

This somnambulist was a young priest in a Catholic seminary; the witness and reporter of the facts, the archbishop of Bordeaux, who used to go into his chamber after the priest was gone to sleep, and observe his proceedings. He sometimes arose from bed, took paper, and wrote sermons. After finishing a page, he read (if the act was properly reading) the whole aloud; and, if necessary, erased words and wrote his corrections over the line with great accuracy. "I have seen the beginning of one of his sermons which he had written when asleep; it was well composed, but one correction surprised me: having written at first the words 'ce divin enfant,' he had afterwards effaced the word *divin*, and writtten over it *adorable*. Then perceiving that *ce* could not stand before the last word, he had dexterously inserted a *t*, so as to make the word *cet*." The witness, in order to ascertain whether he made use of his eyes, put a card under his chin, so as to intercept the sight of the paper which was on the table; but he continued to write without perceiving it. Wishing to know by what means he judged of the presence of objects which were under his eyes, the witness took from him the paper on which he was writing, and substituted others repeatedly. He always perceived this by the difference of size, for when a paper of exactly the same shape was given to him, he took it for his own, and wrote his corrections on places corresponding to those on the paper which had been taken away from him. The most astonishing thing is that he would write music with great exactness, tracing on it at equal distances the five lines, and putting upon them the clef, flats, and sharps. Afterwards he marked the notes, at first white, and then blackened those which were to be black; the words were written under, and once happening to make them too long, he quickly perceived that they were not exactly under the corresponding notes; he corrected this inaccuracy by rubbing out what he had written, and putting the line below with the greatest precision.

On one occasion, in the midst of winter, he fancied himself to be walking on the bank of a

* Riflessioni sopra il Somnambolismo; di Francesco Soave. Many of the particulars relating to this case of Castelli have been inserted by Mr. P. B. Duncan, fellow of New College, in a very ingenious essay on somnambulism.

river, and to see a child fall into it, in danger of drowning. He leaped into the river, as he thought, in order to rescue the child, and actually threw himself upon his bed with the action of a man swimming. He imitated the movements of a swimmer for some time, and at length feeling in a corner of the bed a bundle of the clothes, fancied that he had seized the child, held it in one hand, and with the other swam, as he supposed, to the bank of the river; he there put down the bundle, and came out shivering and chattering with his teeth, as if he really had just emerged from a cold stream. He said to the persons near him that it was freezing, and that he was almost dead with cold, and asked for a glass of brandy to warm him; as there was none at hand, they gave him water, but he knew the deception, and again demanded brandy, expressing the risk which he incurred. He drank a glass of strong liquor, and seemed refreshed, but, without awaking, lay down, and continued to sleep soundly.

The reporters of this curious story suggest, by way of comment, the following queries:—"1. How is it possible for a man buried in profound sleep, to hear, speak, write, see, and in short enjoy the use of his senses, and perform correctly different movements? To facilitate the solution of this problem, we shall add," say the writers, "that the somnambulist sees only those objects which he seeks, or which are present to his imagination. This individual composed sermons, saw his paper, his ink, pens, could distinguish whether they marked or not the paper. For the rest he did not suspect that any person was in his room, neither seeing nor hearing any body, unless when he had asked for any thing.

"2. How any person can experience sensation without the assistance of the organs of sense? The somnambulist above mentioned appeared evidently to see those objects which had relation to his own ideas. When he traced the notes of music, he knew exactly those which ought to be black and those that were to be left white, and without mistake blackened the former and omitted the others, and if the lines were not dry, he took the precaution to avoid blotting them. There is no reason to suspect that the other channels of sensation were less interrupted than the ordinary one of vision. This might have been ascertained by stopping his ears, &c.

"3. How did it happen that during the paroxysm of somnambulism he remembered what had occurred during former paroxysms, although, when awake, he lost all traces of such matters?

"4. How is it possible that, without any real cause, he was strongly affected by agents of which he had only imagined the existence, as by the coldness of the water, in which he supposed himself to be immersed?"

We shall leave these inquiries to the consideration of our readers, and now proceed to another division of the subject.

II.—Ecstatic or cataleptic Somnambulism.

A morbid affection analogous in many of its phenomena to sleep-walking, but occurring under different circumstances, has been well known to medical writers since the time of Sauvages and Lorry, who first described it. Sauvages gave it the designation of cataleptic somnambulism. According to this writer the attack is ushered in and followed by a complete fit of catalepsy. This happened in the case described by him, but in other instances the preceding symptoms are not so strongly marked: coma, or insensibility in various degrees, may, however, be considered universally present. The most correct idea of the phenomena of this affection will be conveyed by some examples. The following is the first case published by Sauvages. "In the month of April 1737, a female who had been for some time affected with fits of hysterical catalepsy, experienced in conjunction with these attacks other symptoms, of which she had more than fifty returns. The fits were divided into three periods; the beginning and termination had perfectly the character of catalepsy; the intermediate period, which sometimes lasted from the morning till the evening, was occupied by what the girls in the house called the *live fit*, while they termed the catalepsy the *dead fit*. I shall now describe the phenomena," says Sauvages, "which I should certainly have believed to be feigned if I had not become convinced of the contrary by numerous proofs. What I shall say respecting one attack may be understood to apply, with the variation of some circumstances, to all the rest. On the 5th of April 1737, visiting the hospital at ten o'clock in the morning, I found the patient in bed, which she kept on account of her debility and the pain in her head: the fit of catalepsy had just seized her, and it quitted her after five or six minutes; this was perceived by her yawning and raising herself into a sitting posture, the prelude to the following scene. She began to talk with a degree of animation and *esprit* never observed in her except when in this state. She sometimes changed her subject, and appeared to converse with some friends whom she saw around her bed. Her discourse had relation to what she had said during her attack on the preceding day. She repeated word for word an instruction in the form of a catechism, which she had heard on the evening before, and she made pointed applications of it to persons in the house, whom she took care to designate by invented names, accompanying the whole with gestures and movements of her eyes, which *she kept open*, and alluding to the circumstances and actions of the preceding evening. Yet she was all this time in deep sleep; a fact which was strongly averred, but which I should never have ventured to declare if I had not obtained satisfactory proof by a series of experiments on the organs of sense: when she began to talk, a blow of the hand inflicted smartly on her face, a finger moved rapidly towards her eyes, a lighted candle brought so near to the organ of vision as even to burn the hair of her eyebrows, a person unseen uttering suddenly a loud cry into her ear, and making a stunning noise with a stone struck forcibly against her bedstead, brandy and a solution of ammoniacal salt placed under her eyes and introduced into her mouth, the feather of a pen, and afterwards the extremity of a finger applied on the cornea, Spanish snuff blown into the nostrils, pricking by pins, twisting her fingers; all these means were tried without producing the least sign of feeling or perception. Soon afterwards she rose, and I expected to see her strike

herself against the neighbouring beds; but she passed between them and turned corners with the greatest exactness, avoiding chairs and other furniture that happened to be in her way, and having walked about the ward, returned between the beds without feeling her way, lay down, covered herself, and in a few minutes became again cataleptic. She afterwards awoke as if from a deep sleep, and perceiving by the looks of those about her that she had been in her fits, she became very confused and wept all the rest of the day, not having the least idea of what had passed during the paroxysm." Sauvages adds that this patient recovered; her fits became less frequent; she had some relapses, but the disorder at length nearly left her.*

Lorry has described the phenomena of two remarkable cases of ecstasis, of which he was an eye-witness. A woman in a state resembling somnambulism used to converse aloud with absent persons, supposing them to be present. She was so insensible to external impressions, that she could not be excited by pricking or pinching her body, yet she perceived objects to which the current of her thoughts directed her, or to which they had relation. Her arms and fingers retained the positions in which they were placed till they were changed by a voluntary movement of the limb. After the paroxysm she had lost all recollection of what had passed. The other case given by Lorry was that of a female who had deficient catamenia. During her paroxysms she used to address herself to some individual actually present, whom she evidently saw, while all that she said to him turned upon the subject of her reverie. In the mean time she appeared unconscious of the presence of others, and could not be made to hear them or perceive them. "This fact," says Lorry, "I witnessed with the utmost astonishment, but many other persons are living who can attest it. The mother of this female died unexpectedly; after which the daughter used to hold conversations with her as if she were present."

A remarkable circumstance in these cases is the fact that while the individual is insensible to all other impressions in a wonderful degree, he retains perception of all objects which fall in with the course of his ideas, or connect themselves with the thoughts and feelings which occupy his attention for the time being. This feature is common to the cases of ecstasis and somnambulism. It was observed in an example of the former kind, of which an account was published several years ago by the writer of this article. A boy, about thirteen or fourteen years of age, suddenly exclaimed that somebody was beating him on his head, and fell into a state of insensibility; he became subject afterwards to similar attacks. He first perceived a mist or darkness before his eyes, and would say that he was then going off. He became then unconscious of external impressions; had his eyes open, but did not perceive objects; used to hold conversations with absent persons, repeat his lessons, supposing himself to be at school, and play on a flute, during which action he evidently perceived that other boys accompanied him, and evidently directed his attention to them. He recovered from this state by starting as if from sleep, and never retained the slightest trace of any occurrence during the paroxysm. The circumstance above indicated, in reference to the state of the perceptive faculty, is important as illustrating the character of these affections, and as accounting for the phenomena.

Another striking characteristic of this affection is the instantaneous change which it occasions in the thoughts and state of consciousness, and in the whole catastasis of the mind, the total suspension of present ideas which takes place during an indefinite period, and the equally sudden and remarkable restoration of the former state of mind after the termination of the paroxysm. These facts are well illustrated by some cases published by Professor Silliman of Yale College, in the American Journal of Science, of which we shall give a brief abstract.

Case 1. A lady in New England, of respectable family, became subject to paroxysms of delirium, which came on suddenly, and after continuing an indefinite time, went off as suddenly, leaving her mind perfectly rational. It often happened that when she was engaged in conversation she would stop short in the midst of it, become in a moment delirious, and commence a conversation on some other subject not having the remotest connection with the previous one; nor would she advert to that during her delirium. "When she became natural again, she would pursue the same conversation in which she had been engaged during the lucid interval, beginning where she had left off. To such a degree was this carried, that she would complete an unfinished story or sentence, or even an unfinished word. When the next delirious paroxysms came on, she would continue the conversation which she had been pursuing in her preceding paroxysm; so that she appeared as a person might be supposed to do *who had two souls*, each occasionally dormant and occasionally active, and utterly ignorant of what the other was doing." It is evident, that, although this affection is termed delirium, it was neither that state in the ordinary acceptation of terms, nor any form of madness, but one of coherent reverie. We have no means of forming an opinion as to the state of mind which subsisted during the paroxysm in the succeeding cases.

Case 2. An intelligent lady, in the state of New York, undertook a piece of fine needle-work, to which she devoted her time almost constantly for many days. Before its completion she became suddenly delirious, and she continued in that state about seven years. She said not a word during this time about her needle-work, but, on recovering suddenly from the affection, immediately inquired respecting it.

Case 3. A farmer, in New England, became dejected and melancholy under the impression that he had made an unwise sale of his property. He was preparing for the enclosure of a lot of land, and began with a beetle and wedges to split timber; at night he put his tools into a hollow tree and went home. Here he was seized with delirium, which continued several years. He sud-

* Histoire de l'Académie des Sciences, an. 1742. Traité du Somnambulisme, par A. Bertrand, Paris, 1823. A very curious and remarkable case of ecstatic somnambulism is to be found in the German translation of Muratori. It is extracted by Richertz from the Breslau Sammlungen. See Muratori über die Einbildungskraft, band. i. p. 361.

denly recovered, and the first question which he asked was, whether his sons had brought in the beetle and wedges? He appeared to be wholly unconscious of the lapse of time from the commencement of his attack. His sons avoided any explanation, and simply replied that they had been unable to find the tools. He immediately rose from his bed, went into the field where he had been at work a number of years before, and found the wedges and the rings of the beetle where he had left them, the beetle itself having mouldered away.

The phenomenon of thought alternately interrupted and restored, or of *dipsychia*, as we might term it in following Professor Silliman's suggestion, though it reminds us of the old romantic tales of princes laid asleep in enchanted castles, is nevertheless confirmed by sufficient evidence, and may be considered as a well-established fact. An instance of this description has been reported in the Edin. Philosophical Transactions by Dr. Dyce,* and is cited by Dr. Abercrombie. The patient, who was a servant-girl, was first attacked by fits of somnolency during the day, which came on with a cloudiness before her eyes and a pain in her head. In these fits she talked of scenes and transactions which appeared to be as in a dream, used to follow her occupations, dressed herself and the children of the family, and laid out a table correctly for breakfast. Being taken to church during the attack, she behaved properly, evidently attended to and was affected by the preacher so as to shed tears. In the next paroxysm she gave a distinct account of the former, although during the interval she had no recollection of being at church. During the attack her eyelids were generally half shut; her eyes sometimes resembling those of a person affected with amaurosis, that is, with a dilated and insensible state of the pupil, but sometimes they were quite natural. She had a dull vacant look, but when excited knew what was said to her, though she often mistook the speaker: it was observed that she discerned objects which were but faintly illuminated. The paroxysms generally continued about an hour, but she could be roused out of them; and then she yawned and stretched herself, like a person awaking out of sleep. At one time she read distinctly a portion of a book that was presented to her, and she sang much better than in the waking state. After six months this affection ceased on the appearance of the catamenia.

However extraordinary are many of the phenomena presented by these cases, as to the different states of consciousness manifested in them, still there is nothing that establishes the opinion that sensation has taken place in any instance through unusual media. In many of the above instances of ecstasis or cataleptic somnambulism—for it is to them that we confine our reference at present—we are informed that the individuals affected had their eyes open and saw, and otherwise perceived objects by the ordinary instruments of sensation. This circumstance throws a great additional improbability on the opinion of some late writers to which we have already adverted, and shall direct our attention more fully in the sequel.

A series of cases remain to be noticed in which individuals are reported to have had the usual channels of perception entirely closed, while the sense of sight, or something analogous to it, was diffused over the whole surface of the body, or transferred to the fingers' ends, while smell and hearing obtained a new seat in the epigastrium. As these wonderful relations have been reported and admitted chiefly by the advocates of animal magnetism, and in connection with the evidence brought forward by them in proof of their doctrines, we have hitherto merely alluded to them, being unwilling to blend the consideration of facts which, though clearly authentic, are in themselves sufficiently extraordinary, with that of stories which most persons in this country look upon as entirely fabulous and absurd; while those who do not reject them in the mass find it extremely difficult to draw a line which may serve as a limit to the demands made upon their credulity. We must, however, proceed to this part of our subject, after laying before our readers what is a necessary prelude to it, namely, a brief outline of the history of animal magnetism, and the controversies to which its discovery or invention has given rise.

III.—Of Artificial Somnambulism. History of Animal Magnetism.

It is well known that the practisers of animal magnetism profess to have the power of calling forth, by the exercise of their art, a state of the system analogous to that of natural somnambulism, or to the ecstacy of cataleptic persons, and that surprising accounts are related of individuals in this state. They are said to become possessed of *clairvoyance*, a sort of second sight, or the power of seeing at an indefinite distance, of foretelling future events, discovering diseases in the interior of their own bodies and in those of others, knowing the unexpressed thoughts of persons by whom they are magnetised, or with whom they are brought into magnetic connection. Such testimonies are treated in this country with the ridicule which they seem at the first view of the subject to deserve; they are rejected in the mass; few persons give themselves the trouble to inquire whether there is any basis of truth on which a superstructure of such extraordinary pretensions has been raised. The Germans and French have treated the matter differently. Among the physiologists and other scientific men on the continent, many are persuaded that animal magnetism, though its powers have been greatly exaggerated, is not without a foundation in truth, and even contains in itself the discovery of some hitherto unknown and very important fact or series of facts in the animal economy. M. Cuvier expressed this opinion many years since, and long before the persuasion became so general as it is at present. He says, "We must confess that it is very difficult, in the experiments which have for their object the action that the nervous system of two different individuals can exercise one upon the other, to distinguish the effect of the imagination of the individual upon whom the experiment is tried, from the physical results produced by the

* Transactions of the Royal Society of Edinburgh, vol. ix. The case related by Dr. Dyce is very curious, and in some of its particulars bears resemblance to the history of Negretti.

person who acts upon him. The effects, however, obtained on persons ignorant of the agency, and upon individuals whom the operation itself has deprived of consciousness, and those which animals present, do not permit us to doubt that the proximity of two animated bodies in certain positions, combined with certain movements, *have a real effect*, independently of all participation of the fancy. It appears also clearly that these effects arise from some communication which is established between their nervous systems." Here we find Baron Cuvier giving a full assent to the fundamental doctrine of the animal magnetists.

M. De la Place, in his work entitled "Théorie Analytique du Calcul des Probabilités," says, "The singular phenomena which result from the extreme sensibility of the nerves of some individuals, have given rise to many opinions upon the existence of a new agent, that has been called animal magnetism. It is natural to suppose that the action of these causes is of a very delicate nature, and very easily disturbed by a number of accidental circumstances; thus, when in many cases it is not manifested, we must not conclude that it does not exist. We are so far from knowing all the agents of nature and their different modes of action, that it would be very unphilosophical to deny the existence of phenomena solely because they are inexplicable in the present state of our knowledge."

In Germany and other northern countries, animal magnetism has long had partisans among men celebrated for their attainments in science and rank in the medical profession. In Prussia, Hufeland, after opposing it, at length declared himself convinced by the evidence adduced in its support. At Berlin, M. Wohlfahrt; at Frankfort, Passavent; at Groningen, Baker; at Petersburg, Stoffresten, first physician to the empress of Russia, and Count Panin at Moscow, have admitted the reality and have pursued the practice of this art. At Stockholm it is customary for those who graduate in medicine to make animal magnetism the subject of inaugural dissertations. (*Bertrand*, Traité du Magnetisme Animal.)

It is unnecessary to multiply citations in order to evince the propriety of giving this subject a share of our attention. If so many intelligent persons in different countries, several of whom must be admitted to be competent to form correct opinions, and in general to be rather sceptical than credulous in their habits of judgment, have come, apparently under the guidance of evidence, to admit the existence of facts which among us are generally discredited, we have sufficient inducement to examine the real merits of the question, and to consider the statements made by the supporters of the new doctrine, before we determine finally to adhere to our own opinion.

We shall, without further apology, proceed to lay before our readers a brief statement of the history of animal magnetism, and refer those who wish for more ample information to the writings of Déleuze, Bertrand, Rostan, &c.

The supporters of animal magnetism carry back its history, as do the historians of freemasonry, to a period of high antiquity. Some of these writers persuade us that it was the great arcanum of the mysteries, the initiations, and secret ceremonies of the pagan world; that the vertigo of the Delphian priestess, the prophetic visions of the sibyls, the wonderful powers of magic, the raptures of eastern seers, and in fact all that is related of miraculous or portentous in former periods of the world, is to be explained by reference to this power, now for the first time developed and understood. Many passages have been discovered in the writings of the ancients which have appeared to afford some plausible ground for the supposition that animal magnetism was not unknown to the priests who ministered in the temples of Æsculapius, or in those of Apollo. Some of these passages bear allusions more or less obvious or probable to ceremonies not unlike those of the magnetisers. In none is the allusion in this sense more closely applicable than in a passage attributed to Solon, and preserved by Stobœus, which was first pointed out in a work very recently published:—

Πολλάχι δ'ἐξ ὀλιγῆς ὀδύνης μέγα γίγνεται ἄλγος,
Κοὐκ ἄν τις λύσαιτ' ἤπια φάρμακα δοῦς.
Τὸν δὲ κακαῖς νούσοισι κυκώμενον ἀργαλέαις τε
Ἁψαμένος χειροῖν αἶψα τίθησ' ὑγιῆ.

"The smallest hurts sometimes increase and rage
More than all art of physic can assuage.
Sometimes the fury of the worst disease
The hand by gentle stroking will appease."*

A passage in Plautus has been cited by the same writer. The poet means to express, in a humorous manner, "What if I knock him down!" *Quid si illum tractim tangam ut dormiat!* There seems to be an allusion to some method of setting persons asleep by a particular process of manipulation similar to that of the magnetisers.

It has been only in periods comparatively recent, and especially in the visionary times of Paracelsus and Van Helmont, that we find theories becoming general which approach very nearly to those of Mesmer, and in fact identify themselves with the very speculations which that singular person actually adopted and made the basis of his art. The doctrine of a subtile fluid universally diffused, which was supposed to be the agent in all the great movements of the heavenly bodies, was very long general, and served to account for the phenomena of electricity and of magnetism at the several periods of their discovery. By the chemical physiologists this fluid was imagined to have its chief seat in organized living bodies. Here a preparation was obviously made for pretensions such as those with which Mesmer began his career.

Bertrand says that Mesmer was born at Vienna; but another account, which is adopted by Mr. Colquhoun, states him to have been a Switzer by birth. However, he took his degree at Vienna in 1766, and wrote his inaugural dissertation, "*On the Influence of the Planets on the Human Body.*" According to his theory, all the phenomena of life depend upon a particular current of the universal magnetic fluid enclosed in each organized body. It can be increased or diminished in intensity by external agencies, and especially by the medium of magnetic instruments. According to Bertrand, Mesmer was a man of very

* See Mr. Colquhoun's Introduction to the Report on Animal Magnetism, by a Committee of the Royal Academy of Medicine of Paris.

moderate talents, but possessed with an ardent desire to distinguish himself by novelties, and by escaping from the beaten track of his contemporaries. Father Hell, a Jesuit, who was professor of astronomy at Vienna, had invented plates of a certain form for the purpose of performing experiments on the magnetic properties of different substances; these were applied by Mesmer to the bodies of his patients, and with results as marvellous as those which Perkins obtained in later times by his tractors. The effects of the magnetic remedy were published, but only drew on their author ridicule and contempt; and Mesmer quitted Vienna for Paris, as affording a more ample field. At the latter place he took up his residence in 1778; and here he soon became the object of general curiosity. Crowds of persons, of all ages and both sexes, resorted to him, in the hope of obtaining cures for their complaints; and his fame spread far and wide. He made some attempts to obtain the sanction of the Academy of Sciences and of the Royal Society of Medicine; but being treated with coldness, he expressed his contempt for such bodies, and declared that he sought patronage from the king, the father of his people, and not that "*d'un tas de petits importans.*" After some interval Mesmer addressed himself to the faculty of medicine, and became intimately associated with M. Deslon, a docteur-régent of that body, and physician to the Count d'Artois, who strongly espoused his part, notwithstanding the resolution of the faculty to expel any of its associates who refused to enter into a positive renunciation of Mesmer and his pretensions. Mesmer talked of leaving France and carrying his precious discovery into foreign countries; but the multitude of persons who placed a high value on his curative power prevailed upon the government to offer him a stipend of 30,000 livres in order to fix him among them. This he disdainfully refused, and went to Spa, where he was residing when the alarming intelligence was brought to him that Deslon had set up for himself, and was magnetising multitudes in Paris, and eclipsing his master. Mesmer returned to Paris, and engaged to communicate his secret to a certain number of persons, on condition of his receiving payment at the rate of 100 louis-d'or from each. By this arrangement he is said to have obtained the enormous sum of 340,000 livres. His pupils designated themselves as the Society "de l'harmonie." When they had acquired the instructions for which they had paid so considerable a sum, and were preparing to publish the same for the benefit of humanity, Mesmer complained indignantly of their conduct, declared that they were bound to secresy by an indenture, which appears to have been the fact; and being yet unable to prevent their proceeding, which interfered with his unbounded hopes of gain, left France, carrying with him the riches which he had acquired, and proclaiming that he had been cruelly treated and betrayed. (*Bertrand*, Traité du Magnetisme Animal.)

Animal magnetism was practised very extensively in France. Ladies of the first quality were among its most sanguine votaries, as well as crowds of all descriptions. At length the government interposed, it being evident that either good or mischievous results were likely to ensue from so popular an object of attention. The appointment of the celebrated royal commission to try the merits of Mesmerism is a great event in the history of this art. The commissioners were men of the highest authority in science; Franklin, Lavoisier, Bailly, and Jussieu were among the number. The report of their observations on the practices of animal magnetism, carried on at that time by M. Deslon, is an authentic and important document. It was drawn up by M. Bailly; and it is well observed by Bertrand, that no unprejudiced person who reads it can fail of partaking in the opinions of the celebrated men who were parties to its adoption.

The following is a description of the method in which Mesmer and his colleagues carried on their proceedings. According to this report, a little wooden tub, of different forms, round, oval, or square, raised one foot or one foot and a half, was placed in the middle of a large room. This tub was called "*the baquet;*" its covering was pierced with a certain number of holes, from out of which came branches of iron, jointed and flexible. The patients were placed in several rows round this "*baquet;*" and each person held his branch of iron, which, by means of the joints, could be applied directly to the part affected; a cord was placed round the bodies of the patients, which united them one to another. Sometimes a second chain was formed by communication with the hands, that is to say, by applying the thumb of one between the thumb and the first finger of the next person; the thumb thus held was then pressed, and the impression received on the left was returned by the right, and circulated all round. A piano-forte was placed in a corner of the room; different airs were played upon it; sometimes the sound of the voice in singing was added. All the magnetisers had in their hands a little rod of iron, ten or twelve inches long. This rod was looked upon as the conductor of magnetism; it possessed the advantage of concentrating it in its point, and of rendering the emanations more powerful. Sound, according to the principles of Mesmer, was also a conductor of magnetism; and, in order to communicate the fluid to the piano, it was sufficient to let the rod approach it. The cord with which the patients were surrounded was destined, as well as the chain of thumbs, to augment the effects by communication. The inside of the "*baquet*" was said to be so formed that it might concentrate the magnetic fluid; there was nothing, however, in reality, in its formation which could excite or retain magnetism or electricity.

The patients, ranged in great numbers and in several rows round the baquet, received magnetism by all the different ways: by the iron branches which come out of the tub; by the cord which was entangled round their bodies; by the union of the thumbs; by the sound of the piano, and agreeable voices which mingled with it. They were more directly magnetised by means of the finger and the iron rod, moved before the face, above or behind the head, and upon the diseased parts, always observing the distinction of the poles. They were acted upon by a fixed look, but, above all, they were magnetised by the appli-

cation of hands and by the pressure of fingers upon the hypochondria, and upon the abdominal region; an application often continued for a long time, sometimes during several hours. Such was the method of Mesmer, and to which was added a multitude of practices, much too long to describe. They magnetised in this manner several natural objects, and among others trees, which hence acquired magnetic virtue; so that persons who put themselves "en rapport" with them, fell into a crisis. They could likewise magnetise inanimate bodies, such as a bottle, a glass, or a cup.

The effects produced on the subjects of this strange ceremony are thus described :—

"Some remained calm and tranquil, others coughed, spat, felt some slight pain, a local or universal heat, and had sweats; others were agitated, tormented with convulsions, most extraordinary by their force, their number, and their duration.

"As soon as one began, another succeeded; the paroxysms lasted sometimes three hours; the patients spat a thick, viscous, and sometimes bloody fluid; the attacks were characterized by precipitate, violent, and involuntary movements of the members or the whole body, by constrictions of the throat, by spasms at the epigastrium and hypochondria, piercing cries, tears, hiccough, and immoderate laughter. Nothing could be more astonishing than the sight of these agitations and various seizures: the sympathies which established themselves between all these individuals struck us with amazement. We beheld the patients precipitating themselves one towards the other, smiling and talking to each other with affection, and mutually alleviating their agitations. Every thing depended upon the will of the magnetiser; were they in an apparently deep sleep, his voice, a look, a sign drew them out of it." "We cannot," say the commissioners of the king, "prevent ourselves from recognising in these constant effects a powerful agent, which acts upon patients, subdues them, and of which the person who magnetises them seems to be the depository."

The commissioners soon discovered that it was very difficult to ascertain to what point the results produced were the effects of imagination, to the excitement of which so many circumstances were adapted, and how far to any peculiar agency. They resorted to private trials of the same manipulations. Some of the most interesting of these experiments were performed at Passy, at the residence of Dr. Franklin, who could not be present at Paris at the public exhibition. Here M. Deslon tried his art in vain upon the obdurate American, as well as upon the members of his family, who, notwithstanding that some of them were ladies in delicate health, were found quite insensible to the whole ceremonial of magnetism. Neither of the other commissioners could perceive any effect in his own person. One of the experiments made at Passy is worthy of a particular recital. It consisted in the magnetising of a tree in Dr. Franklin's garden. M. Deslon affirmed that if this was done by himself and a youth introduced who should be purposely selected as an individual susceptible of the magnetic influence, the result would be manifest on his approaching the particular tree. A boy, aged twelve years, was chosen by M. Deslon, who insisted on the necessity of his presence and co-operation. Care, however, was taken to prevent collusion. The boy was made to approach four trees successively, without knowing which was the magnetised one, having his eyes covered with a bandage, and to embrace each tree for two minutes, according to the previous arrangement of M. Deslon. That gentleman stood in the garden, and kept his cane pointed at the magnetised tree, in order to maintain its magnetism. Under the first tree not magnetised, at the end of a minute the boy perspired in great drops, coughed, expectorated, felt a slight pain in his head; he was then twenty-seven feet distant from the magnetised tree. Under the second tree he felt stupor and the same pain in his head. Under the third tree these symptoms were greatly increased; he believed himself to be approaching the magnetised tree; he was, however, then at the distance of not less than thirty-eight feet from it. Under the fourth tree not magnetised, at the distance of twenty-four feet from the magnetised tree, the young man fell into a crisis. He lost all consciousness, was carried to a neighbouring grass-plot, where M. Deslon soon reanimated him. The operator accounted for this untoward phenomenon by saying that the trees had probably become spontaneously magnetic. "But," rejoined the commissioners, "if trees are in the dangerous habit of assuming this state of their own accord, a susceptible person walking in a garden must incur the continual risk of falling into a crisis."

The commissioners having repeated and varied the experiments in every way that seemed to afford an opportunity of arriving at the truth, at length came to the conclusion that the whole proceeding of the magnetisers was calculated in several ways to do injury; that it was devoid of any salutary or useful influence, and that the results were wholly to be attributed to imagination and other feelings, which were excited by the performances. M. Jussieu, however, refused to coincide in the report, and returned one of his own, which, though by no means favourable to Mesmer and his pretensions, and explaining most of the results in the same manner as M. Bailly had done, yet admitted that in four particular experiments, he could not account for the results by attributing them to imagination. He proposed an hypothesis of his own, viz., that animal heat, or, as he termed it, "*the electric fluid animalized*," directed and accumulated on certain parts, may be the cause of the effects produced.

Notwithstanding the unfavourable nature of this report, and the retirement of the principal from the scene, Mesmerism continued to be practised extensively in France. The members of the Society of Harmony, who were spread through the country, continued their operations in the provinces. Among them the Marquis Puységur was one of the most distinguished, and it was during his proceedings that the most remarkable phenomenon accompanying these exhibitions was first noticed. We allude to the production of that state which has been termed the magnetic or artificial somnambulism. The commissioners, in the report to which we have already alluded, had remarked that nothing was more astonishing than the spectacle which they witnessed in the operations of M. Deslon, and that they were equally

surprised at the profound repose of a part of the assembled group, and at the agitation of others. These opposite effects were produced by the same agency, according to the different predispositions of individuals. But as the method of display was gradually changed by later operators, the agitations in a great measure ceased to be observed, while the appearance of a state of somnolency became much more striking and general; and in numerous instances, though by no means in a great proportion of persons, a species of somnambulism displayed itself, of which we shall proceed below to examine the peculiar characters.

The political revolutions in France withdrew the public attention from animal magnetism. Many of the party interested in this pursuit perished, and others were exiled. It was not till the return of better times that the practice of this art was resumed, and its historians declare that on its revival animal magnetism was found to have retained very few features of its ancient character. The mode of treating patients was quite changed; the theory of the magnetisers was new; the only circumstances connecting the old magnetism of the age of Mesmer and his immediate disciples with the present method, is the appearance in both of somnolency and somnambulism.

We shall trace very rapidly the few remaining events in the history of animal magnetism, and then say a few words on its actual character.

In the year 1813, M. Déleuze, a writer highly respectable for his moral integrity, talents, and good sense, published his critical history of animal magnetism. The appearance of this work occasioned a favourable change in the opinion of many scientific men in respect to the new art, and some who had before concealed their opinions were now emboldened to speak more openly in defence of it. In 1820, M. Husson instituted a series of experiments at the Hôtel Dieu, which were attended by scientific men, and the result was a general conviction that some very powerful influence was brought into operation, though some difference of opinion existed as to the nature of this influence.

A series of experiments at the Salpêtrière was followed by similar effects, and it was now that animal magnetism obtained two highly distinguished proselytes, viz., M. Rostan, author of the essay on this art in the Dictionnaire de Médecine, and M. Georget, well known as a man of most acute penetration, who adopted with entire sincerity the whole doctrine.

In 1825, a letter was addressed by M. Foissac, an advocate for animal magnetism, to the Royal Academy of Medicine, urging that body to appoint a new commission to inquire into its merits. The proposal met with strong opposition, but was at length carried, and a number of individuals were requested to investigate the subject anew. The report of this body was drawn up by M. Husson, already well known as an advocate for animal magnetism. It is said by M. Bertrand to have produced a strong impression in favour of the art, but as this document has lately been translated and published in Scotland,* we shall say nothing further on the subject on the present occasion.

We have already observed that animal magnetism had some time ago obtained an extensive prevalence in the north of Europe, [and in Great Britain and this country it has, of late years, excited great interest.]

IV. — Present mode of operating in producing the phenomena of Animal Magnetism.

The person, as M. Rostan informs us, who is to be subject to this proceeding, is seated in a chair, and the operator places himself opposite in such a manner that their knees and the extremities of their feet may touch; then the magnetiser takes the thumbs of the subject and holds them till their temperature is brought into equilibrium with that of his own hands. He afterwards places his hands on the shoulders of the patient, and after some minutes draws them down the arms, taking care to direct the extremity of the fingers along the tract of the nerves which are there spread. This manipulation must be repeated several times, after which the hands must be applied to the epigastrium and held there for some instants of time, and then drawn down towards the knees and even to the feet. Afterwards the hands of the operator must be brought back to the head of the patient, care being taken to keep them in returning at a distance from his person; again they must be drawn down the arms, and as far as the feet. After this practice has been repeated several times, magnetic phenomena begin to display themselves. The patient experiences involuntary drawings of the limbs (tiraillemens), a sense of uneasiness (embarras) in the head, heaviness of the eyelids. After some repetitions of this performance, and sometimes even at the first sitting, he falls into a profound sleep.

M. Rostan adds that the magnetiser must not let his thoughts wander while he is performing the operation; his attention must be entirely concentrated upon it; any distraction of mind is incompatible with success. He informs us that the looks and the expression of countenance of the magnetiser powerfully contribute to the effect. We must observe that M. Rostan is one of those who suppose that the volition of the operator, his intense desire to bring about the result, the agency of *his* mind rather than any influence exerted on the mind of his patient, is the first and principal cause of the effects which ensue.

The effects of these proceedings are described by M. Bertrand nearly as follows.

The majority of persons subjected to magnetism experience results much less striking than somnambulism, and yet sufficiently remarkable.

Whatever may be the sex, temperament of the patient, or the nature of the disorder, the magnetic operation is generally followed by a singular calmness of feelings both physical and moral; the individual is conscious that the pains which he felt before the operation are gradually soothed; he experiences a desire of repose which it would be irksome to him to resist; his limbs become heavy, and his eyelids oppressed and drawn together. It is often declared by persons who have been subjected to this operation, that a sense

*Report of the Experiments on Animal Magnetism made by a Committee of the Royal Academy of Medicine of Paris, read at the Meetings of the 21st and 28th of June, 1831. Translated by J. C. Colquhoun, Esq. Edin. 1833.

of heat more or less strong follows, over the surface of the body, the hand of the magnetiser, though passing over the clothes, and even at the distance of some inches from the skin. In other instances the impression is rather of coldness than of warmth. This sensation is variously accounted for. The partisans of the art attribute it to the magnetic fluid ejected from the hand of the operator. This opinion seems to have been held long ago, since even Bailly thought it necessary to oppose it, and to contend that the heat felt was that of the hand, and the cold that of the atmospheric air displaced by its movement. Bertrand maintains that the effects, as well as all the results of magnetism, are to be attributed solely to the excited imagination of the person who submits himself to the operation; and he declares that the effects produced within his experience have always borne the most exact proportion to the conviction of the patient. The temperature of the body is generally increased, according to the same writer, in persons who undergo the magnetic treatment, and a tendency to perspiration follows; the pulse becomes in many instances increased in fulness. Some individuals experience a general tremor at every renewal of the manipulations, which has been as strongly marked as the rigor which belongs to the cold stage of an intermittent. Convulsions are not frequently produced under the present mode of magnetic treatment. Many persons who experience little or no effect from the proceedings of the magnetiser during his operation, yet feel, after the business is at an end, such weariness or numbness of the limbs that they fall back into their chairs in attempting to rise. This is attributed to the accumulation of the magnetic fluid in the lower extremities, and the operator relieves it by means of certain frictions, by which it is believed that the fluid is dissipated or drawn off. Bertrand supposes that the sensation has in general no other cause than the ordinary fatigue occasioned by remaining long in one posture.

The feelings above described are frequently followed by a sense of drowsiness, which is at the same time irresistible and agreeable. The patient then becomes plunged into a state of vague reverie. Individuals who have experienced this state describe it as affording some peculiar delight. This interval of dreaming repose is often followed by a sort of sleep, which, though not somnambulism, yet resembles it, and differs from ordinary sleep in this respect, that the patient can with great difficulty be roused from it before the period of its spontaneous cessation. The loudest noises are sometimes without effect, but the experiment is said to be occasionally dangerous, and to give rise to convulsions. After this follows somnambulism or the lucid state, which is in fact the characteristic peculiarity of the magnetic process. In some individuals all these phenomena display themselves in a very short time, and even during the first sitting; but in general it is not till after several repetitions of the proceeding that the full effects of animal magnetism are produced.

V.—Theory of Animal Magnetism.

How does the proceeding of the magnetisers operate in giving rise to these effects? The theory generally adopted by the partisans of this art is as follows. The instrument which is set in action is a peculiar vital fluid, secreted, or at least accumulated, in the brain, and to which the nerves perform the office of conductors. This fluid, which presides over all the movements of the body, is in an especial manner under the direction of the will, and may, under its influence, be propelled, or directed towards, and accumulated upon, any external body living or inert. If this theory is not clearly developed in the writings of all the magnetisers, it is at least implicitly adopted by them. The characteristic peculiarity of their doctrine is the admission of an influence, residing in the will of the magnetiser, on the emanation of the fluid alleged to exist, and on the consequent production of magnetic phenomena—an influence so great, according to the prevailing theory, that all magnetic action is regarded as subordinate to the exertion of will which sets the fluid in activity.

This hypothesis, which, as its supporters seem to be aware, must appear to the generality of persons very wild and visionary, has been supposed to derive some support from the conclusions of MM. Reil, Autenrieth, and Von Humboldt, who have attempted to prove the circulation of a nervous fluid, as well as the outward expansion of that fluid,—an expansion said to take place with a force and energy sufficient to form a sphere of activity resembling that of electrified bodies.

The doctrine thus stated, which has been with some trifling modifications adopted by MM. Georget, Rostan, Husson, and the generality of those who maintain the efficacy of animal magnetism in France, must, in the actual state of our knowledge, be considered at least as a very bold speculation. It soars so far above the region of observation and experiment that it cannot be subjected to proof, and it is at the same time impossible to determine whether, if conceded or established, it would be sufficient to account for the phenomena of which an explanation is sought. A much more probable opinion is that of M. Bertrand, who, after surveying with calmness and discrimination the whole history of magnetism, and witnessing with his own eyes the proceedings of the operators in this art, and practising them himself with considerable effect, comes at last to the conclusion that all the results of these operations are brought about through the influence of the mind; not by the will of the magnetiser, radiating forth his own vital spirit, and operating through this material or immaterial instrument on the vital spirits of other men, who are the passive recipients, but by the energy with which the feelings and imagination of the latter act upon themselves.

A strong confirmation of this opinion is derived by Bertrand, from the manner in which the Abbé Faria performed magnetisation, in which he brought about all the results of this agency in the persons subjected to his attempts without the instrumental methods used by Mesmer's earlier or later followers, and in a way which seems to preclude any other influence than that merely of the mind. Abbé Faria made no attempt to avoid the imputation of quackery, and actually received sums of money for his exhibitions. Yet in the opinion of M. Bertrand, he entertained much more correct notions of the real principles of magnetic phenomena than most of its partisans. Having been

taught by a long course of experiments that the cause of somnambulism, or, as he termed it, the *lucid sleep*, as well as of all the other magnetic phenomena, is connected with the state of the individual who is the subject of treatment, he varied his proceedings in such a manner as to render them expeditious. His method was as follows: He placed the patient in an arm-chair, and after telling him to shut his eyes and collect himself, suddenly pronounced, in a strong voice and imperative tone, the word "dormez," which generally produced on the individual an impression sufficiently strong to give a slight shock, and occasion warmth, transpiration, and sometimes somnambulism. If the first attempt failed, he tried the experiment a second, third, and even a fourth time, after which he declared the individual incapable of entering into the state of lucid sleep. Abbé Faria used to boast that he had put more than five thousand persons by this method into somnambulism, and though in this there may be some exaggeration, yet it is incontestable, as M. Bertrand observes, that he very often succeeded. A very considerable number of persons, removed from all suspicion of connivance, have experienced the influence of this method. The complete identity of the phenomena thus produced by a method which operated confessedly through the imagination, with those which display themselves under the ordinary treatment of the magnetisers, affords a strong reason for concluding that the results in other instances depend upon a similar principle. The state of crisis or insensibility produced in Dr. Franklin's garden, in the experiment above described, is sufficient of itself to prove that the influence ascribed to the imagination is not greater than the reality. We have here a cause proved to be sufficient for the phenomena, with which it is more philosophical to rest satisfied than to resort to the visionary hypothesis of the magnetic fluid radiated forth by the will of the operator upon surrounding persons and objects, or to confess the strange doctrine, that the volition of a human body is capable of exerting an immediate influence on other minds and bodies than his own. The generality of magnetisers persist, indeed, in the assertion that the manipulations of the performer have no effect upon the subject, unless accompanied by a powerful agency of the will, by continued, strong, intense volition to produce the result. This is denied by M. Bertrand, who declares that in trials made by himself precisely the same results followed, whether he WILLED to produce them or not, provided that the patient was inwardly persuaded that the whole ritual was duly observed.

A very important question refers to the curative powers of magnetism, and to the salutary effects which may be obtained from it in the treatment of disease. M. Bertrand declares that it is difficult to imagine with what facility the practisers of the art succeed in relieving the most severe affections of the nervous system. Attacks of epilepsy in particular are rendered considerably less frequent and severe by this method, skilfully employed; which displays in so remarkable a manner the influence of moral impressions on the physical state of the constitution. In some instances magnetism has been injurious by occasioning delay in the use of remedies of a more efficient class. and M. Déleuze enjoins the precept that a patient should never be consigned to the operation of a magnetiser without the advice of a physician. On the whole, when we consider the degree of suffering occasioned by disorders of the class over which magnetism exerts an influence through the medium of the imagination, and the little efficacy which ordinary remedies possess of alleviating or counteracting them, it is much to be wished that this art, notwithstanding the problematical nature of the theories connected with it, were better known to us in actual practice, and that some of the foreign operators would introduce it more extensively into this country.

VI.—Concluding Remarks on Animal Magnetism.

We shall briefly advert to the most remarkable phenomena which are said to characterise the lucid sleep of animal magnetism. Some of these far exceed the ordinary limits of belief, and seem to have been admitted on very imperfect evidence; others, which are sufficiently curious, though less wonderful than the former, are established by an accumulation of testimony which almost forces our assent.

1. *Phenomena referring to the state of consciousness and perception.*—Persons in magnetic somnambulism are said to be unconscious of external impressions in general, and yet to remain under the influence of the magnetiser, who is able to engage them in conversation, and without difficulty obtain replies to questions. Some facts already mentioned in connection with the preceding instances of cataleptic somnambulism or ecstasis, may tend to illustrate this peculiarity. In the relation of a case cited from Lorry, it appeared that a female who was the subject of that affection, held conversation with one person, and addressed herself constantly to him, while she was unaware of the presence of any other individual, and unconscious of her actual state. From this and other instances, it appears that certain individuals may become so connected with the reverie of the somnambulist, and so brought into relation with it, as to enter within his sphere of perception, while others are removed from it or separated by that mysterious veil which isolates the ecstatic person, and places him as it were in a world created by his own phantasy.

The degree of insensibility to external impressions which is said to exist in some cases of artificial somnambulism is altogether surprising. A lady has a scirrhous tumour in her breast which requires excision; she cannot summon courage to submit to the operation; she is thrown by a celebrated practitioner into magnetic sleep, undergoes the operation in that state, and on being awakened is surprised and sheds tears of joy on hearing that the much-dreaded business has been accomplished. Strange as this statement appears, it seems to have been credited by the committee appointed by the Royal Academy of Medicine. Few persons in this country will follow their example, and yet by rejecting it we do not extricate ourselves from the difficulties with which the subject is environed. The witnesses of the case are persons of undoubted veracity and reputation. It is hardly possible to conceive that the lady who was the subject of the

operation could be influenced by fondness for imposture and deceit to such an extent, as the supposition that she feigned or acted a part implies. On the other hand, if it is a matter of fact that a state is induced by animal magnetism such as we have seen described, a condition of the system is admitted to be present in persons subjected to its influence, in which ordinary sensation is suspended, and to what degree this suspension reaches we have no means of estimating. We are not justified in fixing arbitrarily any particular limit beyond which we will not believe the absence of feeling to extend. If the insensible state of the system induced, in some unintelligible way, but probably through the influence of the imagination, is analogous to natural or ecstatic somnambulism, we can only form an idea of its nature through this comparison; and when we refer to the cases above cited from Sauvages and others, we shall find reason to believe that the insensibility to outward impressions was in some of these instances very great, and almost insuperable by any stimuli whatever. Pricking by pins, irritating the ball of the eye, putting a solution of ammonia under the eyes and into the mouth, striking the face, and making all sorts of noises in the ears, produced no effect.

2. *Alleged transference and exaltation of feeling.*—But if we could admit that a state of the system takes place in persons subjected to animal magnetism characterized by a remarkable and even surprising insensibility to external impressions, we should still be far from being convinced of the alleged transference of specific sensations from their appropriate organs.

Some writers have endeavoured to illustrate this phenomenon, and afford a degree of probability to the statement respecting it, by bringing forward cases of natural somnambulism in which analogous facts are said by them to have been observed. The most remarkable of these were published by M. Pétetin, a physician of Lyons, in a work on what he entitled 'Animal Electricity.' In this the author detailed experiments made by him on eight cataleptic females,—a surprising number as occurring in the practice of one physician within a short space of time,—in which, according to the statement, the seat of sensation was transferred to the epigastrium. Young females, quite deaf to sounds in the ordinary way, heard plainly when M. Pétetin whispered to them close to the epigastrium. The great sympathetic had, it seems, taken up the suspended function of the auditory nerves. We shall not repeat the particulars from which this statement is deduced, but refer our readers to M. Pétetin and to M. Bertrand, who has given sufficient extracts. The latter writer also refers to the Annales de Chimie et de Physique, and to the Gazette de Santé, for December 1807, for the account of another female who saw with her fingers' ends; and to a publication in Germany, by Baron Strombeck, describing the case of a young woman, who had the still more admirable faculty of seeing through floors and walls, and even of discovering objects in an upper story of the house where she dwelt, and far removed from her own apartment. With respect to these cases, we may observe that they have been brought forward by professed supporters of animal magnetism, and that they occurred in places where that practice was at the time in vogue, and an object of lively interest.

Secondly, it is very important to remark that, whatever may be argued to the contrary by the votaries of magnetism, such phenomena have no parallel in the facts connected with natural somnambulism, as recorded before the period of magnetism, and uninfluenced by the representations of its professors. It was partly in order to establish this conclusion on a sufficient basis, that we were induced to investigate so fully the phenomena of somnambulism as recorded by the authors above cited. If this object has been accomplished, we are satisfied that the advocates of magnetism seek vainly in this quarter for facts which give countenance to their doctrine.

The powers of magnetism are variously estimated in their extent; but most practitioners maintain that the subjects of this art become endowed with the faculty of seeing, or in some way discovering the internal state of their own bodies. The sensibility of the ganglionic system, the nervous system of physical or organic life, being greatly exalted, the individual obtains an inward feeling, which in the natural state of the system has no existence, of the condition of his own viscera, whether healthy or morbid; he foreknows in some mysterious manner various changes which are destined to take place in it, and if indisposed foretels the event of his own case. This is the most moderate estimate of the faculty of prevision. With some it comes but little short of the gift of prophecy. The lucid sleeper is not limited to the contemplation of his own interior; he casts a penetrating glance into the body of his magnetiser, or of any person who is brought into magnetic relation with him; he has likewise an exalted or perfect instinct of remedies: in the enthusiastic language of a votary of magnetism, "he becomes inspired with the genius which animated Hippocrates!" (Lettre du Docteur Foissac à la Académie de Médecine. Août, 1825.)

Hippocrates made no pretension to an "*instinct of remedies*," otherwise we should not so often have heard the maxim, "Ars longa, vita brevis." But if we are invited to believe that certain *démoiselles* in Paris acquire, or recover—if it be a natural faculty of man—through magnetism, a sort of intuitive knowledge or instinctive appetency for remedies proper for diseases, as sick animals eat certain plants, we may fairly expect some decisive proof. Let the magnetisers obtain from their lucid patients remedies for some intractable disorders. If they learn to cure cancer, for example, all the world will make suitable acknowledgments. With respect to the power of prevision, as this faculty is very much lowered in its claims in the late report, and seems likely to dwindle to the mere foretelling of hysterical fits, any practitioner who has had much experience in hysteria will be ready to believe the fact, provided that the patients only remember their predictions at the period of fulfilment. As to the talent of seeing through stone walls, whether with the eyes or epigastrium, we do not think it can be turned to any practical advantage. Not so the inspection of living bodies, and the power of discovering morbid changes in the living thorax and abdo-

men. A magnetic nurse in each ward of an hospital, who could perform autopsy while the patients are alive, would save us a world of trouble in auscultation and percussion, and might even obviate the necessity of post-mortem examinations. But if she had the instinct of remedies, where would be the want of a physician?

[Of late, both in this country and in England, animal magnetism has experienced numerous revivals; all the phenomena previously ascribed to it having been produced and re-produced; and several extensions having been given to it, which we should be disposed to regard as eminently ridiculous, had not sober-minded men—sober-minded, that is, on many other matters—given their entire credence to them. But although we may hesitate as to the term to be applied to such credence, we must withhold our own in *toto*. Of the reality of certain of the effects ascribed to the manipulations of the animal magnetiser, no doubt, we think, ought to be entertained. The whole history of the art exhibits, that impressible individuals may have irregularities of nervous distribution induced through the medium of the senses, especially through those of sight and touch; and that somnambulism and hysteric sleep, with other phenomena referable to a like condition of the nervous system may be elicited; but that there is any thing like a magnetic fluid or agent, which may be communicated by the magnetiser to the subject of his experiments, is not only not proved, but is by no means presumable. There can be no doubt of the curious phenomena produced by this singular condition in the greatly developed sensibility to some irritants, and the total insensibility to others. The writer has seen different persons bear, without the slightest muscular action, the application of a straw or feather to the conjunctiva; the insertion of pointed bodies into various parts of the cutaneous surface; the extraction of a tooth, &c.; and yet start at the least puff of air made to come in contact with the face. These phenomena have been so often witnessed as not to admit of disbelief; and from what the writer has himself seen, he can readily credit the statements affirmed on respectable testimony, that even the major operations of surgery may have been executed whilst the patient was in this state of *mesmeric sleep*—if it may be so termed. As to the *Hellsehen*, *Clairvoyance*, or "lucidity of vision," said to have been possessed by the magnetised, could we assign our belief to it at all, it would only be on the ground—"*credo quiâ impossibile est*." When skilfully analysed, however, the phenomena have usually admitted of rational explanation.

One of the most startling of recent announcements is the statement, that if one of the compartments of the skull, as mapped out by the craniologist, be touched while a person is in the mesmeric state, he will immediately have his thoughts turned in the direction of the mental faculty that corresponds with the particular phrenological organ, and exhibit manifestations thereof in his actions and speech; yet it has been shown, that where the person operated upon has had no previous acquaintance of any kind with phrenology, not the slightest manifestation can be elicited, and whilst, by stating aloud, that the manipulator was about to touch a certain organ, although he touched another, the thoughts and actions corresponded with the organ mentioned, and not with the one over which the finger was placed; and moreover, that in no case could the phenomena be elicited in the child, who had never seen or heard of a phrenological chart or cast. (See on this subject, Dr. J. K. Mitchell, in *Quarterly Summary of the Transactions of the College of Physicians of Philadelphia* for May, Sept. and Oct. 1842, and the writer's *Medical Student*, p. 252, Philad. 1844.)]

We must now dismiss the subject of animal magnetism, and conclude this article, of which somnambulism is the proper subject, with some further observations on the pathology of that disorder.

VII.—Further observations on the Pathology of Somnambulism.

Richertz has observed that the tendency to somnambulism is to be reckoned among morbid conditions of the system, and he founds his opinion on the following reasons:—First, the relation of this affection to various diseases. He says that when somnambulism has continued long with frequent and severe returns, it is apt to pass into epilepsy, apoplexy, hypochondriasis, melancholy, and madness, to which last he thinks it has a near relation. (Zusätze des herausgebers von Muratori über die Einbildingskraft, th. i. p. 226, &c.) We shall presently consider the grounds of this opinion.

Secondly, he regards somnambulism as a disease, inasmuch as it is a phenomenon contrary to nature, which ordains sleep as a state of repose and refreshment from labour, whereas with night-wanderers it becomes an occasion of additional weariness and more than ordinary fatigue. Paroxysms of somnambulism are generally followed by a long and heavy sleep, and by a feeling of debility and lassitude on the ensuing day.

Among the predisponent causes of somnambulism, the most important, as it may be observed with respect to other diseases of the nervous system, is a peculiarity of constitution. This appears from the fact that the disease is hereditary. Negretti's son was subject to it from early boyhood. Dr. Willis knew a family in which the father and all the sons were afflicted with this troublesome complaint; the sons in their nightly discursions ran against and awakened each other.

Intemperance is said to be among the causes of somnambulism, and the analogy of facts prevents our doubting the assertion. Scipio Maffei, a correspondent of Mead, and one of the eye-witnesses of Negretti's adventures, attributed the disorder of that person to his immoderate fondness for wine.

Age and sex are to be taken into the account by those who investigate the etiology of any constitutional disease. According to Richertz, somnambulism is chiefly incident to the male sex and to the early period of manhood. It seldom appears in a strongly marked form in early youth, and generally lessens or ceases with the commencement of old age.

A plethoric state of the constitution, and whatever causes tend to induce fulness in the vessels of the head, increase the disposition to this disorder. Signor Pozzi, body-physician to his holiness Pope Benedict the 14th, assured Muratori, that he was obliged to have his hair cut at least every

second month, in order to prevent his becoming a somnambulist.

We have accumulated these somewhat quaint observations with the view of leaving nothing incomplete in the history of somnambulism as we find it upon record. To the practical physician the nature of this disease and the treatment which it requires must be almost self-evident.

Richertz was certainly correct in his opinion as to the pathological relations of somnambulism both to comatose and to maniacal diseases, and this is a consideration of some interest. In the first place, the symptoms which usher in and terminate the paroxysms of somnambulism, and the transitions from one disease to another, mark the connection between sleep-walking and comatose affections. These facts may be noticed in many of the cases above mentioned. There are frequent transitions from one form of disease to another. Ecstatic somnambulism, as being the most severe affection, has been most frequently connected with other disorders of the brain. In females it is often conjoined with catalepsy and hysteria, and in males with epilepsy. Dr. Darwin has related a case of ecstasis occurring in a boy, which was supposed to proceed from worms. It began with an epileptic aura, and terminated in stupor. Another instance recorded by the same writer was that of a female, and it was combined with uterine epilepsy, or perhaps with hysteria. In its phenomena it appears to have resembled the example related by Sauvages. Two cases are described by Martinet, in both of which epileptic fits formed a part of the disease. In one of these, somnambulism was vicarious of epilepsy: in the other, fits of ecstasis were ushered in by the usual symptoms of epilepsy.

The relation of ecstasis to insanity is in several of its phenomena still more apparent than that which it bears to comatose diseases. In the first place, it seems extremely probable that those affections termed cases of insanity, in which a patient is suddenly attacked by a peculiar kind of delirium, which holds him under its influence for a time, and then leaves him without any impression on his memory of what has taken place from its commencement, are truly examples of ecstacy, and similar in their nature to the fits of day-dreaming above described. Some of the cases cited from Dr. Silliman's American Journal of Science were considered as instances of insanity; and Dr. Haslam has recorded other examples of a similar description, which he also regarded as cases of that disease. (On Medical Jurisprudence in relation to Insanity.) In all these the impressions of the delirant period had entirely vanished from the memory of the individual affected. In such instances it is very probable that a relapse of the disease would have brought with it a renewal of the thoughts and feelings so entirely suspended during the interval. The phenomena, at least so far as they are described in these cases, are so analogous, that we may expect this analogy to extend even further than the facts recorded. In the next place we have seen that night-walkers and ecstatic persons are not found uniformly to have forgotten the visionary scenes presented to them during their paroxysms, and a recollection or retention of such impressions, blended with the waking state of consciousness, may bring these cases into a closer association with insanity. Indeed, Professor Heinroth has reckoned among the forms of madness one which he terms "*reiner wahnsinn*, or *ecstasis*," and identifies with the *melancholia attonita* of Chiaruggi. (Formenlehre in Heinroth's Störungen, b. ii.) Its essential character consists in intense reverie. Many instances of disease are upon record, and some well-marked cases have fallen under our own observation, in which the indisposition has appeared to commence with some ecstatic vision, and this has left a powerful impression on the mind of the individual, and has given its peculiar character to the series of morbid phenomena which ensued. We know the family of a clergyman who had been for some time in indifferent health, when standing one day at the corner of a street he saw a funeral procession approaching him. He waited till it came near to him, saw all the train pass him with black nodding plumes, and read his own name on the coffin, which was carried by and entered with the whole procession into the house where he resided. This was the commencement of an illness which put an end to his life in a few days. Vivid dreams and intense reverie occur in cases of insanity, but they mark a peculiar form of that disease, and are rather to be considered as the proper phenomena of ecstasis than of insanity in strict propriety so termed. There are, however, examples in which the symptoms are so mixed and blended, as to render the determination extremely difficult and even impossible to which head such examples should rather be referred. This remark may at least be applied without hesitation to a very striking and peculiar case, with a recital of which we shall terminate the present article.

A gentleman, about thirty-five years of age, of active habits and good constitution, living in the neighbourhood of London, had complained for about five weeks of slight headach. He was feverish, inattentive to his occupation, and negligent of his family. He had been cupped and had taken some purgative medicine, when he was visited by Dr. Arnould of Camberwell, who has favoured us with the following history. By that gentleman's advice he was sent to a private asylum, where he remained about two years; his delusions very gradually subsided, and he was afterwards restored to his family.

The account which he gave of himself was almost verbatim as follows. We insert the statement as we received it from his physician. "One afternoon in the month of May, feeling himself a little unsettled and not inclined to business, he thought he would take a walk into the city to amuse his mind; and having strolled into St. Paul's Church-yard, he stopped at the shop-window of Carrington and Bowles, and looked at the pictures, among which was one of the cathedral. He had not been long there before a short grave-looking elderly gentleman, dressed in dark brown clothes, came up and began to examine the prints, and occasionally casting a glance at him, very soon entered into conversation with him, and praising the view of St. Paul's which was exhibited at the window, told him many anecdotes of Sir Christopher Wren the architect, and asked him at the same time if he had ever ascended to the top

of the dome. He replied in the negative. The stranger then inquired if he had dined, and proposed that they should go to an eating-house in the neighbourhood, and said that after dinner he would accompany him up St. Paul's; 'it was a glorious afternoon for a view, and he was so familiar with the place that he could point out every object worthy of attention.' The kindness of the old gentleman's manner induced him to comply with the invitation, and they went to a tavern in some dark alley, the name of which he did not know. They dined, and very soon left the table, and ascended to the ball just below the cross, which they entered alone. They had not been there many minutes, when, while he was gazing on the extensive prospect, and delighted with the splendid scene below him, the grave gentleman pulled out from an inside coat-pocket something like a compass, having round the edges some curious figures; then having muttered some unintelligible words, he placed it in the centre of the ball. He felt a great trembling and a sort of horror come over him, which was increased by his companion asking him if he should like to see any friend at a distance, and to know what he was that moment doing, for if so the latter could show him any such person. It happened that his father had been for a long time in bad health, and for some weeks past he had not visited him. A sudden thought came into his mind, so powerful that it overcame his terror, that he should like to see his father. He had no sooner expressed the wish than the exact person of his father was immediately presented to his sight on the mirror, reclining in his arm-chair, and taking his afternoon sleep. Not having fully believed in the power of the stranger to make good his offer, he became overwhelmed with terror at the clearness and truth of the vision presented to him; and he entreated his mysterious companion that they might immediately descend, as he felt himself very ill. The request was complied with; and on parting under the portico of the northern entrance, the stranger said to him, 'Remember, you are the slave of the man of the mirror!' He returned in the evening to his home, he does not know exactly at what hour; felt himself unquiet, depressed, gloomy, apprehensive, and haunted with thoughts of the stranger. For the last three months he has been conscious of the power of the latter over him." Dr. Arnould adds, "I inquired in what way his power was exercised? He cast on me a look of suspicion mingled with confidence; took my arm, and after leading me through two or three rooms, and then into the garden, exclaimed, 'It is of no use—there is no concealment from him, for all places are alike open to him—he sees us and he hears us *now*.' I asked him where this being was who saw and heard us? He replied, in a voice of deep agitation, 'Have I not told you that he lives in the ball below the cross on the top of St. Paul's, and that he only comes down to take a walk in the church-yard and get his dinner at the house in the dark alley. Since that fatal interview with the necromancer,' he continued, 'for such I believe him to be, he is continually dragging me before him on his mirror, and he not only sees me every moment of the day, but he reads all my thoughts, and I have a dreadful consciousness that no action of my life is free from his inspection, and no place can afford me security from his power.' On my replying that the darkness of the night would afford him protection from these machinations, he said, 'I know what you mean, but you are quite mistaken. I have only told you of the mirror, but in some part of the building which we passed in coming away, he showed me what he called a great bell, and I heard sounds which came from it, and which went to it; sounds of laughter, and of anger, and of pain; there was a dreadful confusion of sounds, and as I listened with wonder and affright, he said, 'This is my organ of hearing; this great bell is in communication with all other bells within the circle of hieroglyphics, by which every word spoken by those under my control is made audible to me.' Seeing me look surprised at him, he said, 'I have not yet told you all; for he practises his spells by hieroglyphics on walls and houses, and wields his power, like a detestable tyrant as he is, over the minds of those whom he has enchanted, and who are the objects of his constant spite, within the circle of the hieroglyphics.' I asked him what these hieroglyphics were, and how he perceived them? He replied, 'Signs and symbols which you in your ignorance of their true meaning have taken for letters and words, and read as you have thought, '*Day and Martin* and *Warren's blacking*.' Oh! that is all nonsense! they are only the mysterious characters which he traces to mark the boundary of his dominion, and by which he prevents all escape from his tremendous power. How have I toiled and laboured to get beyond the limits of his influence! Once I walked for three days and three nights, till I fell down under a wall exhausted by fatigue, and dropped asleep; but on awaking I saw the dreadful signs before my eyes, and I felt myself as completely under his infernal spells at the end as at the beginning of my journey.'"

It is probable that this gentleman had actually ascended to the top of St. Paul's, and that impressions there received being afterwards renewed in his mind when in a state of vivid excitement, in a dream or ecstatic reverie, became so blended with the creations of fancy as to form one mysterious vision, in which the true and the imaginary were afterwards inseparable. Such at least is the best explanation of the phenomena that occurs to us.

J. C. Prichard.

[SPERMATORRHŒA. — The term spermatorrhœa was, at one time, used by many for an involuntary discharge of sperm without erection; but it has been employed, likewise, in a more extended signification, — to include too great a flow of sperm, whether produced by masturbation, or occurring during the night (*Gonorrhœa dormientium*) whilst the individual is asleep. These cases are extremely common: the writer is frequently consulted by persons suffering under the effects—as they conceive—of inordinate discharge of sperm, either from vicious habits, or in dreaming. That excessive secretion of sperm may act injuriously upon the nervous system, there can be little doubt; but the injurious physical consequences, that have been ascribed to it, have often been fabulous. Speaking of it in a medical point of view, there

can, in the writer's opinion, be no greater evil to the economy from a flow of semen accompanied by venereal desire, without sexual intercourse, than with it: but where vicious habits have been contracted, alarm is often excited by the perusal of cases of serious disease, ascribed to similar practices; and the individual becomes nervous and apprehensive, until ultimately his life is rendered miserable to him. He observes, in the advertisements of the empiric, the numerous mental and bodily evils that may be his lot; and it has happened, that he has not had courage enough to support his fancied afflictions, and has been led to commit suicide. This has more especially occurred if the person has been engaged in marriage, and has been impressed with the idea, that impotence must necessarily result.

It is proper to state, that of the many cases in which the writer has been consulted by young men thus circumstanced, and who have married subsequently, in no instance has he heard of any impediment to procreation existing subsequently; and, consequently, unless the spermatorrhœa occurs in the day-time, and without venereal desire; or, unless, along with such desire, it takes place immediately on the erection of the male organ, he has advised the fulfilment of the patient's matrimonial intentions, and has never heard a complaint afterwards.

Spermatorrhœa, in the form of *nocturnal pollution*, is common; and unless it occurs more than once in the course of the night, and every night, it ought scarcely in a young and robust individual to be esteemed a pathological condition. The presence of sperm in the seminal ducts or vesicles produces an excitement during sleep, which is appreciated by the brain, salacious dreams are the consequence, during which the seminal emission occurs.

These forms of spermatorrhœa cannot be mistaken. The patient either induces them by his own acts, or has full evidence of them from his sensations during sleep, and the appearances on awaking. Another form, however, is not so clear. In this, there is a discharge of a glairy, viscid fluid, whilst the last drops of urine are discharged, or on straining during the evacuation of the bowels. But the presence of such a fluid in those circumstances by no means shows that it is sperm. Indeed, it probably rarely is so, and is nothing more than the mucous fluid from the prostate or the glands of Cowper. It has been proposed to employ the microscope in our doubt; and that if proper animalcules be found in the fluid, we may pronounce the secretion to be seminal; but this would not be decisive, inasmuch as those animalcules have been found in the mucous secretions of the urethra, and even in the urine. Moreover, M. Lallemand (*Des Pertes seminales involontaires*, Paris and Montpelier, 1837–41) believes, that the seminal animalcules are deficient in these very cases, which ought certainly to be unfavourable to the idea that the fluid proceeds from the spermatic vessels. In most of the instances that have fallen under the care of the writer, he has been satisfied, that the glairy fluid was mucous and not seminal.

The general effects ascribed to spermatorrhœa are various: the functions of the alimentary canal are said to become gradually impaired, and to be irregularly accomplished; but the animal functions suffer chiefly; the mind especially feels the effects; and the individual becomes hypochondriacal, misanthropic, and may even fall into a state of dementia.

Elsewhere (*Practice of Medicine*, ii. 288, 2d edit. Philad. 1844,) the writer has inquired into the effect of spermatorrhœa in the causation of insanity, and has given ample reason to believe that it has been exaggerated. M. Lallemand has had an opportunity of examining the bodies of patients who had died, he conceived, of exhaustion caused by involuntary discharges of sperm, or had perished from some accidental affection during the continuance of such discharges, He found the orifices of the ejaculatory ducts dilated, the seminal vessels hardened and contracted, and the prostate generally diseased. In several subjects, the gland was filled with a multitude of small abscesses, and its whole tissue was pale and soft. The urethra was rarely free from disease; it was thickened, and a firm and extensive stricture was found in several patients; the bladder and kidneys, too, participated in the morbid condition.

Causes.—These are—gonorrhœa, which is very liable to leave behind it the lesions mentioned above; excessive sexual indulgence, or masturbation; affections of the rectum, that oppose a mechanical obstacle to the passage of the fæces, and occasion pressure on the vesiculæ seminales, and the prostate; and a fissure of the rectum, or hemorrhoids, by occasioning violent straining, may produce the same effect. Ascarides in the rectum would seem to have caused so much irritation as to react upon the urethra and vesiculæ seminales, and to give rise to profuse involuntary discharges of sperm. A case is given by M. Lallemand, of obstinate spermatorrhœa occurring chiefly during sleep, which resisted all methods of treatment until the ascarides were removed by large and repeated enemata of very cold water. It is not improbable, however, that the impression made indirectly by the cold on the parts implicated may have been salutary.

Treatment.—It need scarcely be said, that in all cases of spermatorrhœa, the treatment will have to be moral as well as physical. If the disease be kept up by vicious habits, these must be abandoned; and the mental effects resulting directly or indirectly therefrom must be modified by a change of all the influences surrounding the individual, like that advised under Hypochondriasis; attending, at the same time, to the physical aberrations that may present themselves. Of course, if the spermatorrhœa be owing to, or connected with, disease of the rectum, obstinate constipation, irritation from worms or any other appreciable cause, it will yield on the removal of these conditions; but if it be dependent upon an altered state of the urethra, ejaculatory ducts and prostate — as described above—it may not give way to any remedy except direct cauterization. This may be practised by passing solid nitrate of silver into the urethra, enclosed in an appropriate canula, and turning it very rapidly over the part to be cauterized, retaining it in contact as short a time as possible, and then rapidly withdrawing it. After the application of the caustic, the discharge of urine is excessively painful for a day or two, and

is sometimes a little tinged with blood; but after the pain has ceased, the spermatorrhœa is often suspended, and the whole of the local and general symptoms gradually pass away. (Lallemand, *op. cit.* and Raige-Delorme, art. *Spermatorrhée* in *Dict. de Méd.* xxviii. 518, Paris 1844.)

For the nervousness, or great impressibility often seen in these cases, the physician is sometimes called upon to prescribe; and he is led to combine tonics with astringents. Thus, the *tinctura ferri chloridi*, (gtt. x. ter die,) and the *liquor ferri iodidi*, (gtt. xv. ter die,) are not unfrequently prescribed; and they are as likely to prove serviceable as any therapeutical agent; but the writer has not derived any marked advantage from them. Where the mental distress is considerable, especially under the circumstances before mentioned, —where a matrimonial alliance is projected, and the individual is afraid he may prove impotent,— provided he is capable of erection, it may be proper to advise, that the alliance should be entered into; and although moral impotence may exist for a time, it will gradually wear off. As before remarked, the writer has never heard any complaint subsequently, where this course has been pursued; and he has recommended it in many instances.

ROBLEY DUNGLISON.]

SPINAL MARROW, DISEASES OF THE. —The abnormal states of the spinal marrow are not so numerous as those of the brain, whether we take into account their congenital malformations or morbid conditions. As regards the latter, it seems, upon a fair consideration of all the facts hitherto collected, that those of the brain predominate; and considering the greater vascularity of that organ, its proximity to the surface, the close adhesion of its fibrous covering to the interior of its bony case, and, in fine, the part which it plays in, or the connection which its functions have with, the phenomena of mind, we cannot but accede to the justice of this conclusion.

Passing to the consideration of these conditions, we shall first notice the congenital malformations, to little more than a bare enumeration of which our space restricts us. Total absence of the spinal marrow has been frequently observed accompanying acephalous or anencephalous monstrosities, but never otherwise. To this form of monstrosity Beclard has given the name of *amyélie*. It is a question whether its absence is attributable to a real defect of the development of the organ, or to its destruction while yet in a state of great delicacy by the formation of a dropsical effusion either around it, or in the canal or ventricle which exists in it at an early period of its development. Cases of this deficiency are recorded by some writers as having reached an advanced period of uterine life. (*Ollivier*, sur la Moelle Epinière, vol. i. p. 139.) One of the most complete cases of this kind is recorded by Lallemand. The fœtus had firm flesh, and the epidermis was sound; the testicles were situated at the orifices of the inguinal canals; the motions of the child were distinctly felt by the mother before birth; and, judging from the size of the limbs and the declaration of the mother as to the duration of her pregnancy, it was concluded that the fœtus had reached the period of between seven and eight months; yet it had neither brain, cerebellum, nor spinal marrow.* The spinal marrow is, moreover, found in various degrees of imperfection, constituting the *atelomyélie* of Beclard. These defects of form are thus enumerated by Ollivier, (Loc. cit. p. 153): 1. the malformation of various kinds of its upper extremity when the brain is absent, or when a variable portion of the upper part of the trunk is wanting; 2. its division, to a greater or less extent, into two portions; 3. its double form, as in cases where the spine is single to a certain extent, and then bifurcates at one extremity either to support two heads, or to form two trunks separated below and re-united above; 4. varieties in its length and breadth; 5. the existence of a canal in its interior; 6. its congenital dropsy, (*congenital hydrorachis,*) which in general is accompanied with an accumulation of fluid in the meningeal cavity of the spine.

Of all these varieties of congenital defect the last is that which is most frequently presented to the notice of the practitioner. The dropsy of the spine, called **hydrorachis,** consists of an accumulation of fluid [which, in health, has been estimated by Magendie (*Précis de Physiologie*, 2de édit. i. 181, Paris, 1825,) at two ounces, but often amounts to five,] in the substance of the spinal cord, in the subarachnoid cavity between the arachnoid and pia mater, or in the arachnoid sac. It very frequently happens that there co-exists with this disease a congenital deficiency of the posterior portions of the vertebral rings — the spinous processes and vertebral laminæ being absent—for a variable number of vertebræ. Hence the term hydrorachis has been constantly confounded with that of *spina bifida*, which merely has reference to the incomplete state of the bony canal. It cannot be denied that hydrorachis, or a superabundant quantity of fluid, may exist in the spinal cavity without the osseous deficiency; but it will be always important for the practitioner to remember that a natural fluid exists in this canal before he pronounces with certainty on the morbid character of an effusion. When a congenital hydrorachis, strictly so called, (or, as J. P. Frank terms it, *hydrorachia incolumis*, De Curandis Hominum Morbis, tom. vi. p. 374,) exists, it is generally only part of a dropsy affecting the whole cerebro-spinal axis, and therefore its symptoms are those of congenital hydrocephalus in an aggravated form, sense and motion being affected to a greater degree, and its treatment will be to be conducted on a similar plan. But that form of hydrorachis which is found along with a deficiency of the vertebræ (*hydrorachia dehiscens* of Frank) we decidedly think to be, in the majority of cases, an accumulation which the absence of the natural resistance from the posterior wall of the spinal canal allows to take place, and therefore this defect constitutes the essence of the peculiar affection under consideration. The presence, therefore, of this congenital defect is generally if not always indicated by the existence of a tumour proportionate in extent to the number of defective vertebræ, prominent in one or more regions of the spine. Such a tumour may occur in any region of the spine; but it is most frequently found in the lumber

* Observations Pathologiques propres à éclairer plusieurs points de Physiologie. See also a well-observed case by Morgagni, epist. 48. § 50.

region, next in the sacral, rarely in the dorsal, and least of all in the cervical; it may exist in two regions at the same time, or may occupy all the three regions, the whole spine being bifid. In the cervical region, spina bifida generally coexists with an open condition of the cranium posteriorly, resulting, as Isid. Geoffroy St. Hilaire remarks, from a sort of "*spina bifida cranien.*" There is a free communication between the tumour or tumours and the rest of the cavity of the spine, or even of the cranial cavity, as appears from the diminution in the size of the tumour produced by pressure, or by an alteration in the position of the infant, for when it is in the erect posture the tumour is tense, but if the head be placed lower than the rest of the trunk it becomes flaccid. It is said that respiration also causes remarkable changes in the tumour, that it swells during expiration, and falls during inspiration. (*Ollivier*, loc. cit.)

The coverings of these tumours vary, sometimes including the skin, and, when that fluid is accumulated in the marrow, the pia mater; but the dura mater and arachnoid — that is, one layer of it—will constantly be found among its coverings. The condition of these coverings is also variable, the skin being either sound, thickened, ulcerated, almost gangrenous, or covered with fungous growths or tufts of hair; and the membranes may likewise be congested or thickened. The fluid itself is generally of the same characters as that of hydrocephalus; it may vary in quantity from a few ounces to six or seven pints, and has been found to occupy various situations, of which Andral enumerates the following:—1. In the cavity of the arachnoid; 2. between the arachnoid and dura mater; 3. between the arachnoid and pia mater; 4. between the latter membrane and the osseous parietes of the spinal canal; 5. in a canal formed in the spinal cord; 6. in a cyst situated outside the dura mater, which latter, as well as the other membranes, was perfectly free from alteration. (Anat. Pathol. by Townsend, vol. ii.) Sometimes serous cysts filled with clear fluid have been found in the tumour. Fleischmann (De vitiis congenitis circa thoracem et abdomen, Erlangæ) reduces the defects of the vertebræ to three classes: — 1. When the whole vertebræ, body as well as processes, is divided; 2. where the lateral arches are imperfectly developed; 3. where, although the lateral arches are developed, they are not united. Of these the first and third are rarely observed. Lastly, the condition of the spinal cord demands attention. Otto says, "In the most severe forms the spinal marrow is entirely wanting, and we find merely the membranes fallen togegether, usually slit at one or more spots, or even more or less degenerated and adherent to each other, forming sometimes a closed sac filled with lymph." (Path. Anatomy, by South.) In the more ordinary cases it is, according to Ollivier, most frequently sound; but Meckel thinks otherwise, and that it is more frequently altered either in situation, being found in the cavity of the tumour, or in structure, being softened or reduced to a pulp and diminished in size, and sometimes imperfectly divided into two parts, or spread out into a kind of membrane. The nerves undergo some alteration in their mode of distribution. Sometimes the posterior branches do not pass beyond the tumour, but are distributed upon the internal surface of the walls of the tumour, and terminate there: in some cases they form a nervous net-work in their ramification on the internal surface of the tumour. (Stafford, in loc. cit. pp. 21, 22, 23.)

This affection is for the most part fatal in its termination, and has hitherto been deemed almost incurable, but very few cases having either recovered or been ameliorated by treatment. The lower limbs are generally paralysed, as well as the bladder and rectum, and sometimes there are convulsions and hydrocephalic symptoms. The hopelessness of a cure is of course increased, when, as is not unfrequently the case, there are other congenital defects, as deficiency of the abdominal walls, extroversion of the bladder, imperforate anus, &c. &c.

The duration of the life of the infant will depend on the size of the tumour — the larger the latter is, the shorter will be the former. On the other hand, however, it is abundantly proved that a state of integrity of all the functions may occasionally exist even with a tumour of considerable size, for many instances are recorded of children living several years, and even arriving at the respective ages of 17, 18, 19, 20, 21, or even 50 years, with such tumours. If the tumour burst suddenly, death almost certainly will immediately result, preceded by violent convulsions; and the same consequence is apt to follow the opening of the tumour by cutting instruments, even where its evacuation is effected slowly.

Various plans of treatment have been proposed by surgeons to remove or remedy this congenital defect. The application of a ligature round the base of the tumour, pressure by a truss, (*Benjamin Bell,*) the introduction of a seton, counter-irritants, (*Richter,*) have been justly discarded. Compression and puncture were originally proposed by Mr. Abernethy, and have been since successfully carried into effect. Compression was devised by Mr. Abernethy, from the idea that it would supply that which was wanting in consequence of the incomplete state of the vertebral canal. This, however, is only a palliative remedy, and requires to be constantly kept up in order to prevent the increase of the tumour. Sir A. Cooper applied pressure by means of plaster of Paris fitted to the tumour, and maintained by a roller applied with a moderate pressure round the waist. This was removed after a time, and its place supplied by an umbilical truss, which answered every purpose, and kept the tumour entirely within the channel of the spine. (Med.-Chir. Trans. vol. ii. p. 323.) Mr. North, so well known to the profession by his work on Infantile Convulsions, has related to us an equally successful case which occurred in his practice. The subject of it, a girl, is now arrived at adult age, and able to perform the duties of a servant in a family in London.

The plan of treatment by puncture also has been successful in the hands of Sir A. Cooper. The tumour was punctured by a needle, and its contents evacuated every fourth day, and a roller applied round the body: after some time the walls of the tumour became solid, and the child was relieved from all inconvenience. This mode of

treatment seems decidedly to be the only one likely to effect a permanent cure by the final consolidation of the tumour, and it is evident that its success will in great measure depend on the degree of perfection of the spinal marrow itself.

We may here allude to that peculiar yellow discoloration of the spinal marrow and of its serous covering which M. Lobstein has noticed in fœtuses at an early period, and which he has denominated "*kirronosis*." The colour is a golden yellow, and does not seem to be attributable to any particular extraneous colouring matter, for it resisted repeated washings and a prolonged immersion in alcohol. M. Lobstein has not found this discoloration at a more advanced period of life, and has always noticed it in the nervous tissue and serous membranes. (Répertoire Gén. d'Anat. et Phys. fasc. i. 1826; and Ollivier sur la Moelle, &c. v. i. p. 209.)

The morbid conditions of the contents of the spinal canal may be discussed in the following order: — 1. those of the spinal meninges; 2. spinal effusions; 3. the morbid states of the spinal marrow itself.

1. The Morbid States of the Spinal Meninges.—The membranes of the spine are so similar to those of the brain in the healthy state, that it is natural to expect their diseases should closely resemble each other. As in the case of the cerebral membranes, we rarely find one of the spinal coverings acutely affected without the others being more or less implicated. The anatomical characters of acute **Spinal Meningitis** may be thus enumerated:—increased arterial vascularity of the meninges and of the tissues immediately in the vicinity of them; slight increase of thickness of the dura mater, and an exudation of lymph upon the surface of the arachnoid, or according to Ollivier, more frequently between the arachnoid and pia mater, so as to give the marrow the appearance of being enlarged in circumference. Sometimes there is purulent effusion between these membranes, or considerable serous effusion into the arachnoid cavity, while that membrane itself is rendered opaque, probably by the thickening of the subjacent pia mater. If the arachnoid membrane appear red, it will be so from the turgescence of vessels subjacent to, not in it; for this membrane, like the other serous membranes, does not afford any signs of red vascularity. Where there is a morbid state of the bones, local or circumscribed inflammations are observed. Lallemand, (Lettres sur l'Encéphale, t. i. p. 309,) Ollivier, and, Bergamaschi, (Giornale della Soc. Med. Chir. di Parma. Guigno, 1810,) relate cases in which effusion existed on the exterior of the dura mater, between it and the osseous wall of the spinal canal.

When the lymph is thrown out upon that portion of the arachnoid which lines the dura mater, it gives an appearance of increased thickness to the latter membrane, which of course will vary with the quantity of effused lymph. Adhesion of the two layers, and consequent obliteration of the sac of the arachnoid, as well as opacities of the membrane itself, often produced by a close adhesion to the pia mater, may be regarded as consequences of inflammation. Ulceration and mortification are also spoken of by some writers.

The greater number of cases of spinal meningitis occur in connection with acute disease within the head, either antecedently or subsequently, and most frequently the inflammation spreads to the substance of the marrow itself; hence instances are rare where this affection has existed alone, and consequently those symptoms which exclusively depend on irritation of the membranes are imperfectly ascertained. Pain, sometimes extremely intense, occupying a greater or less portion of the spine; rigidity, or violent spasms of the muscles of the back, occasionally producing opisthotonos, and also of other muscles, as those of the neck, upper extremity, &c.; a peculiar sense of constriction either round the neck, back, or loins, according to the part of the spine affected; rigors, more or less of exalted sensibility, or paralysis of motion; dysuria, or even retention of urine from paralysis of the bladder, and constipation of the bowels, are among the most prominent symptoms. The locality of the paralytic symptoms, as well as of the muscular rigidity, varies with the situation of the spinal disease. On the first invasion of the disease, there are generally some obscure symptoms about the patient; pains resembling those of rheumatism, attended with lassitude, and a feeling of weight about some part of the spine. The tetanic contraction is, as Ollivier remarks, particularly manifested when the patient is moved. In some instances the rigidity is continued and permanent until death, but most frequently there are remissions of a more or less complete character. Dr. Tweedie has related to us a case, the symptoms of which there is strong reason to think resulted from partial spinal meningitis. A young lady, in the advanced stage of a severe attack of fever, during which the brain had been severely affected, was seized rather suddenly with violent muscular contractions of the extremities, so that the arms were alternately thrown out from and drawn back to the trunk with great violence; while, at another, similar contractions of the muscles of the lower extremities occurred. These violent and irregular motions ceased almost immediately after large detraction of blood from the region of the spine, followed by counter-irritation, and the patient completely recovered. In another case, that occurred to Dr. Tweedie, in which the early symptoms assumed the form of cerebral fever, the muscles of the lower jaw became so rigidly contracted, that medicines and nourishment were with the utmost difficulty administered. The muscles of the trunk became next affected, complete opisthotonos being induced. This lady died, and on examining the spinal cord, the dorsal portion bore traces of violent inflammation; the investing membrane was intensely injected, and the substances of the spinal marrow, for the space of an inch, reduced to a softened pulpy mass.

The exalted sensibility is, according to Ollivier, a constant phenomenon in spinal meningitis, and may serve, as he thinks, to distinguish it from inflammation of the marrow itself, which is in general attended with diminished sensibility. The respiration is sometimes difficult and oppressed; the pulse preserves its regularity, but gradually becomes weak, and the patient dies exhausted by the severity of the spasms, or the intensity of the pain, or from convulsions, which are sometimes

accompanied with trismus. The bladder is sometimes inflamed, either in consequence of the loss of its protecting sensibility or of the acrid nature of the urine, which becomes decomposed in the bladder. The causes of spinal meningitis are not always discoverable. It may arise from disease of the bones — from violence applied to the spine externally; it may appear consecutively to a similar inflammation within the cranium, as in Dr. Tweedie's case just related, or, as some think, it may be caused by a suppression of the menses or of a hemorrhoidal flux; it may be the effect of cold, or on the contrary of a prolonged exposure to great heat, as from the sun's rays. It is generally fatal.

Treatment.—Copious local or general bleeding is obviously indicated as the first step of the treatment. Goss recommends free and deep incisions along each side of the vertebral spine, with a view of opening the veins which communicate so freely with those of the spinal marrow. The warm or vapour bath may be advantageously employed. Ollivier recommends the application of ice along the back, on the same principle that it is used in cerebral inflammations. Counter-irritation can have but little effect except it be severe and applied over an extensive surface. For this purpose, a sinapism or blister extending the whole length of the spine, or the ointment of tartarized antimony, may be employed.

The chronic affections of the spinal meninges consist chiefly of new formations in or upon them. Such are the cartilaginous pieces found on the arachnoid, in various regions; bony incrustations, which however rarely occur, as well in the dura mater as in the arachnoid; chronic tumours of various kinds; hydatids; tubercles. The cartilaginous incrustations appear to be developed in the arachnoid. They are generally very small and numerous, nor does it appear that they are prone to be converted into bone. Several cases of one or more hydatids found in the spinal canal have been observed. Cancerous or fungoid tumours, originating externally, may send deep processes into the canal, and thus compress the marrow. Of this Ollivier gives a remarkable case. (Page 751, vol. ii.) The tumour originated externally in the neck, and a deep process from it was prolonged into the cervical portion of the spinal canal through the intervertebral foramina; the tissue external to the dura mater was for a considerable extent converted into a similar matter. There was paralysis of the arm of the same side.

The symptoms produced by these chronic growths are by no means uniform; they will vary according to the region of the spine they may be placed in, or according to the part of the spinal cord upon which they may directly press, whether anterior or posterior. Paralysis, as well of sensation as of motion, sometimes general; muscular spasm, pain in the course of certain nerves, sometimes a morbidly acute sensibility of the cutaneous surface to a considerable extent, constitute the principal phenomena resulting from their presence. It is proper to remember that a large aneurism, compressing and causing the absorption of the bodies of the vertebræ, may so find its way to the spinal cavity as to compress the marrow, and produce additional symptoms still more calculated to perplex the practitioner than those which are commonly attendant on those cases. The writer lately assisted in the examination of the body of a man who exhibited, some time before death, symptoms which seemed to depend on spinal compression. For a considerable period prior to his death, the integument of the thorax was so exquisitely tender that he could not bear the least touch; this continued till four days before death, when the integuments became perfectly insensible, except along the middle line, both anteriorly and posteriorly, where the former tenderness remained. This was a case of aneurism occupying nearly the whole thoracic aorta; the bodies of the corresponding dorsal vertebræ were completely destroyed from the pressure of the tumour. The spinal marrow in that region struck us as being peculiarly firm; and the fatty membrane, external to the dura mater, presented an unusual degree of density.

2. Spinal Effusions.—These effusions vary as to their locality, and as to the nature of the effused fluids. They may take place—1. between the bony wall of the spinal cavity and the dura mater; 2. in the arachnoid sac; 3. in the space between the visceral layer of the arachnoid and the pia mater, (the sub-arachnoid cavity,) which in the healthy state is filled by the cephalo-spinal fluid of Magendie. In those situations serum, blood, pus, or air, may be effused, and thus produce symptoms analogous and sometimes precisely similar to those caused by the development of chronic growths from the membranes. Such effusions, however, may appear from other causes than those which operate directly upon the spinal meninges; the free communication between both the arachnoid sacs and sub-arachnoid cavities of the head and spine allows the fluids of one to pass to the other, and if there be cerebral apoplexy, the spinal fluid may readily be deeply coloured with blood. Pus and blood may come from chronic abscesses or aneurisms which have caused the absorption of the bodies of the vertebræ.

Effusion external to the dura mater may, as Dr. Abercrombie observes, be regarded as unequivocal evidence of spinal irritation. We have already alluded to cases of this kind related by Ollivier, Lallemand, and Bergamaschi. In that by Ollivier, the principal symptoms were opisthotones, difficult deglutition, and coma; a red and very consistent fluid was found between the dura mater and the bony canal in the tissue situated there, with serous effusion within the membranes; and the arachnoid of the cord was covered with an albuminous layer for the extent of four inches. In Dr. Abercrombie's case, (that of a child aged two years,) the symptoms commenced with fever; after two days she was seized with violent convulsions, which lasted an hour, and were succeeded by coma; and about two hours after the first she had a second convulsive fit, which left her in a state of coma from which she never recovered. During the fits, and for some time after them, there were violent and irregular action of the heart, and a peculiar spasmodic action of the diaphragm. The eye was completely insensible, and the pulse very frequent. She had several slight attacks of convulsion, and one more severe, a short time before death, which happened thirty-three hours after the

first attack. The brain was healthy; on the outer surface of the dura mater there was a copious deposition of colourless fluid, most abundant in the cervical and upper part of the dorsal regions; there was a little effusion of bloody fluid into the arachnoid sac, and the substance of the cord seemed softer than natural at the upper part. (*Abercrombie*, loc. cit. p. 375.)

Serous effusions occur most frequently in the space between the arachnoid and pia mater, and in forming an opinion as to the morbid nature of them, we must be careful to make due allowance for the quantity of fluid which naturally exists between these two membranes. A case of unusual superabundance of this fluid is recorded in one of the numbers of the Journal Hebdomadaire for August, 1833, by M. Montault. The patient, ætat. 68, a porter, strong and athletic, after a fit of intoxication (not unusual), fell rapidly into general paralysis, for which he was bled largely by leeches applied behind the ears, at the anus, and on the left side of the chest; he became delirious, and then comatose, and died on the sixth day. The body was examined fifteen hours after death; an enormous quantity of fluid was accumulated between the arachnoid and pia mater of the brain and spine. It amounted to nearly thirteen ounces in quantity, and extended into the lateral ventricles. There was no alteration in the texture of the brain or spinal cord.

Venous congestion may produce an increase of this natural effusion; but we conceive that it will often be impossible to say with certainty that it was not formed after death by the separation of the serum of the blood, and its infiltration through the coats of vessels. Increased serous effusion may also arise from any irritation in the immediate vicinity, and is found in cases of spinal curvature, or in meningitis, especially when chronic. This effusion may also occur in the arachnoid sac; and here it is impossible to say that it has not transuded from the sub-arachnoid cavity through the layer of arachnoid. It takes plase under circumstances similar to those which produce that last mentioned. Both these forms of effusion are in general present, at least after death, in dropsy of the spine. We have already stated that a form of hydrorachis of a different kind from that which is connected with congenital deficiency of the bones, is frequently found in children with hydrocephalus, and in all probability is attributable to the same cause: it also frequently accompanies serous apoplexy in the adult. There is no external tumour in these cases, as may be reasonably supposed; the posterior wall of the spine being so resisting, except at its inferior extremity, where this wall is completed by a ligamentous expansion closing the sacral canal. Morgagni (Epist. 12, § 9, and Ollivier, loc. cit. vol. ii. p. 494,) relates a case from Genga, in which spinal dropsy of this kind manifested itself externally at the situation of this ligament. A child, aged four years, was attacked with hydrocephalus in consequence of a blow on the head. About a month afterwards a tumour appeared at the coccyx; it was opened, and the head appeared to diminish gradually in size as a large quantity of water was discharged from the puncture. Compression on the head increased considerably the impetus with which the fluid flowed from the opening; a circumstance which proved that this tumour communicated with the head, and resulted from the distension of the spinal membranes. It should be observed, however, that spinal effusion is not necessarily coexistent with hydrocephalus, for the exit of the fluid from the ventricles may be and often is prevented by the closure of the opening beneath the valve of Vieussens. Sometimes we find a viscid almost jelly-like matter effused round the cord, but this is most probably merely a post-mortem effect.

Effusion of blood into the spinal cavity, or between the membranes, constitutes the disease termed spinal apoplexy. The blood is generally found in a state of coagulum. This effusion may arise from concussion of the cord, occasioned by a fall from a great height—by a blow inflicted on the back; it is found also after death from cerebral apoplexy, hanging, tetanus, (Vide Reid on Tetanus and Hydrophobia,) hydrophobia, (*A. T. Thomson*, Med. Chirurg. Transactions, vol. xiii,) and in children whose death has been occasioned by difficult parturition. Sometimes a portion of the spinal marrow itself is so mixed up with the coagulum as not to be distinguished from it, in which case the hemorrhage would appear to have originated in the tissue of the marrow.

Convulsions, paralysis, sometimes a diminution and at others an increase, of sensibility, pain in the back, are the most usual symptoms which have been observed in such spinal lesions. In a case related by Dr. Abercrombie, of a child seven days old, the symptoms were repeated attacks of convulsions with trismus, and sometimes universal tonic spasm. Death took place on the fourth day. On dissection, a long and very firm coagulum of blood was found lying between the bones and membranes of the cord on the posterior part of the whole cervical region. A case of encysted spinal apoplexy is recorded by Dr. Stroud. The cyst was an inch in length, and about half an inch in diameter; it was external to the cord, and existed at the upper part of the dorsal region on the left side. The patient died universally paralysed; the disorder, however, set in with hemiplegia, to which succeeded paraplegia, and then the palsy spread.

Purulent effusions in the spinal canal are the surest indications of inflammation of one or more of the meninges, which likewise present other characters to particularize them.

Effusions of air, constituting *pneumatorachis*, have been described by Ollivier as occurring in the spinal canal. We are not acquainted with any writer who has fully confirmed his experience on this point. Otto has met with air in the spinal canal, but, he says, not under such unequivocal circumstances as would justify him in regarding it as a morbid product. Andral does not at all allude to its occurrence. M. Ollivier says, "It is not very rare to find the lumbar portion of the meningeal canal more or less swollen by a gaseous fluid, inodorous and colourless, which cannot be attributed to putrefaction, inasmuch as I have seen it in the spinal canal of subjects recently dead, and could not discover it in a great number of others which were dead some days. I have not remarked that this disengagement of gas took

place as a consequence of any particular disease." (Opus cit. vol. ii. p. 537.) The cases in which he has found air in the meningeal sheath did not present symptoms of spinal disease before death; in most of the cases the examination was made twenty-four hours after death. Billard met with a case in connection with ramollissement of the brain and spinal marrow.

In the treatment of spinal effusions it is obvious that the practitioner must have in view not only the removal of the effusion, but also that of its cause, when that cause may happen to continue. To effect the latter object, it is evident that he must vary his treatment according to what the symptoms would indicate as the most probable cause; but to remove the effusion various remedies may be had recourse to. Sometimes it fortunately happens that the effusion is absorbed as soon as its cause is removed, and thus the application of one remedy answers a double purpose. When after accidents of the spine there are numbness and pains in the limbs, symptoms in all probability denoting an increase in the natural spinal effusion, these symptoms are often removed with a remarkable rapidity after a free local depletion or a pretty extended counter-irritation. This latter object may be effected by the usual blister, by the moxa, by setons or issues, or by frictions along the spine with any irritating applications that will produce a discharge. Of these we decidedly prefer the last; they are often purely local in their action; whereas when blisters are used, some active principle of the cantharides seems to be absorbed into the system, which, though it may not be manifest from appearance of strangury, yet, we cannot help thinking, produces in a similar way that aggravation of symptoms which so constantly follows the injudicious application of blisters. Mercurials may be administered with benefit in these cases, either internally or through the medium of the skin. Perfect rest, the horizontal posture, and an exemption from such causes as may disturb the circulation or respiration, are obviously indispensable.

3. **Morbid conditions of the Spinal Marrow.**—These conditions may be thus enumerated:—Inflammation and its consequences; atrophy and hypertrophy; new formations in the substance of the marrow.

Inflammation of the spinal marrow, called by Harles (Ueber die Entzündung des Rückenmarks,) and Ollivier *myelitis*, is principally known by its terminations; the first stage, that of simple hyperæmia, being of rare occurrence, inasmuch as the derangement of function which it occasions is seldom sufficient to cause death. It is only in cases where death has occurred in consequence of severe injuries, that we can expect to find the early stage of myelitis. Mr. Stafford speaks with a confidence which would imply that he has seen this early lesion; he says,—"All that can be perceived is that it is redder than natural, and that when a section of it is made its vessels are found turgid, presenting bloody points in its substance; it is usually found in this state in injuries of the spine, opposite to where the blow was received." (Loc. cit.) From all that has hitherto been collected relative to inflammation of the spinal cord, it seems pretty well ascertained that it may present the following terminations:—1. Ramollissement; 2. induration; 3. suppuration.

1. **Ramollissement.**—As in the brain, anatomists are not agreed respecting the inflammatory nature of ramollissement in the spinal cord. But when the medullary substance surrounding a portion of marrow thus softened is in a vascular state, and that vascularity extends even into the softened portion; when, moreover, (as is not uncommon,) there is unequivocal evidence of meningitis, it appears to us that there are ample grounds for the opinion that the ramollissement is inflammatory; and as such cases as we have described are the most common, a great number of the cases of ramollissement may be regarded as the results of *myelitis*. The softened part is in general of a brownish colour, resembling that of the lees of wine; it is most frequently found in the lumbar region, and next in frequency in the cervical. According to Ollivier it commences in the grey substance; but that substance is itself so obscure, that we can hardly regard this opinion as fully substantiated. M. Dupuy has frequently found ramollissement of the cervical and lumbar portions of the spinal marrow in horses. So great is the softening in some cases, that the substance of the marrow has become a diffluent mass; and in raising the cord out of the vertebral canal, it gives way at that part, the upper and lower portions being only united by the pia mater. Sometimes the softening does not extend through the whole thickness of the spinal marrow, appearing in one or two cases to be accurately confined to the anterior or to the posterior columns.

Ramollissement of the spinal marrow is by no means uncommon with new-born infants; it is most frequently coexistent with a similar ramollissement of the brain. One remarkable feature in this ramollissement is that it exhales a marked odour of sulphuretted hydrogen, indicative of a rapid advance of putrefaction. Such an alteration, Billard says, is generally found in infants who had lived only a few days, respired with difficulty, and exhibited but few signs of sense and motion. Congestions of blood are in general found in the viscera of the other cavities, and there is extensive disorganization of the brain. (Maladies des Enfants, &c. pp. 614–15.)

It is a fact deserving of attention, that the substance of the spinal cord softens very rapidly after death: the lapse of half an hour, during which the nervous substance has been exposed to the air, often produces a manifest alteration. This we have verified on numerous occasions.

2. **Induration** may be likewise regarded as a consequence of the inflammatory action on the cord; but the inflammation appears to be of a more chronic character. The opinion is founded upon the occasional co-existence of meningitis with many cases of this alteration and increased vascularity of the cord in the neighbourhood. When the induration is considerable, Ollivier observes that the nervous substance is similar to the white of egg boiled hard. It is not vascular; and in such cases there are not, in general, obvious indications that the indurated portion had been the product of inflammation. Induration has been found by Esquirol and Pinel in the spinal marrow of epileptics; and Ollivier gives an instance of

induration in the whole length of the cord in an epileptic. Billard, also, found it so extensive in a new-born infant, that the cord, after being stripped of its membranes, was able to support nearly a pound weight; in this case the meninges were lined by false membranes. (*Andral*, Anat. Path. by Townsend, vol. ii. p. 750.)

3. **Suppuration.**—When pus is found in the spinal marrow, it is generally infiltrated through its substance. Abscess of the spinal cord is very rarely met with. Two cases of this lesion are now recorded; one by Velpeau, and the other by Mr. Hart of Dublin; a third, which was met with by Dr. Carswell, has been alluded to in the article Abscess.

The symptoms which result from inflammation of any portion of the spinal marrow, vary according to the region in which the inflamed part exists. In the early stages there will be increased sensibility, more or less pain in the back, muscular spasm, and sometimes convulsion; as disorganization proceeds, the sensibility becomes blunted, and paralysis of sense and motion ensues; sometimes there is no paralysis, but violent convulsions, and in such cases the fatal result ensues speedily. The progress of the symptoms is proportioned to the activity of the inflammation. Hence in some cases we have a train of obscure premonitory symptoms: pain in the course of particular nerves; formication; feebleness of muscles; sometimes a kind of subsultus; deficient action of some internal organs which may be connected with the spinal marrow. If the seat of irritation be in the cervical region, difficulty of deglutition is among these precursory symptoms, and sometimes slight dyspnœa, which may end in complete asphyxia; but there is a remarkable variety as to the extent of the paralysis which follows disease in this region. In some cases it has extended to the four extremities, but in others it was confined to the upper, and in a few instances the paralysis affected the lower extremities only, although the upper part of the cord was most extensively the seat of disease. This fact has been regarded by some physiologists as proving that the several segments of the spinal marrow are independent of each other; though it is obvious that, if we admit the justice of this inference, a difficulty, perhaps as hard to be surmounted, will arise to account for the occurrence of paralysis from a lesion precisely similar in locality, extent and nature. It is well known that the division of the spinal marrow in the neck of an animal leaves his four extremities powerless; and that the dislocated cervical vertebra which so compresses the marrow as, if we may so speak, to stop the nervous current downwards, paralyses every part below it. Have we not, then, as much reason to infer from these facts, that the inferior portions of the marrow are dependent on the superior, as to suppose them independent, merely from the occurrence of a few such cases as those we have alluded to? In the present state of our knowledge as to the connection of the brain and spinal marrow, and their influences on each other, and on the organs of motion and sensibility, we are not authorized to form conclusions from data which, to say the least, are not completely established.

Sometimes the symptoms of an acute affection of the heart have manifested themselves when the irritation was seated in the dorsal region. M. Serres relates a case of meningeal inflammation and ramollissement of the cord, in which the heart's action and impulse were of such a nature, that the disease was pronounced to be dilatation with hypertrophy of the left side of the heart, which notwithstanding proved to be perfectly sound.

The lumbar region of the spinal marrow is most frequently the seat of morbid irritation: this produces all the symptoms of paraplegia, more or less perfectly paralysed limbs; formication or insensibility; tendency to the formation of bullæ; gangrene from pressure; retention and incontinence of urine; paralysis of the sphincter ani, &c. We would remark as to the nature of the incontinence of urine in these cases, that it is of that description which, paradoxical as it may appear, can exist along with retention. In some of these cases the bladder seems to be reduced to the condition of an inert reservoir, alike insensible to stimuli from within, and incapable of obeying them. Although all anatomists are not agreed as to the existence of a sphincter to the bladder, yet all admit that the *detrusor urinæ* muscle is opposed by muscular fibres, which prevent the urine from transgressing at least the limits of the prostatic portion of the urethra: we allude particularly to the muscle of Wilson, which compresses the membranous portion, and so opposes the flow of urine through it. This muscle may be paralysed, and so the passage of the urine remain free; or the sensibility of the mucous surface may be destroyed; and thus, although the muscle may be in a state of integrity, it will not act because the insensible surface will not convey the necessary stimulus. Hence, the retention of urine is always a prominent symptom from paralysis of the detrusor; and the incontinence appears whenever a patient is placed in such a position as will cause the urine to flow by its natural gravity.

To determine, then, the precise situation of the spinal inflammation, the practitioner has recourse to the early symptoms—the parts paralysed—and a minute examination of the spine. For this last purpose he may have recourse to the method proposed by Mr. Copeland, viz. passing a sponge filled with hot water along the spine; the patient will shrink as the sponge passes over the affected part. Percussion may in some instances direct us to the inflamed spot.

We subjoin two interesting cases of encysted abscess of the spinal cord, with a view to illustrate the symptoms in that stage.

The first is from the pen of Mr. Hart, a distinguished anatomist of Dublin, and is extracted from the fifth volume of the Dublin Hospital Reports. (P. 523.) A child, aged nine months, had been for about a month suffering from irritation of the bowels, which the parents supposed to be owing to dentition, when a lateral curvature of the lumbar portion of the spine to the right side was observed, accompanied with spasmodic twitching of the right leg and thigh. Soon after this occurrence the child was affected with convulsions, which became more frequent, and were shortly accompanied with well-marked symptoms of hydrocephalus, which, notwithstanding active treatment, proved rapidly fatal. On examination of the

head, there were the usual appearances from hydrocephalus. When the spine was opened, the spinal cord appeared of unusual thickness: an incision was made into it, from which some *thick purulent matter* flowed out. It was found that this matter was contained in a cyst which occupied the very centre of the spinal cord. This cyst was of an oblong form, extending from the first to the twelfth dorsal vertebræ, and was terminated by an obtuse extremity both above and below. Its diameter was about four lines, its parietes were a line in thickness, and so solid as not to collapse when the contained fluid was discharged. So completely did it occupy the centre of the cord, that the medullary substance formed a tube of equal thickness on every side.

The second case is quoted by Dr. Abercrombie from Velpeau. A woman, æt. fifty-six, was affected with sudden loss of power of the limbs of the left side without loss of feeling; it soon amounted to perfect palsy; her voice became feeble and her speech embarrassed; the pulse was natural, but the respiration quick. The left arm became œdematous. After four days the speech could not be understood, the pulse became feeble, with increasing general debility and stertorous breathing, and she died in a week. In the centre of the right column of the spinal cord, in the middle of the cervical portion, there was a cavity three inches long and two or three inches in diameter. It was full of a soft matter like pus, which became more consistent towards the parietes of the cavity, which were firm and about a line and a half in thickness. In the left column there was a similar disease but less extensive, being about one inch long and one in diameter, and its contents were less purulent, rather resembling ramolissement of the substance of the cord. (Velpeau, Revue Médicale, 1826.)

As to the duration of inflammation of the spinal marrow, it may be said to vary considerably; some cases have terminated fatally in three days. It has been observed that the fatal termination is much more rapid when the dorsal region is the seat of the disease; a fact which is attributed by Mr. Earle to the greater narrowness of the spinal canal in that region. When the disease has become chronic or passed into any of the stages above mentioned, life may continue for even a very prolonged period, patients thus affected continuing to live from five to fifteen or twenty years; but the ordinary period of duration of the chronic disease is two, three, or four years.

Treatment.—There is no reason why inflammation of the spinal marrow should not be cured, but it is so very seldom met with in the first stage, that the practitioner has always to labour at a great disadvantage. In the treatment of inflammation of the spinal marrow, the antiphlogistic system must be rigidly observed; general and topical bleeding, with counter-irritation from blisters or stimulants of various kinds. Issues or setons are to be employed if the inflammation be of the chronic form. The tepid or the cold douche applied from a great height to the suspected region, has been known to be very serviceable.

In the chronic stage we may expect to confer some benefit by the application of remedies. Perfect rest in the horizontal posture is, perhaps, the most necessary and useful measure, to which we may add the adoption of means to keep up a continued counter-irritation. Close attention to the digestive organs, a continued course of purgatives, combined with a mercurial, tepid or cold bathing or the douche, will often be found useful. The strychnine, too, may be administered either internally or to a blistered surface through the medium of the skin.

The effects of concussion of the spinal marrow seem to depend very much upon chronic inflammation. Concussion sometimes proves immediately fatal; probably in consequence of the altered circulation about the spine and the general shock to the nervous system, but in general no morbid appearances can be detected. It is possible that acute inflammation may follow concussion, but more frequently there are all the signs and symptoms of chronic inflammation, which in some instances disappear without any bad consequences. At other times the concussion is followed by some permanently morbid state of the cord, which causes permanent paralysis. Sometimes these symptoms continue from the moment of the accident, but at others the patient is taken up powerless; he recovers, and in a short time gradually relapses into a worse state. General paralysis has not uncommonly succeeded to this accident.

Atrophy.—According to M. Chaussard, the spinal marrow is one of those organs in which the effects of old age become very conspicuous. This organ, he states, becomes much increased in density as age advances, and exhibits a proportionate diminution in volume as well as in length. These changes take place simultaneously with similar ones in the brain. Ollivier has confirmed these observations. The volume of the spinal roots he found in a direct ratio with that of the spinal marrow, and atrophy was appreciable in each of them. It has also been noticed by Cotunnius and Magendie that the quantity of fluid round the marrow is in these cases inversely as the size of the organ.

Prolonged inactivity will produce atrophy even to the whole extent of the spinal cord, as in two cases seen by Ollivier and Magendie; and in many cases of paraplegia the spinal cord is found in a state of atrophy at the original site of the disease which caused the palsy. The condition of the roots of the nerves in atrophy of the spinal marrow is worthy of notice. In one case the anterior roots exhibited little more than neurilemma, but the posterior did not exhibit any obvious change. In another case the roots of the lumbar nerves were reduced to threads.

Prolonged pressure, as from a displaced vertebra, or a tumour in the spinal canal, has been known to produce atrophy of the compressed part.

Hypertrophy.—This affection has been a few times noticed in the cord. It is characterized, to use the words of Andral, by the enlargement and increased firmness of the cord without the presence of hyperæmia. The cord then fills the whole cavity of the dura mater, and is closely applied to the parietes of the vertebral canal. Laennec and Hutin have observed this condition to exist in the whole length of the spinal cord. Andral found it in the cervical region of an epileptic girl.

In consequence of the induration which accompanies hypertrophy, Ollivier inclines to the opinion that it is the product of chronic inflammation.

We know of no symptoms which particularly indicate the existence of either this or the preceding affection.

New Formations in the Substance of the Spinal Marrow.—There appears to be a perfect identity as to the nature of the morbid conditions of the brain and spinal marrow. This is in nothing better exemplified than in those chronic formations which are met with in the substance of the latter organ. All of them tend to the production of similar affections of sensibility and the power of motion, varying, like all the other diseases of this organ, according to the portion of the marrow in which these products are developed. The access and progress, however, of these symptoms are uniformly insidious and slow, and at first often simulate diseases of other organs; so that until the sensitive and motive faculties begin to be impaired, either together or separately, the practitioner is at a loss to account for the train of symptoms, or attributes them to a cause very different from the true one. These morbid products are as follow:—1. tubercle: 2. encephaloid and other tumours similar in the slowness of their growth: 3. entozoa: 4. osseous or cartilaginous tumours; but these are of rare occurrence.

Tubercle occurs more frequently in children than adults, and is much more rarely found in the lower than in the upper parts of the cord. In general, and according to Gendrin and Leveillé always, these tumours are surrounded and separated from the nervous substance by a cyst. Very often the symptoms resulting from the presence of one of these bodies are localized to one extremity, or to a particular nerve or nerves of an extremity, but in general there is very great variety in them. Epileptics are frequently found to have had tubercles in the spinal marrow.

Encephaloid tumours exhibit the same characters here as in other parts. We often find other tumours of a cellular or cellulo-vascular nature producing similar effects and similar symptoms.

The entozoa found in the spinal cord are principally hydatids and cysticerci. They are likewise found exterior to the meninges, which sometimes have seemed to have entered from some external part through the intervertebral foramina.

Having thus examined the obvious and tangible morbid changes which the spinal cord or its meninges exhibit, we shall next inquire how far a disturbance of the functions of the spinal cord may take place without the occurrence of any change of the structure visible after death.

It is by no means uncommon for the practitioner to meet with cases in which pain referred to some particular region, generally about the thorax or the abdomen, seems to have a remarkable connection with the spine. If, in these cases, the finger be passed down along the spinous process, making slight pressure on each, the patient will shrink when it comes to one or two particular vertebræ, and will complain that the pain shoots forward from the point compressed by the finger to that where the pain was previously felt. A very slight degree of pressure is in general sufficient to produce this result; but an increase of the pressure always adds to the intensity of the pain. Sometimes there is so much tenderness that the least touch will cause pain, and when there is such extreme tenderness it is not generally confined to one spot, but extends over the whole or a greater portion of the spine; at first, one would be led to consider the integuments as the seat of this extreme sensibility, but it is difficult to account for the connection of this increased cutaneous sensibility with the pain which had previously existed; and, moreover, it is equally difficult to conjecture how pressure of the kind alluded to on an osseous ring, such as the vertebra, can be communicated to a part so well protected and so far separated from the surface of the vertebral canal as the spinal marrow. That these cases very frequently, more especially when the irritation is confined to a small space, recover rapidly after the local detraction of blood by leeches, or by some counter-irritant, is a fact now pretty generally known; nor can we say that this fact serves to throw much light upon the true cause of the symptoms we have mentioned. On the other hand, instances are by no means wanting where these remedies have totally failed in removing the symptoms in question. The difficulty of finding an adequate explanation is greatest when the phenomena are slightest and confined to a very limited extent; but when the tenderness occupies the whole spine —when not only pressure from without, but even the slightest motion, aggravates the pain—we are then forced to admit that the origin of the evil is in the vicinity of the spinal cord itself. It is not fair to deny the previous existence of a morbid compression or irritation of the spinal cord or of the spinal nerves at their origins, because the anatomist can detect no vestige of disease after death. It must be remembered that the spinal cord and the nerves which emerge from it are surrounded by a venous anastomosis of remarkable complexity; that these veins do not possess valves; that they communicate freely with the superficial veins and with the numerous muscular veins in the region of the back. That respiration exerts a considerable influence on the venous circulation, has been long since fully proved. Nowhere can we expect this effect to be more marked than in the venous plexus of the spine, where the respiratory movements are so constantly felt, and where muscular action is so prominent in all the efforts of the trunk. From these anatomical and physiological considerations we may with justice infer that such a degree of congestion or turgescence of this spinal venous plexus as will excite irritation at the origins of the spinal nerves, may easily occur; and it appears to us that it is equally fair to conclude that such a congestion may exist *ante mortem*, and no trace of it appear *post mortem;* for to set aside all other means of accounting for the absence of the appearances, the very sections which are made to get at the supposed seat of the disease are sufficient to dissipate the venous congestion: we have stated thus much to show that anatomy affords some support to the doctrine of **spinal irritation,** as a source of many obscure morbid phenomena, a doctrine which has been put forward with more enthusiasm than discretion, and which, for that very reason, has received more opposition and less dispassionate consideration

than it deserved. While we would express our fullest concurrence in the wise caution which Dr. Abercrombie gives, that we should take care that this doctrine be not a *gratuitous principle* assumed so as to answer phenomena rather than deduced from observation, we must likewise endeavour, on the other hand, to avoid setting too slight a value on observations which are supported by many respectable names, and thus falling into an error which might debar us from many an opportunity of relieving distressing and obstinate symptoms.

The most complete account of the phenomena resulting from what is called "spinal irritation" yet published, is to be found in a work by Messrs. Griffin, of Limerick, on what they term "Functional affections of the spinal cord and ganglionic system of nerves." These writers are entitled to the merit of having with great industry collected many interesting cases, in all of which anomalous symptoms prevailed, and had a more or less obvious connection with that irritable condition of the spine to which we have alluded. To enumerate these symptoms would be but to recount the numerous ills to which flesh is heir: it will suffice to state generally the result of their observations, which it is but just to say bear the internal evidence of truth and accuracy. The symptoms are in general localized to those regions of the body which receive their nervous supply from that segment of the spinal marrow that occupies the irritable portion of the spine. Thus, when the cervical region of the spine is the seat of irritation, there may be painful affections of the head, the neck, the upper extremities, the respiration may be affected, or there may be pain in the chest. Some of these symptoms are of so severe a nature as to give rise to the suspicion of acute or chronic organic disease, and indeed one of the greatest difficulties connected with this subject consists in being able to discern when organic disease and when a simple spinal irritation gives rise to these symptoms. In some of the cases there have been fits of insensibility, paralysis, numbness of the cutaneous integument, deafness, cough and oppression, amaurotic symptoms, hesitation and difficulty of speech; all of which would at a first view of the case excite apprehension as to the existence of organic disease. Again, when the dorsal region of the spine is the seat of tenderness, there are pains about the chest or in the side, weight and constriction in the chest, cough and fits of syncope, sense of sinking, loss of appetite, vomiting, gastrodynia, pain in the region of the liver, hiccup, and where the lumbar region is affected, pains in the abdomen, dysury, or ischuria, pains in the testes or lower extremities, with disposition to paralysis. In a few cases there are symptoms resembling those above enumerated, but without any spinal tenderness; these cases were however considered and treated as cases of spinal irritation.

Females of a nervous temperament, who have passed the age of puberty and are prone to hysteria, are commonly the subjects of spinal irritation. The duration of this complaint is variable, sometimes yielding readily to the simplest treatment, and at other times resisting every mode of practice that can be devised; sometimes it yields and returns again, and so continues alternately to vanish and re-appear. It is obviously highly important that the symptoms which arise from this condition should be distinguished from those which result from organic disease as well of the spinal cord itself as of the vertebræ. According to the Messrs. Griffin, from whom (pp. 214, 15) we take the liberty of quoting the following paragraph, the symptoms which more particularly indicate spinal irritation, are

1st. The pain or disorder of any particular organ being altogether out of proportion to the constitutional disturbance.

2d. The complaints, whatever they may be, usually relieved by the recumbent posture, always increased by lifting weights, bending, stooping, or twisting the spine, and among the poor classes often consequent to the labour of carrying heavy loads, as in drawing water, manure, &c.

3d. The existence of tenderness at that part of the spine which corresponds with the disordered organ, and, we would add, the increase of pain in the organ by pressure on the corresponding region of the spine.

4th. The disposition to a sudden transference of the diseased action from one organ or part to another, or the occurrence of hysterical symptoms in affections apparently acute.

5th. The occurrence of fits of yawning or sneezing, which, though not very common symptoms, yet as scarcely ever occurring in acute or organic diseases, may generally be considered as characteristic of nervous irritation.

The treatment in these cases is either local or constitutional: sometimes local treatment alone rapidly removes all symptoms; but in general it is necessary to combine with it a plan of constitutional treatment calculated to regulate the digestive organs and to tranquillize the nervous system generally. Bleeding by leeching and cupping, blistering or counter-irritation by other means, constitute the local treatment; the use of the cold or tepid shower-bath, the vapour bath, or the warm bath, may also be advisable. Change of air and scene, and indeed all remedies which tend to divert the patient's mind to other objects than himself and his sufferings, are peculiarly applicable in these cases.

Most of our readers will recollect that the coincidence of spinal tenderness with hysteria forms the subject of a small volume by Mr. Tate, in which he gives several instances of the successful employment of the friction of the back with tartar emetic ointment. (Tate on Hysteria.) This writer, like many other practitioners, considers that the frequency of the occurrence of spinal tenderness in hysterical cases may be accounted for by a supposed connection between the uterus and the spinal marrow. There can be no doubt that an anatomical connection does exist between these two parts, as well through the medium of those uterine nerves which are of spinal origin, as indirectly through the filaments derived from the sacral ganglia which inosculate with the anterior branches of the sacral nerves. Moreover it very frequently happens that symptoms of spinal irritation or more serious spinal disease rapidly make their appearance after the sudden stoppage of the menstrual flux from whatever cause. The generative system in the male seems

to have somewhat a similar connection with the condition of the spine, and we now and then read of and meet with cases in which the symptoms seemed to follow as a direct consequence upon an excessive abuse of sexual intercourse. The extreme pain and tenderness of the loins which precede a difficult menstruation or a hemorrhoidal flux, or which follow the stoppage of the latter, and which often accompany amenorrhœa, cannot be supposed to have their seat primarily in the lumbar muscles; but may, as it seems to us, be reasonably accounted for on the supposition of the existence of a vascular turgescence surrounding the branches of the lumbar and sacral nerves as they escape from the spinal foramina. This view may with equal probability be applied to account for the phenomena of spinal irritation generally, as it is obvious that a congestion affecting the nerves at their exit from the spine will be just as apt to produce the varied symptoms which we have detailed, as if the marrow itself were the congested part.

Mr. Teale adopted the doctrine of spinal irritation in explanation of many forms of neuralgia, and, as we think, with much justice. He records several cases of neuralgia of the scalp, upper extremities, the mamma, — lower extremities, the knee, in which there was an evident connection with spinal tenderness, and which were successfully treated by remedies applied to the spine. Mr. Teale's experience fully accords with that of the Messrs. Griffin, as well as that of Dr. Brown, who was among the first to call attention to spinal irritation in a paper which he published in the Glasgow Medical Journal for May 1828. Similar views were entertained by the late Dr. Darwall, whose opinions are recorded in a paper entitled "Observations on some Forms of Spinal and Central Irritation," and published in the Midland Medical and Surgical Reporter for May 1829.

We have thought it unnecessary in this article to enter into any statement of the views of many authors as to the degree in which the spinal marrow is engaged in many diseases of a convulsive or nervous character. Under the respective articles, Convulsions, Epilepsy, Hydrophobia, Tetanus, the reader will find this fully treated of.

R. B. Todd.

SPLEEN, DISEASES OF THE.—The internal structure of the spleen is very similar to the erectile tissue, being composed chiefly of arteries ramifying on the walls of cells formed by irregular perforations in the sides of the veins. It is connected in a remarkable manner to the stomach by the vasa brevia. Its artery is of great size and strength, and remarkable for its great tortuousness: the vein also is very large, and always forms a principal branch of the vena portæ; it is well supplied with nerves and lymphatics.

Diseases of the spleen are little studied, because they are not very obvious, and are supposed to be rare; but they are by no means of unusual occurrence. In moist countries, whether warm or temperate, they are endemic, as in Italy, Holland, South America, and some parts of India—in fact, wherever malaria exists.

Great diffidence seems to prevail in pronouncing on the existence of splenic diseases. It is most true that these affections are often rendered obscure by complication with other diseases, by the simplicity of the offices performed by the spleen, and by its being an organ of much endurance, occasionally suffering, with little apparent inconvenience, considerable derangement when produced slowly. Further difficulties are created by the situation of the spleen; placed, as it is, deep in the left hypochondrium, and surrounded by organs of great importance and easily disturbed. But it is by no means rare, as some seem to imagine, that diseases of this viscus are to be detected only when cure has become impossible.

The diseases of the spleen may be enumerated according to the various alterations in its structure: — 1. inflammation and its consequences— suppuration or abscess, and gangrene; 2. softening; 3. induration; 4. simple enlargement and hypertrophy; 5. atrophy; 6. hemorrhage or apoplexy of the spleen; 7. hydatids or cysts; 8. tubercles; 9. melanosis; 10. calcareous deposits.

Inflammation of the Spleen. — This may be either *acute* or *chronic*. The symptoms of *acute* splenitis, according to Grotannelli, are, after a sensation of cold and partial rigor, a feeling of weight, fulness, and pain in the left side extending to the left shoulder, increased on pressure and coughing; thirst, some degree of nausea, dry cough, with the usual symptoms of pyrexia. Hæmatemesis, faintings, or pain on respiration are occasionally observed, but not frequently in the simple form of this disorder. The same author states that a natural crisis is frequently observed after hemorrhage from the nose or stomach, after a copious deposit from the urine, after the disappearance of the headach; when the hemorrhoidal or menstrual flux supervenes, and also after a profuse discharge of the lochiæ. In violent examples of this disease, those which rapidly terminate in a general dissolution of the splenic tissue, incessant vomiting is a prominent symptom, which is often attended by discharge of grumous or clotted blood both from the stomach and intestines.

In the most satisfactory accounts of dissections of acute splenitis on record, we find it stated that the peritoneal coat is inflamed and adherent to the surrounding parts: the parenchyma is observed to be swollen, hardened, and variously discoloured. If the disease have been violent, the organ is more or less dissolved into a semi-fluid pulp of grumous or coagulated blood and sanies. There is often disseminated throughout this mass a creamy pus, either in innumerable drops, or in one or more large deposits — without being at all times contained in a distinct sac. Similar appearances were observed by M. Gendrin in the spleens of dogs, in which he had excited inflammation by the insertion of caustic into their substance. In these cases, when the inflammation was in its first degree, he found the splenic parenchyma of a brownish red colour, gorged with blood, denser than natural, though easily torn. At a more advanced stage, the spleen became of a greyish brown and still more friable, and when cut into, presented a close sponge-like tissue, filled with blackish blood. In the third degree of intensity, the spleen was resolved into a pulp, like the lees of red wine.

Dr. Ley has fully detailed a case of acute

splenitis, complicated with inflammation of the uterus, which terminated in nine days. (Trans. Coll. Ph. 1. v. 304.) On dissection, the spleen was found adherent to the contiguous peritoneum. Internally it seemed like a piece of extremely soft sponge. Its cells had been filled with an intimate mixture of pus and grumous blood. On placing it in water, innumerable vessels, as fine as the fibres of swan's-down, floated separately, rising from every point of the superficies of the organ. The contents of this spongy mass having been removed by repeated washings, something like an attempt at the formation of cavities, to contain the matter, manifested itself: no regular cyst, however, had been formed. All the other viscera, abdominal and thoracic, were healthy, except the uterus, whose inner surface was gangrenous.

The example of acute splenitis in a boy, aged three years and a half, related by M. Huguier, (Journ. Hebd. vii. 424,) is very curious. After the ordinary symptoms of the disease had existed for a week or ten days, occasional convulsions with insensibility came on and lasted a week. After the use of leeches and aperients, the boy became much better, but on the twentieth day of the illness, gangrene attacked successively the right foot, leg, and thigh, and some days afterwards passed to the left leg. The child died on the thirty-sixth day from the first seizure.

The external coat of the spleen adhered all around pretty generally, and in its substance two abscesses were found. All the other viscera of the body were sound. The most remarkable feature in the case, as connected with the sphacelus of the lower limbs, was that all, or very nearly all, the branches of the abdominal aorta below the second lumbar, were found plugged up with fibrinous clots. There was a dense clot in the aorta near its bifurcation, which seemed older than the rest.

If, after a certain period, the inflammation of the spleen do not yield, it assumes the chronic form. Dr. Grotanhelli thus enumerates its symptoms, as the disease occurs in Italy; and the description applies well generally. "There is a sensation of weight and pressure in the left hypochondrium, fulness and swelling in that situation; an obtuse pain or sensation of uneasiness, especially when turning in bed; indigestion; disturbed sleep and unpleasant dreams; sometimes dyspnœa, with a dry cough; defective nutrition; a sallow complexion, and sometimes scurvy. The enlarged spleen may occasionally be distinctly felt early, and always late in the disease."

Wandering pains in the limbs, sometimes ending in collections of pus under the integuments of the thigh, arm, &c. are not uncommon in chronic splenitis. In the latter periods of the disease, the debility and emaciation become very great; the complexion darkens and the appetite fails. Hectic, more or less violent, (sometimes very slight,) comes on, with diarrhœa or vomiting of unconquerable pertinacity, and blood is frequently discharged both upwards and downwards; the patient often complains of aching pains all over the body, accompanied with restlessness, anxiety, vertigo, or sleeplessness.

The variation in the severity and duration of the complaint is very great. If it have accompanied ague, the symptoms may possibly not have been urgent in the outset, but it is almost always a painful as well as formidable disease. It commonly continues for some months, and may last for years with remissions.

The spleen is so closely connected with several important organs, that it cannot well be inflamed without implicating one or other of them. When the diaphragm becomes inflamed, the breathing is hurried, laborious, and painful; there is frequent dry cough, with palpitation at times. Thus, in a case related by Cozè, (Ed. Med. and Surg. Journ. xx.) and in another by Cruveilhier, (M. C. Rev. xii. 63,) great anguish and an occasional sense of impending suffocation aggravated the sufferings of the patient; and dissection showed that the enlarged spleen, and the adjacent part of the diaphragm, were covered with false membrane. In an example described by Dr. Bree, the suffocative feeling came on in spasmodic attacks, attended with faintness and confusion of head. These paroxysms left the patient very weak, and were attended with intolerable pain in the side. In two cases, one reported by Mr. Howship, and the other by Mr. Cozè, (before quoted,) the spleen adhered closely to the stomach, and poured its contents into it by an opening. In that of Mr. Howship, the man, during life, passed blood constantly both by stool and by vomiting; and, on dissection, the stomach was found full of that fluid. M. Cozè found the spleen full of pus: the vomiting, during life, had consisted of pus and blood.

The liver, according to systematic writers, is usually diseased in this form of splenic inflammation, but we believe that this does not so often occur as is supposed. Out of fourteen severe cases ending in abscess, the liver was only in some degree deranged in two. In five other protracted and finally fatal cases, not ending in suppuration, this organ had only undergone slight alteration in four. If the complaint last very long, any of the surrounding viscera may become involved in inflammation; and the instances are not few. One of the most remarkable combinations takes place when the disease extends to the kidney, and proves rapidly fatal, with the usual symptoms of ischuria renalis. (Abercrombie.) Accumulation of serum in the peritoneal sac is not an uncommon effect of chronic inflammation of the spleen.

The terminations of chronic splenitis are resolution, hypertrophy, suppuration, softening, induration, ossification, and gangrene. Though there are cases on record of the termination of inflammation of the spleen in resolution, this does not take place often. Collections of pus in the spleen are on the whole rare, and the symptoms of their formation are obscure and unsatisfactory. When the pus is deposited in the parenchyma, the membranes being sound or nearly so, the pain in the part is small; but there is uneasiness, and both strength and flesh waste gradually until the patient dies. As soon as the investing membranes are affected, the sufferings become varied and acute; frequently with a peculiar sense of heat in the left hypochondrium. The pain often strikes to the spine, clavicle, or shoulder. The membranes are almost always affected sooner or later, and, together with the neighbouring viscera, are covered with coagulable lymph. The pus is of the ordinary

creamy kind, but is sometimes concrete. (Cruveilhier.) It varies in amount from a few ounces to many pounds. It is often found infiltrating the whole or part of the substance of the spleen, or in minute yellow dots intermixed with the blood in the cells. (Andral.) The filamentous tissue of the organ, though bathed in pus, is sometimes quite uninjured; but generally it is pulpy and diffluent. On most occasions the pus is collected in a distinct sac or sacs, within the parenchyma of the spleen, which is more or less softened, or even altogether destroyed. The pain and fever generally run high when there is an organized sac. The sac may be fibrous, cartilaginous, or even bony. It is often very large, and is occasionally easily torn, although perhaps half an inch thick. The matter may find its way into the stomach, colon, peritoneal cavity, the left side of the chest, or into the lungs, inducing symptoms of phthisis; or it may burst outwards through the abdominal walls. In Dr. Tweedie's case of splenic abscess during fever, it had nearly perforated the contiguous part of the diaphragm; and in two cases given by Drs. Grotannelli and Raikem, there was a purulent discharge through the abdominal parietes, the spleen having formed an adhesion to them.

Softening.—We have stated that there are many cases of chronic splenitis in which the only morbid changes observable in the viscus are, an inflamed and even ulcerated state of the membranes, and the dissolution of its substance into a bloody colluvies. Under such circumstances, the spleen is generally enlarged, and converted into a cyst with thickened and hardened coats, full of dark-coloured sanies, as in a case narrated by Dr. Heberden, (Comm.) and in one of Dr. Abercrombie's cases it was broken down like grumous blood, and full of a matter like the lees of red wine.

Besides the inflammatory softening there is another of a character quite peculiar, and not as yet well understood. The structure of the spleen is here more or less destroyed; and it is often reduced to a simple bag, containing a substance which varies from the state of clotted or grumous blood to that of tar. It is unattended by any of the characteristics of inflammation. Such, most probably, is the softening of this organ so constantly accompanying fever, if we take into consideration, with Louis, that the whole tissue of the organ is always affected, that in his forty-six cases, the peritoneal membrane was never inflamed, and that pus was never formed: it seems in some way connected with a febrile state of the body, and dependent on a change in the blood. Andral inclines to believe that the softening in intermittents is owing to the miasmatic poison altering the qualities of the blood. In forty-six dissections of typhoid fever, (Edin. Med. and Surg. Journ. xxxiii. 128,) Louis found the spleen natural only in four. In three-eighths of the cases, it was enlarged to more than thrice its usual volume; in three-fourths it was softened; in a fifth part of these to such a degree as to be reduced to a pulp with the greatest ease; and its colour was also generally changed. As this diseased state was universal in those who died at an early period, and was less and less frequent in the more advanced stages, it probably was never absent at the beginning. Softening of the spleen occurred much less frequently in other acute diseases, namely, in little more than a fourth part. Dr. Tweedie's (Illustrations of Fever,) experience is similar. Pearson Dawson, Vetch, Wardrop, and others, state that in the Walcheren fever, the spleen was usually found, after death, of great size, and generally a mere bag, filled with a liquid like tar, and weighing from three to five pounds. In the malignant fever of Italy, the dissolved or pulpy spleen, just described, is very common, in conjunction with acute inflammation of various organs, especially of the membranes of the brain, of the stomach, and intestines. Fatal rupture of the spleen, from extreme tenuity, is in these diseases an ordinary event.

Most chronic diseases, and especially those of the liver, and the dysentery of Arracan, are occasionally accompanied with this softening of the spleen, but the fact is often not known until after death.

Induration.—After symptoms of splenitis, we sometimes find the spleen much enlarged, with a compact structure like healthy liver. (*Hodgkin*, Med. Gaz. ix.) Dr. Abercrombie (Edin. Med. and Sur. Journal, xvii.) gives a case where the spleen was thus hard and enlarged, after all the symptoms of phthisis, for three years. The liver was also enlarged, but the lungs sound. The coats of the spleen in these instances are sometimes cartilaginous. Baillie states that cartilage usually shows itself on the convex surface. It is commonly smooth, and resembles the cartilages of the nose and ears rather than that of the ends of the bones. The substance of the spleen is sometimes so hard and brown as to have acquired for it the designation of scirrhus, but without any statement of particulars. Sauvages quotes a scirrhous spleen which weighed thirty-three pounds; but Dr. Baillie questions the existence of scirrhus in this organ.

Ossification, which is enumerated as another termination of chronic splenitis, is usually confined to the investing membranes, and is most frequently seen in elderly persons. Morgagni is probably correct in his opinion, that the ossifying process almost always commences on the dorsum of the spleen. He supports it by many examples. Morgagni describes the spleen of a day-labourer as "osseo-lapideum." The man had severe pain in the seat of the spleen. Andral once found this viscus transformed into a mere osseous shell, with a bony cancellated structure within. It contained a small quantity of reddish fluid like muddy wine. (Path. Anat. ii. 439.) Mr. Bampfied (Med. and Phys. Journ. xlv. 15) details the appearances on dissection, of a drunken wine-porter, who died of hydrothorax, with dilatation of the heart, in whose spleen a large bony tumour was imbedded and fixed to the parts about the spine. The man had for years had pain about the large end of the stomach, which left him after vomiting. He was also troubled with constipation, dyspnœa, cough, and pain in the left side of the thorax. Littre (Med. Essays, vol. i.) mentions an elderly gentleman of gay disposition, who, dying suddenly, was opened. He never complained during life. The spleen only weighed an ounce and a half; it was completely ossified.

Gangrene.—Ollivier (Dic. de Méd. xviii.) speaks of inflammation of the spleen proving mortal by gangrene; and Portal, in his Anatomie Médicale, says that this condition of the organ is often seen, and that it is more especially to be recognised by its fetid odour. There are, however, on record very few incontestable examples of gangrenous splenitis. Morgagni only gives two cases, and these not in detail.

In the treatment of *acute splenitis* we must be prompt and energetic; general bloodletting should be practised as long as the inflammatory pain is considerable, provided the patient's strength will admit of it. A moderate degree of catharsis should be kept up. A plentiful application of leeches to the seat of pain, followed by vesication, will sometimes complete the cure; but the disease is apt to remain latent: it may subside apparently, and then reappear with a violence sooner or later fatal.

In *chronic splenitis*, besides the removal of the cause and the restoration of the system to a healthy condition, we have to overcome subacute inflammation, to impart tone to the relaxed organ, and to stimulate its absorbents. This is a most obstinate disease under whatever shape it appear. The treatment indicated by Sauvages, (Nos. Meth. t. v. 493,) and even by earlier authorities, is that which, with some additions, is practised at present by most physicians in Europe. It consists chiefly of the combination of aperients with iron and sedatives. These had been laid aside, in Great Britain, in favour of mercury, until recently; but now almost all concur in testifying that the good effects of mercury as a deobstruent in chronic diseases of the spleen, are precarious, trivial, and temporary at best, while usually this remedy procures no mitigation of the complaint whatever. For this return to successful practice we are much indebted to Dr. Bree. He trusts principally to a combination of aloes with antimonials and neutral salts, given in small doses twice a day, with great perseverance; but he has latterly preferred the drastic purges to neutral salts. From three to six stools are procured daily with a decided increase of strength, and the gradual removal of the complaint; which, however, seems to require from three to six months to complete. The Hindoos for ages have cured this disease by administering vinegar and steel, and by procuring at the same time the above number of alvine evacuations daily by means of aloetics. Dr. Bree subdues increased irritability by conium and other sedatives; and if inflammatory exacerbations occur, he meets them in the ordinary way. This physician mentions that there is sometimes an apparent connection between epilepsy and chronic splenitis; at least, that there is a coincidence, and that by means of drastic purgatives he has cured both diseases. A similar remark is made by Hoffmann, in the chapter "De Vomitu cruento."

If the spleen seem to suffer from relaxation, more especially after iron, bitters, and acids have been used, iodine becomes worthy of trial: indeed it is strongly indicated here whether the strumous diathesis be present or not. Dr. Milligan (Med. Chir. Trans. ix.) and many others have furnished cases where cures have been effected by iodine, in chronic enlargement of the spleen, accompanied by a low degree of inflammation, occurring in children. We have ourselves seen this medicine of decided service.

Grotanelli recommends, as soon as the passive state is formed, those remedies which act chiefly by promoting absorption, and by operating through the kidneys, and which at the same time are both antiphlogistic and diluent. In conformity with this plan, he prescribes squills combined with digitalis and colchicum, the precipitated sulphuret of antimony joined to nitre and the supertartrate of potass.

In the chronic splenitis which terminates by softening, the stomach is peculiarly irritable: a blister should therefore be laid on the precordia occasionally, and an effervescing draught with a few drops of laudanum will be found beneficial. Smart purging was always productive of immediate relief in M. Cruveilhier's protracted case of chronic inflammatory softening. Issues and setons in the left side have been found particularly useful in this complaint, and especially in cases preceded by uterine disorder. Dr. Glionna, in Arch. de Méd. tom. xvii. gives a singular case of a cabinet-maker, aged twenty-nine, in whom an abscess of the spleen pointed externally, and was relieved of three pounds of pus by the insertion of a trochar. The wound closed after remaining open some days, and the man was restored to perfect health.

We think that the saline chalybeate springs of England, such as those of Leamington or Cheltenham, or the sulphureous waters of Harrogate, are entitled to a prolonged trial: the probability of their being serviceable is very great; they answer at once many indications of cure, and possess valuable collateral advantages.

In the temporary exacerbations of fever and pain in the side, which are but too common, general bleeding expends too much of the powers of the constitution to be used frequently in this protracted malady. Cupping, leeches, fomentations, or bran poultices, are productive of great benefit.

Simple Enlargement and Hypertrophy of the Spleen.—There is a simple enlargement of the spleen from mere temporary congestion, [*Splénohémie*, of Piorry,] as when brought on by sudden mental emotion, or by oscillations of the circulation from internal causes. Andral observed the spleen of the living dog to undergo remarkable changes of bulk during a painful experiment, (Dict. de Méd. art. *Erectile*); and Cruveilhier mentions the great frequency of rupture of the spleen in the draught-horse, after violent exertion. (Dict. de Méd. et Chir. i. 291.) Numerous observers (Stoker, Andral, &c.) state that, during the cold stage of the ague, the spleen has been perceived to be painfully tumefied, subsiding immediately after the fit. In temperate climates, the more permanent enlargement or hypertrophy of this organ not being accompanied by the same violence of constitutional disease as in the hotter, is usually of a passive character, and probably in a majority of instances is owing to relaxation of fibre. In Lincolnshire, individuals carry about with them very enlarged spleens for many years, and die eventually of other diseases. Lommius knew many who had tumid spleens all their lives. Lieutaud speaks of a woman who had for seventeen years a

spleen weighing thirty-two pounds. Haller abounds in such facts. The most frequent causes of enlarged spleen are ague and remittent fever; it is therefore chiefly to be found where these are endemial, but it is not very uncommon in any part of Great Britain.

Hypertrophy is liable to pass into inflammation, but it may remain stationary, or yield to the restorative powers of the constitution, with or without the use of medicine.

The most characteristic symptoms of hypertrophy are, a sense of weight in the left side, with or without evident swelling; inability to lie on the right side with ease; debility; disordered stomach; dry cough, and absence of fever. When obvious enlargements take place, we can almost always distinguish them from other tumours by their history, and by their usually increasing obliquely from above downwards, or from left to right. Percussion makes us sensible of a peculiar uniformity of consistence in them, and often enables us to trace their boundaries with great accuracy. It is true that there are here many sources of deception, as, for instance, tumours in the peritoneum, increased bulk in the left lobe of the liver or left kidney, thoracic disease, &c. But in such cases we shall be greatly assisted by the symptomatology.

The indications of treatment in this form of splenic disease are, first, to remove the cause; secondly, to restore the organ to its natural condition; and, thirdly, to improve the general health. If ague be the exciting cause, it must be combated by the appropriate remedies. Warm and brisk purgatives should be given once or twice a week, of the kind affecting the upper bowels. Mercury in all its forms should be avoided, from its having been found prejudicial on extensive trial.

The bowels being kept somewhat more open than ordinary, the nascent irritative stage having gone by, and the case being strictly passive, tonics are to be had recourse to, and especially the acids, with the preparations of iron. The quinine, which has been prescribed to cure the ague, will probably be serviceable to the hypertrophy.

[Of late, strong testimony has been brought forward in favour of very large doses of sulphate of quinia—from twelve to eighteen grains and more in the twenty-four hours; and the most obstinate cases are said to have yielded to a continuance, for a few days, of this treatment. (MM. Bally, Nonat, and Piorry, cited in *Med. Chir. Rev.* for July, 1840, and Dalmas, Art. *Rate* in *Dict. de Méd.* xxvii. 269, Paris, 1843.) The sulphate of quinia has likewise been used both endermically and iatraleptically; but this course appears to have had more effect upon the fever than upon the splenic enlargement. In most cases, the action of the sulphate of quinia is aided by the previous abstraction of blood, by cupping or leeches, from the left hypochondrium. Occasionally, the application of a mercurial plaster, with which six or eight scruples of sulphate of quinia have been incorporated, has relieved the enlargement effectually. The plaster must be renewed when the substances of which it is composed are exhausted, which requires from 40 to 50 days. This method, however, must necessarily be slow in its action.]

When the complaint is preceded or accompanied by suppression of the menses, in addition to the application of leeches to the left side, and moderate but sustained purging by aloetics, the sulphate of iron should be prescribed in such doses, and as soon, as the pulse will permit. Under the use of iron we may expect to see the morbid pulsation of the heart and arteries, the tumefaction of the spleen, and the chlorotic tint, depart as by a charm.

[In long protracted cases of every kind, no better preparations exist than the combination of iodine or bromine with iron: iodine ointment may also be rubbed on the region of the spleen night and morning; or the ointment may be composed of iodine and iodide of potassium; or of iodine and mercury.]

Repeated emetics have frequently dispersed simple enlargement; and cataplasms of tobacco-leaves have, according to Mr. Stedman, (Med. Essays, Edinburgh,) produced the happiest effects.

Kneading with the hand twice or thrice a day has been practised with benefit, and especially in the West Indies. Equable and moderate pressure by a broad elastic belt would probably create a beneficial excitement in the diseased organ.

The diet should be bland, nutritious, easily digested, and less liquid than usual.

[In certain highly malarious countries, splenic hypertrophy is attended with a series of symptoms, which have been termed, in the aggregate, **Splenic Cachexia**; and although this *vice* of the whole system of nutrition is more common in torrid climes, it is occasionally witnessed in the temperate. The patient is sallow, almost anæmic; liable to dropsical effusions, and to hemorrhages, which are checked with difficulty, owing to the irregularity in the circulation, which is partly produced by the modified transmission of blood through the spleen. (See Twining, *Clinical Illustrations of the more important Diseases of Bengal and Calcutta*, 1832.)]

Atrophy of the Spleen is by no means so common as hypertrophy. Haller, (Elem. Physiol. vi.) Bonetus, and modern writers relate instances, but their statements are so meagre and contradictory, that no use can be made of them. It is sometimes found exceedingly small and even shrivelled, when some other organ is much enlarged, where there have been great discharges of blood, in ascites, and in extensive chronic disease. This form of disease of the spleen obviously admits of no remedy.

[An interesting case of the kind fell under the care of the writer, and was exhibited by him to the clinical class of the Philadelphia Hospital, in the winter of 1842–43. The spleen was not larger than an almond. The patient died of dropsy, without any indication of splenic disease.]

Hemorrhage, or Apoplexy, of the Spleen.—We shall here introduce M. Cruveilhier's valuable observations on internal hemorrhage of the spleen, which he denominates "apoplexie." (Dict. de Méd. et Chir. Pratiques, i. 291.) "I have often," he says, "met with in the substance of the spleen, apoplectic deposits of various sizes, round in figure, and exhibiting all the changes which the blood undergoes in such circumstances in the brain and other organs. The spleens of persons affected with agues have often presented, at one or more points in their parenchyma, brownish blood in larger or smaller quantities. I have also seen

ochry-brown cicatrices and fibrous cysts of the same colour—indubitable traces of former hemorrhages, with breach of substance. I am persuaded that these appearances are very frequent in the spleen. This is very distinct from pulpy softening of this viscus. At every strong muscular effort, the blood rushes in abundance into the cells of the spleen, and distends them, and so rupture may be the consequence. What renders this opinion probable is the frequency of hemorrhage in the spleen of the horse. I showed at one of my lectures hemorrhagic deposits, in many stages, in the spleen of a horse. Bailly gives two cases of spontaneous rupture in remittent fever."

It is impossible to predicate this state of the spleen in the living subject; if it were ascertained, however, the treatment is the same as in hemorrhage from the lungs or any other organ.

Hydatids have the same origin in the spleen as in the liver and other organs in which they are found. They may be simply attached to its surface, be placed between the membranes, or within its substance. They are met with in males and females of relaxed and feeble stamina, but more frequently the latter sex. Their occasional causes are not known. The disease arises quite unconsciously to the patient, the first intimation of its existence being debility, dyspepsia, and the uneasiness created by a slowly increasing tumour, which, in its progress, causes further derangement by compression and displacement of other organs, and becomes itself but too perceptible externally. It is only when the containing membrane, or some organ, becomes inflamed, that fever, pain, and their fatal consequences ensue. The patient may die of another complaint during the indolent continuance of this; it may end in suppuration or ulceration of the containing sac, when the hydatids will probably destroy life by passing into the peritoneal cavity. The cysts may be burst by external violence. Hydatids may prove fatal without being inflamed themselves, by disturbing the circulation or by irritating other viscera. This is a very obscure disease, and admits of but little medical interference.

Full statements of two very interesting examples of hydatids in the spleen are inserted in the sixth and twelfth volumes of the Medical Repository. The symptoms during life in both were those of a general breaking-up of the constitution. In one there was hæmoptoe. The spleen in both cases was very large, quite disorganized, and divided by a membrane into two cavities, full of large and small hydatids containing serum.

Cysts of other descriptions are also seen in the spleen, which, although not discernible during life, should not be passed by in silence. "The simplest form," according to Andral (Anatom. ii. 438), is that "of small vesicles filled with serous fluid, which are sometimes found in great numbers, either singly or in clusters, not in a sac. These vesicles are not confined to the splenic cells: I have also found them in the interior of the splenic veins, some floating loose, others attached by peduncles to the sides of the veins, and others again lodged between their coats. Cysts of a more complicated structure are likewise found in the spleen. I have seen one with a fibro-serous tunic, which contained in its interior a substance resembling suet interspersed with hairs. In another spleen I found a cyst composed of serous membrane filled with a substance like honey, and of a bright yellow colour."

Dr. Abercrombie (Dis. of Abd. p. 389) describes an infiltration of the substance of this viscus with a gelatinous fluid, and deposition of fatty matter, throughout its structure. It is distinguished by no particular symptoms.

The formation of hydatids in the spleen is irremediable in the present state of medicine. We cannot with any degree of certainty detect them during life until they become very bulky, or until some have been discharged. Almost all that is in our power is, to keep the system as nearly as possible to the healthy standard. If the cyst point, it will be unwise to puncture it, although this has been done in a very few instances with success. If it be resolved to puncture, a trochar must be used, not thicker than a common needle, and then only when the sac evidently adheres to the abdominal parietes. In opening the cyst there is a momentous risk of the contents flowing into the abdomen; and a second risk, of the suppuration of its internal parietes, with the usual fatal consequences of such an event; and, moreover, who will assure the operator that his trochar shall not wound some large vascular trunk in the sac?

Tubercles.—We occasionally find tubercles disseminated in the splenic tissue. They are in masses or grains, few in number or in great quantities. They are of the same nature as the pulmonary tubercle. We rarely meet with tubercles in the spleen, except in cases where they also exist in other organs. They very commonly attack this organ in children, in whom they are often found in a state of softening. This tuberculated condition of the spleen, which is met with in children, is certainly much under the control of iodine, continued long, and in small doses. It should be applied at the same time to the side in the form of a liniment. Of course, the same attention to food, clothing, air, and exercise, which is observed in strumous disease, must be paid here; and the medicines most beneficial in such a diathesis should be employed, if it become necessary to omit the iodine for a time.

Melanosis.—The spleen is occasionally affected with melanosis, as is seen in the accounts of this affection published by Cullen, Halliday, Alison, Carswell, and others.

Calculous deposits are seldom observed in the spleen. Bonetus (Sep. l. ii. s. iv. obs. 48) states that a widow had fever, pain in the back, suppression of urine, and then died dropsical. After death the spleen was found doubled up, as it were, and full of calculi. There was a square calculus in the right kidney. Morgagni (Ep. 36 a. 14) mentions two cases of splenic calculus in a woman and a youth. He says that they are sometimes very white; that they may be many or few. He saw one which weighed twenty-one drachms, and which was formed in concentric layers.

The treatment of melanosis and calculi of the spleen must be obviously palliative, and does not call for particular remark.

Rupture.—Numerous cases are to be found in Bonetus, Van Swieten, and the periodical pub-

lications of the present day, of rupture of the spleen by blows or falls. While the organ is lacerated extensively, the parietes of the abdomen may be little or not at all injured. In the instances which prove fatal in a few hours, the symptoms are great shiverings, coldness of body, vomiting, and other signs of extreme collapse. When there is time and strength for reaction, there is considerable fever, with a remarkable heat of skin, and great pain in the left side, or all over the abdomen; the stools and urine are nearly natural, for a short time at least.

In a case related by Mr. Greene (Med. Gaz. iii. 591), where the man had fallen from the third story of a house, the peritoneum was not inflamed, although much blood had flowed into the sac which it forms. The man lived four days. In the Archives de Médecine, vol. vi., there is an uncommon case reported by M. Deguise, where the splenic vein was ruptured by a blow on the left side, a month before death. The splenic vein had poured its blood into the abdomen. A remarkable example of spontaneous rupture is well detailed by Mr. Ancill in the Med. Chir. Review, vol. xiii. It occurred in a drunken blacksmith. There was immediate and extreme prostration of vital power, together with great sense of weight at the epigastrium. He died in sixteen hours. On dissection, an extensive black coagulum was perceived to occupy the upper part of the belly, and concealed the spleen. The substance of the latter was torn into large triangular fragments of bloody pulp, cemented together by a dark coagulum of a firmer consistence. A small round hole was observed in the dorsum of the organ. It adhered to the surrounding parts much more largely than usual, and seemed increased in size from effusion of blood. Scoutteten and others have noticed very truly that the redness of the parts round the ruptured spleen is not inflammation, but a stain from imbibition.

In the majority of instances of ruptured spleen from external violence, the injury is so overwhelming that little is left for the medical attendant to do. Free venesection and perfect rest, however, have saved life.

J. J. Bigsby.

[**Dislocation** *of the spleen, Splenectopia*, or removal of the spleen from its place, must be an uncommon occurrence, and when it does occur must give rise to phenomena that are by no means easy of comprehension. Few such cases are on record. One, of a highly interesting character, fell under the writer's notice, and has been described by him elsewhere. (*General Therapeutics*, p. 305, and *Practice of Medicine*, 2d. edit. i. 554, Philad. 1844.) In this case the spleen was found after death to have broken loose from its attachments, and was resting with its convex surface on the brim of the pelvis; the lower extremity of the organ being turned up so as to reach the lumbar region of the right side. It was suspended by its peritoneal and vascular attachments, and could be moved freely in every direction.

It need scarcely be said, that if dislocation of the spleen should be detected during life, no skill on the part of the practitioner can restore it permanently to its situation. That position must of course be selected for the patient, which gives occasion to the least inconvenience; this will probably be on the left side; but it can rarely happen that the dislocated organ does not speedily give rise to fatal inflammation of the peritoneum.

Robley Dunglison.]

STATISTICS, MEDICAL. *Vital Statistics.*—The word statistics is of modern origin; it was first invented in 1749 by Achenwall, a professor of Göttingen. Applied to political subjects, this term expresses the investigation and exposition of the actual condition of states and countries. It principally includes those particulars in the condition of a nation which are capable of being reduced to numerical calculation; but its domain is not necessarily confined within such limits. Medical statistics may, perhaps, be defined to be the application of numbers to illustrate the natural history of men in health and disease.

[A recent writer (Raige-Delorme, art. *Statistique Médicale*, in *Dict. de Méd.* xxviii. 549, Paris 1844) considers it to be "synonymous with *numerical method, and calculation of probabilities* applied to the systemization of medical facts," and so treats of it.]

We know too well how enormous is the quantity of facts which has been accumulated in every department of medicine during the last two thousand years; the most pressing want which our science at present suffers, is the reduction of this vast mass into separate groups, and the establishment of certain definite principles. The performance of this important task has occupied the attention of many eminent men; but they do not appear, until lately, to have sufficiently appreciated and employed the valuable instrument of statistical calculation. By the aid of numbers we are enabled to classify the irregular, and many-coloured, and conflicting observations which have been bequeathed to us by our predecessors, and which are daily presented to us by our contemporaries: instead of losing ourselves in a continual reference to opposite authorities, we compute the amount of evidence on both sides of a question, and thus arrive at a positive conclusion. It is probably only by the assistance of the statistical test that we shall finally arrive at fixed conclusions respecting the efficacy of various modes of treating a disease, and the prognosis to be formed respecting the issue of various diseases. It is only by means of this auxiliary that we can estimate the comparative salubrity of different situations and of different modes of life, and that we can justly decide on the value of various modes of discipline and of diet.

As the principle of population is intimately connected with all inquiries of this nature, we shall commence our brief outline with a few observations on that long-contested point; believing that it cannot be indifferent to the physiologist, and that the best solution of its difficulties must always be sought in the stores of medical science.

The majority of writers at present agree with Malthus in maintaining the proposition that *cæteris paribus*, a population will uniformly increase with the powers of subsistence, and diminish with their decrease. To prevent the sufferings from want and disease which would attend the struggles

of a population against those limits on its increase which arise from the want of food, it is generally allowed that we must endeavour gently to check an excessive increase by moral restraint, and by the occasional exercise of a prudential abstinence from marriage. Such a prudential restraint is only that which a young man of education and reflection usually imposes on himself; however desirous of forming an union, he patiently awaits the moment when he can accomplish his wishes without degrading the object of his choice from her former standard of comfort, or without entailing poverty on his offspring; and we find, accordingly, that marriages occur at a later age amongst those classes or individuals who are distinguished for intelligence, sobriety, and self-denial, than among the uneducated and the careless. But, on the other hand, every endeavour should be used, by those who have the means of influencing the movements of nations, *to increase the supply of food*. From the wonderful activity of the principle of population, we are bound to deduce the expediency, not of multiplying checks, which already press but too heavily, but of removing that obstacle which is most opposed to the multiplication of the species and to its happiness and health, namely, the difficulty of obtaining nourishment. It has been justly observed that, until the world is already fully peopled, and until all its fertile soils are cultivated, the problem would appear to be not how to diminish but how to disperse; not how to lessen the number of consumers, but how to increase the means of subsistence; not to keep out of life, by anticipation, the multitudes ready to inherit it, but to place them in the situations most advantageous for their reception, and, in short, most hospitable to the new comer. Perhaps too much has been assumed, in treating of these subjects, respecting the *fixed limits* of every nation. Such limits, however, do not exist generally, and wherever they are found, they are also capable of being removed by enterprise, courage, and industry. Such limits, assuredly, are not the lot of our own country, which includes in the bosom of its various colonies a sufficiency of practicable and unoccupied land to supply bread, under suitable efforts, to inhabitants far more numerous than our present list. Independently of the benefit which colonization confers on the father-land, it promotes the general diffusion of knowledge, of civilization, and of religion in the most eminent degree, and in the only sure and permanent mode: pestilential regions thus become purified, barbarous practices are discouraged, the arts of life are made to travel, the rugged aspect of nature assumes a smile, and a new climate is created in the wilderness where vegetation was extinct, and where life had almost gone out. It is true that the able-bodied emigrant has not always the means of transporting himself from the old and closely-packed country to the comparatively empty land of his adoption; but selfish indeed must be the wealthy inhabitants of the parent state, blind or reckless must be its legislature, dull must be the prophetic spirit of all, if the funds which are ever at hand to gratify ostentation cannot also be supplied to remove the idle, the miserable, too often and too inevitably the criminal, from a theatre in which they are only sullen, ungratified, and unplaced spectators, to a new and ample stage, where they themselves will be enabled to act, and to reap the profits and the honour of their exertions.

Misery is one of the most powerful agents which operates in restraining the excessive growth of population. How far this scourge is capable of being permanently diminished by the wisdom of a legislature and the virtue of private citizens is a matter on which benevolence will always entertain a secret hope of better days, although we have no assurance that in *this* world the reign of great calamities is ever to be at an end. *Famine* is one branch of misery which is, perhaps, least under the control of human precautions; but *war*, the most terrible of all evils, is undoubtedly often induced by the vices of individuals. How frequently, to gratify selfish and grasping ambition, has this consuming fire been kindled to ravage whole districts, to extinguish villages, to destroy thousands of beings totally uninterested in the results, and to bring in its ghastly train both scarcity of food and epidemic diseases, scarcely less fatal than the sword? Unhappily in no age have such enemies of mankind been wanting; and too blindly have historians and poets offered their incense on the altar of blood. How often, if not to serve the views of an individual, at least to promote the designs of some political party, has a war taken its origin, and gradually extended itself over distant nations! War is the real parent of famine and of the most deadly diseases. The most severe epidemic fevers which have ever visited Europe have marched in the van of an invading army, or in the rear of a retreating one.

The price of *corn* has a most remarkable influence on the movements of population and of disease: we have not a sufficient number of data to enable us to estimate the exact amount of its influence, but we shall assuredly not be mistaken in classing it among the most energetic causes which press on the operations of life. This influence extends not only upon deaths but upon births; it affects also the number of marriages, of diseases, and even of crimes. Variations in the price of corn, then, form one of the most serious changes which can occur on the surface of a state; they may insensibly lead to the most unexpected, the most formidable results; and we may affirm with confidence, that one of the most important duties of a government is to temper and to diminish, as far as is possible, all the circumstances which promote these fluctuations in the price of the most necessary article of all which man can purchase.

The causes which tend to produce *longevity* have been repeatedly the subject of controversy; we shall present a few facts towards the illustration of this difficult subject.

The married live usually longer than the single, and it is amongst the married that the greatest instances of longevity have been found. The inhabitants of convents and of monasteries, in spite of the regularity of their habits, do not live longer than men of the world: De Parcieux and an old curate of St. Sulpice have produced tables which show that but few of these individuals attained the age of eighty, during the interval of years which elapsed between the years 1685 and 1745. But monks and nuns are not so long-lived as the

religious orders which are not immured within the gloom of the cloister; and, finally, we may observe, in order to point out the injurious tendency of that mode of life, that celibacy in the lay-classes enjoys a better chance of life than is the portion of the inhabitants of the monastery and the convent.

An abundant supply of the necessaries and even of the luxuries of life has a powerful agency in inducing longevity; and if we add to an easy condition of life the more rare gift of a tranquil mind, we shall have enumerated the two circumstances which are best calculated to ensure it.

Cultivation of the sciences and of literature is not a little favourable to longevity: we might produce many facts in support of this assertion. Such pursuits are well suited to compose, to calm, and to fortify the mind, and hence to form the quietude of soul which is a real elixir of long life.

The instances of *extreme* longevity are very rare, and form lonely exceptions to the established order of things; insomuch that an individual could scarcely be suspected to be in possession of common sense or information who should hope by any modes of diet, or any advantage of constitution, to exceed the age of 100. The most authentic examples of those who have far outstripped a century of years are afforded by the famous Parr, who married at the age of 120, retained his vigour till 140, and died at the age of 152, from a plethora, induced, it is stated, by a change of diet. Harvey, the illustrious discoverer of the circulation of the blood, who dissected him, could detect no signs of decay in any organ. Henry Jenkins, who died in Yorkshire in 1670, exceeded Parr, and attained 169 years. He is probably the oldest man on genuine record in modern times. The latest case is that of Joseph Sarrington, a Norwegian, who died at Bergen in 1797, at the age of 160.

Haller, whose accuracy and industry are well known, collected together the most authentic facts recorded in his time respecting the duration of the life of man, and found the following to be the relative proportions:—

Of men who have lived from 100 to 110 years, the instances have been	.....	1000
From 110 to 120	"	60
" 120 to 130	"	29
" 130 to 140	"	15
" 140 to 150	"	6
169	"	1

An American writer has lately expressed his belief that between 30,000 and 40,000 persons annually fall victims to the abuse of spirituous liquors throughout the United States. This belief is founded on the Bills of Mortality of the city of Boston, which, during the last two years, have reported an average of fifty deaths yearly, as proceeding from this source. Professor Hitchcock of Amherst College, in his Lectures on Dietetics, has lately estimated at from 30,000 to 50,000 the annual number of those who die prematurely, above twenty years of age, in consequence of such intemperance. These estimates are probably beyond the real amount of the mischief, extensive and revolting as it unquestionably is. On the amount of deaths produced by the *indirect* action of ardent spirits our evidence must always remain defective, because there is not a disease so induced which might not also admit of another cause, and here is an insurmountable perplexity.

[These observations are taken from an article by the writer in the *American Quarterly Review*, for Dec. 1830. The American writer, referred to above, affirms that the fifty deaths in the city of Boston, are "occasioned so directly by intemperance as to be entered under names of disease to which none but drunkards fall victims;" and supposing, he adds, "that on an average throughout our country, the deaths from intemperance bear about the same proportion to the whole number as they do in Boston, the *direct* victims to the use of ardent spirits in the United States may be estimated at 10,000 annually." (*American Almanac* for 1830.) The names of disease are not given; allusion is, however, doubtless made to mania a potû or delirium tremens; but it appears scarcely within the verge of possibility that 10,000 persons should die annually in the United States from delirium tremens, which is not a very fatal affection. Of 84 cases, treated during the years 1840–1841, in the women's lunatic asylum of the Philadelphia Hospital, which is under the writer's charge for six months of the year, but one died; and that one under particular circumstances. (*Human Health*, p. 306, Philad. 1844.)]

Mortality, or the calculation of the number of deaths which occur in a country or town, has become an object of important research; and tables are formed in almost every civilized state, by direction of the government, in order to ascertain this point. In some districts this amount is increased or diminished in a slight degree by direct and by local causes; but, on the whole, it appears that the good or bad condition of a people, the possession of the necessaries of life or their absence — the mildness or rigour of the mode of government—the advance or retrogression in knowledge — are the principal circumstances which influence the result. The following calculation of the annual number of deaths in the principal countries of Europe will give a sufficiently exact idea. Among all their inhabitants every year destroys, in

England and Wales, nearly	1 in 60
Pays de Vaud	1 " 49
Sweden	1 " 48
Holland	1 " 48
France	1 " 40
Kingdom of Naples	1 " 35
" " Wirtemberg	1 " 33
Prussia	1 " 33
Lombards—Venetian provinces	1 " 28*

This is the present proportion, but in several of these countries the number of deaths was formerly much more numerous. The mortality has diminished in nearly the same degree in which their prosperity has gradually increased. In England and Wales, for instance, the annual deaths were, in the census of 1780, so numerous as 1 in 40. In 1831 they were 1 in 47. So in France the annual mortality was, in the year 1781, 1 in 29, and in 1802 1 in 30. In Sweden, also, the annual deaths were 1 in 35, during the years between 1755 and 1785.

* In 1817, a year of scarcity, the number of deaths was so large as 1 in 14.

The mortality of large towns exceeds considerably that of small ones: the following table presents an approximation to the comparative mortality of great towns:—

In London, about	1 in	40 dies annually.
Birmingham	1 "	43
Nice	1 "	31
Naples	1 "	28
Leghorn	1 "	35
Paris	1 "	32
Lyons	1 "	32
Strasburg	1 "	32
Barcelona	1 "	32
Berlin	1 "	34
Madrid	1 "	29
Rome	1 "	25
Amsterdam	1 "	24
Vienna	1 "	22½

The late census of 1832 has not, as yet, been sufficiently examined to admit of any accurate inference, but we believe that it is rather less favourable to England than the preceding one.

[From the *Fourth Annual Report of the Registrar-General of Births, Deaths and Marriages, in England*, (London, 1842,) the mean mortality in four years is shown to have been 1 in 45.]

The deaths in a city are almost uniformly more numerous than those in a rural district. It is unnecessary in this place to inquire into the causes of this difference; they will readily occur to medical observers. Cities are the theatres on which the violent passions find their appropriate scene; in them the desperate struggles of life are decided; and they afford the most constant temptation to an excessive indulgence of every appetite. The atmosphere, the scanty exercise, the irregular hours, all add to the depressing influence of civic life; but still there are many individuals who habituate their constitutions with safety to a constant residence in towns, and attain a great age. These are beings cast in a happy mould, who are equally well placed in almost any situation, and flourish under every exposure. Children endure a town life less easily than adults; and, in general, those who are on the eve of sickness, or who have just recovered from it, begin to perceive the injurious effect of the confined air of cities, although they may have never been previously aware of it when in a state of health. As long as the patient remains in this situation, we often perceive that tonic remedies disappoint us of their expected results.

[The great attention which has been paid, of late years, to the influence of occupation and customs on human health, and more especially on the health of operatives, has thrown much light on this subject. (See ARTISANS, DISEASES OF.) The admirable Sanitary Reports presented to the British Parliament by Mr. Chadwick, and the inquiries of Messrs. Ure, Villerme, Noble and others, sufficiently show, that no peculiar evils to health and life attach necessarily to manufacturing pursuits; that, in so far as factories, and other corresponding places of labour, interfere with the right conditions of health, they lead, of course, to the production of disease, and to the shortening of life; but that these evils appertain rather to their *domestic* than to their *industrial* relations (*Brit. & For. Med. Rev.* April, 1843, p. 313.) A reference to the following table, from Mr. Chadwick, (*Sanitary Report*, p. 159, Lond. 1842,) of the mean annual mortality of females in twelve metropolitan districts, demonstrates, that difference of mortality is dependent rather upon locality, inasmuch as the greatest mortality prevails in certain places where no factories exist.

Districts.	Annual Deaths, 1 in
Hackney	57.87
St. George, Hanover Square	57.05
Camberwell	55.34
Islington	50.03
Rotherhithe	38.58
Clerkenwell	38.54
St. Luke	38.49
Greenwich	38.42
St. George, Southwark	33.77
East and West London	33.50
St. Giles and St. George	33.46
Whitechapel	28.15]

The number of deaths which occur at *hospitals* is very various, and yet admits of being explained on some general principles. The deaths in a large hospital are usually more numerous than in a small one; they are also more numerous in the hospital of a great city than in the hospital of a small town. The mortality of hospitals is always greater than that of the same number of cases taken from the same ranks of life in private dwellings, because the separation from the familiar scenes of home and from beloved faces is not compensated by the superior cleanliness and more abundant comforts of an hospital. It will be usually found that the number of deaths in hospitals bears a very near proportion to the state of prosperity and to the diffusion of knowledge in any given country or town. On sifting the reports of the hospitals of the continent, it will be usually found that their mortality is greater than that which is presented by the registers of British hospitals. Amongst other causes of this difference must be assigned the disinclination which has long prevailed on the continent towards the use of copious bloodletting in inflammations. Defective ventilation is one of the most common causes of an excess in the deaths of an hospital. The mortality in dispensaries is much less considerable than in hospitals.

A gratifying result, on the whole, presents itself to us in this section of medical statistics; the number of deaths in hospitals has greatly diminished throughout Europe during the last half century, and particularly in our own country.

It has been lately calculated that the number of the *deaf and dumb* is about 1 in every 1585 individuals. According to this computation, France has about 20,189 deaf and dumb; Austria has 16,684; and Russia in Europe has 27,834. Supposing, then, that Europe contains 214 millions of inhabitants, it will also probably contain 139,212 deaf and dumb individuals.

[According to the census of the United States for 1840, the proportion of deaf and dumb amongst the whites was 1 in 2123; amongst the coloured, 1 in 2933. (Prof. G. Tucker, *Progress of the United States in Population and Wealth in Fifty Years*. New York, 1843.)]

According to a computation recently made at

the Institution for the Deaf and Dumb at Paris, it would appear that only one in twenty-four of those unfortunate beings receives an education throughout the world at large: but that, in France, so many as one in four of them obtains a suitable course of instruction.

Suicide is a theme unfortunately very prolific of examples and of tables in almost all parts of Europe. But the number of its victims is very various in different places. England certainly no longer deserves the pre-eminent disposition to this crime which the conjectures of her neighbours formerly assigned to her. In France, Germany, and Denmark, suicide is extremely frequent; in England it is less common, but far from rare; in Sweden, in the Neapolitan dominions, in Russia, and, above all, in Spain, it occurs only in a scanty proportion. It is far more common in great towns than in small ones; far more frequent in towns than in rural districts; and its victims are more often single than married, more often males than females. It is impossible any longer to ascribe its prevalence to *climate*, or to the weather. We may trace it occasionally to two obscure causes, one of which is the principle of imitation; the other is an hereditary disposition. On the whole, it appears to occur more frequently among the lower classes of life than in the middle or higher stations.

According to the registers preserved in France, and recently analyzed by Mr. Guerry, about 1800 suicides take place in a year in all France; 6900 have been committed between the years 1827 and 1830. Mr. Guerry believes, however, that this number is considerably inferior to the total number of *attempts*; because the judicial authorities only take cognizance of those which terminate in death, or which furnish materials for a process. The nearer each department of France is to the capital, the more abundant are its suicides and its murders; the more distant each department is from the capital, the less frequent are both the one and the other. Thus, in the department of the Seine, which contains Paris, the annual proportion of suicides is one to every 3600 inhabitants; while in the province of the Haute Loire, the annual proportion is only 1 in 163,000 inhabitants. These two departments furnish the maximum and the minimum of suicide in France.

It would lead us too far, if we were here to enter into the interesting details which relate to the *increase* and *decrease* of particular diseases, and into the *comparative prevalence* of disease in different countries. We can only remark, generally, that the results of the inquiry are greatly in favour of our own time and country.

The statistics of the *sexes*, of *marriage*, of *pregnancy*, and of *infant life*, afford the most important information, alone sufficient to fill a volume. The proportion of males to females [born] throughout the world is about 21 of the former to 20 of the latter. The proportion of births to a marriage fluctuates in different countries: in England it is about 4 births to a marriage. At Paris the proportion is scarcely 2·44 births to a marriage, while in some villages of Scotland it is so high as 7. A most remarkable change has occurred gradually in the fate of lying-in women and of infants. In 1750, at the British Lying-in Hospital of London, 1 woman died out of 42, and 1 child out of 15; about the year 1800, in the same hospital, only 1 woman died out of 288, and only 1 child out of 77. In Prussia, 1 mother dies annually out of 112, taking hospitals and private life altogether. The deaths at lying-in hospitals are far more numerous than those which occur among the same class of women at their own dwellings. The deaths from parturition are far more numerous in great towns than in the country. [See, on all these subjects, the excellent work of Quetelet, *Sur l'Homme;* and especially the translation, Edinb. 1842: also, the writer's *Human Physiology*, 5th ed. p. 433, Philad. 1844.]

The subject of *life assurance* ought to be glanced at in this article, because it is almost entirely founded on the facts afforded by medical statistics. And as medical practitioners are very frequently applied to respecting the assurance of lives, it may perhaps be useful to supply the student with some elementary notions, or with an outline which may be easily filled up at leisure by a reference to the labours of Price, Milne, Quetelet, Babbage, and Finlayson.

Nothing is more subject to uncertainty than the duration of the life of a single individual; and a conviction of the frailty of this tenure has laid the foundations of institutions for the assurance of lives. One of the most encouraging signs which a nation can afford of the prudence, economy, and kind affections of its inhabitants, is the growth and popularity of such establishments, because they evince that the individual is content to sacrifice some present enjoyments in order to lay up a little store for some being or beings who are to survive him; and that selfishness is with him a secondary consideration to prospective benevolence. Annuities upon lives are an operation conducted in a spirit totally opposite; although often extremely eligible and suitable, they provide rather for the present than for the future, and it is a good feature in the times when the demands for life assurances are more numerous than for life annuities. It was remarked in France, shortly before its first revolution, that a prodigious number of citizens were eager to obtain life annuities, and thus to convert their capital into an increase of present indulgences for themselves, but to extinguish any benefits which might otherwise have streamed from it to fertilize some kindred soil.

Assurances on lives have no analogy whatever with the speculations of gamesters, since their object is to equalize chances, and not to disproportion the risk; they fix the monied relations of large bodies of society on a basis quite unconnected with the hazard of individuals. In order that this desirable object may be accomplished with advantage to all parties concerned, it becomes absolutely requisite to ascertain the average number, or proportion of persons, out of a numerous population, who die at the different periods of life; or, in other words, we must know the law of mortality (as it is called) which belongs to every age of existence. Nothing appears more difficult, at first sight, than the construction of such a law; but the progressive labours of mathematicians, political economists, and physicians, in different countries, have gradually produced an abundant collection of facts on which to ground

the principles of a science which is entirely the offspring of modern times, and more particularly of our own country.

We shall not enumerate here the various tables of the duration of life which have been founded on observations made in different places; nor shall we do more than allude to that remarkable improvement in the tenure of life which has rendered some of the older calculations obsolete.

But since medical men are universally consulted before assurances of this kind can be effected, it is perhaps not superfluous to explain the nature and process of the transaction. An assurance on life, then, is the assurance of a certain sum which is to be paid in the case that an individual named is alive at a particular time, or dies within a particular time; or which is to be paid within a particular time after the death of an individual named, at whatsoever time that death may occur. The *assurer* is the party who undertakes to pay this sum, and the *premium* of assurance is the sum which he obtains as a recompense for that which he is to pay. The *policy* of assurance is the document or instrument by which the party is obliged to the assured sum. This policy is called *absolute*, when the assured sum is to be paid on the death of an assured party; and it is said to be *contingent* when the payment of this sum is made to depend upon some other circumstance, as, for instance, the existence or the previous death of some other individual or individuals. The premium of assurance is in some cases a sum paid down all at once; but the more usual method is to pay down a certain sum on the day on which the engagement is completed, and to enter into an obligation to pay the same sum yearly, so long as the policy continues in force.

When a party wishes to accomplish an assurance, he receives, from the particular assurance-office to which he applies, a paper called a *declaration*, which he fills up with the name, the age, the time and the place of birth, the actual residence, and some details respecting the health of the individual to be assured. This declaration includes a notice to this very important effect,—namely, that any falsehood introduced into the declaration invalidates or vitiates the policy. The declaration is then properly signed; and in order to confirm the statement, references are afforded to two persons, who must be familiar with the habits of the party on whom the assurance is effected; one of these two is a medical practitioner, and in some instances more than two references are demanded. The individual who makes the assurance next appears in the presence of the directors of the company, who endeavour to ascertain his ordinary and actual condition of health, and introduce a memorandum of the result into their journals. The directors ultimately decide upon the case according to the answers which are obtained from the persons to whom reference has been made, and occasionally from other additional sources of information. If the individual on whose life the assurance is to be effected, is unable to make his appearance in the presence of the directors, or of any person delegated by the directors, an additional payment is demanded in lieu of personal appearance.

Life-assurance offices usually employ a stationary medical adviser, who assists the directors with his judgment respecting the health of the applicant, and with his advice on the evidence submitted.

The questions contained in the circulars which are transmitted by the life-assurance offices to the medical attendants of the applicant are various in form, but nearly similar in import, at all the various establishments. The spirit of these queries may be conveyed in a few words:—How long have you known ——? When did you last see ——? State of health at that time? General state of health? Have you had occasion to know, or to hear, that the applicant is subject to fits, diseases of the lungs, scrofula, insanity, gout, or to any hereditary disorder? Are his habits sober? Is there any circumstance connected with his health, within your knowledge, with which the directors ought to be acquainted?

The questions addressed to the medical friend of the party require, it will be seen, considerable caution in the answer; any suppression of facts, whether intentional or accidental, may in the end render the whole transaction nugatory, or, in other words, may vitiate the policy. These queries refer both to the past and present state of the health of the party, and to his predisposition to disease, either hereditary or acquired. A medical practitioner, placed in intimate relation with the party, may feel a desire to soften certain circumstances, through a natural impulse of friendship; but, in reality, this undue delicacy may prove an ultimate injury to the person whom he intends to serve, and is totally unjustifiable in every sense. His report will be confidential: the motives for rejecting an application will not transpire; and a debt is to be discharged not only to our own conscience, but equally to our friend and to the community at large, because a transaction so beneficial to all parties can only continue to be carried on through the medium of frankness and of good faith.

We might illustrate the practical bearings of this subject more clearly by selecting some of the most important trials which have occurred in consequence of errors in the statement of health; but we should trespass too largely on the space which is more necessarily allotted to practical medicine. It will be sufficient to have pointed out the necessity of caution and the sources of information.

We have been obliged to treat the whole of this article in a cursory manner, and entirely to omit the consideration of several topics belonging to it. There is one general principle, however, which unites together every branch of it, and which, if properly considered, will supply our omissions, and lead the reader to the collection of new materials for reflection and generalization. Life and death, then, mainly depend on the *prosperity* of the circumstances which surround us; physical prosperity and moral happiness, which often depend and re-act upon each other, present a safeguard at every crisis of existence both to individuals and to nations. We may often judge with tolerable accuracy of the mortality which is likely to exist in any given country, town, or hospital, from the degree in which poverty or wealth, knowledge or ignorance, misfortune or success, are seen to prevail. Whenever *want* and *misery* exist, there the mother is more likely to

die in labour, there still-births will be more frequent, there the deaths during infancy will be more numerous, there epidemics will rage more violently, there the recoveries from disease will be more tedious, and the fatal termination of it more probable, and there also will death usually approach at an earlier period of life than in happier situations.

This important conclusion deserves the highest attention, and a variety of considerations flow from it which we cannot here follow in their windings. It is a state of things highly instrumental towards the improvement of our social state. It encourages us to improve our physical and moral frame to the utmost of our power, in order that we may reap the harvest of life which only awaits those who can succeed, to a certain degree, in elevating themselves above want and ignorance. It is a distribution of health and disease, of life and of death, entirely analogous with the state of trial in which we are here placed.

It would be endless to enumerate the works which furnish the materials for this subject, or rather for the illustration of various parts of it. To those who are desirous of prosecuting it we may recommend—*Bérard*, Discours sur les Améliorations Progressives de la Santé Publique, *Paris*, 1826. *Blane*, Select Dissertations. *Tommasini*, della Necessita di sottopere ad una Statistica i Fatti piu importanti della Medicina Pratica, *Bologna*, 1821. *Casper*, Beiträge zur medicinischen Statistik, *Berlin*, 1825. Roberton, Observations on the Mortality and Physical Management of Children. *Quetelet*, Recherches sur la Population, les Naissances, &c. *Bruxelles*, [Sur l'Homme, &c.] *Malthus*, Essay on the Principle of Population: and last, but not least, we may direct the reader's attention to innumerable reviews and essays of great value, which Dr. Villermé of Paris has contributed to the *Geographical Section* of the *Bulletin Universel* (now extinct), and to the excellent *Annales d'Hygiène*.

BISSET HAWKINS.

[Highly valuable information has been afforded by recent medical statisticians, some of whose works have already been referred to,—for example, the various *Reports of the Registrar-General of Births, Deaths, and Marriages in England*, and the remarks of Mr. W. Farr contained therein; the Reports of Mr. Chadwick *On the Sanitary Condition of the Labouring Population of Great Britain;* the papers of Dr. Gouverneur Emerson in the *American Journal of the Medical Sciences;* and the *Journal of the Statistical Society of London;* the article on the vital statistics of Boston, in the *American Journal of the Medical Sciences*, for April 1844, by Mr. L. Shattuck, &c. &c.

The term *medical statistics*—as before remarked—is now often used synonymously with *numerical method* and the *calculation of probabilities*, applied to medicine. Originally statistics meant the science of states—from the German *staat;* but by an extension of signification, which is not uncommon, that which was originally applied to states, came to mean any collection of observed facts of the same order, and was subsequently extended to comprise, as at the present day, numerical methods or numbers employed for the elucidation of any of the sciences of observation; so that the term medical statistics is now as well understood as medical jurisprudence. The employment of numbers as a means of comparison is by no means new; yet in consequence of the word statistics being of modern origin, it has been supposed by many that numerical methods were unknown until recent periods. They have long been used in other branches of science; and as a late writer (*Brit. & For. Med. Rev.*, July 1841,) has remarked, "their non-employment in medicine until a recent period proves, that medicine has profited little by the example of the more perfect sciences, and gives us good ground to hope, that improved methods of investigation may do much to retrieve its character, confer upon it a greater degree of certainty, and enlarge the sphere of its practical usefulness."

Impressed with the imperfect modes of observation that had previously existed, and were existing, M. Louis proposed to introduce as far as possible, the same mode of exact estimation as had been practised in chemistry for example. "Doubtless" he observes, "this department of learning had many learned men among its votaries previous to the last forty years; nevertheless, it is only within this last period that chemistry has made rapid progress. What means has it employed of late, which were not used before? It has demanded exactness; it has weighed and counted always when it was able to do so; it has taken rigid notice of every thing which had any bearing upon a question; it has substituted a strict analysis for an imperfect and careless one; its methods have become daily more and more precise, and its progress is rapid and constant. The same cause which kept chemistry so long in its infancy—viz. the want of rigid method—has weighed upon the destiny of medicine, and prevented its growth." (in *Mémoires de la Société Med. d'Observation de Paris*, tom. i., art. i., Paris, 1837: or translation of the same by Dr. Bowditch, in Dunglison's *Amer. Med. Library* for 1838.)

Much has been written against the practicability of employing numbers or of *counting* in medicine, notwithstanding the valuable information that has been afforded for ages on the laws that govern the movement of the population; the calculation of probabilities in regard to the average duration of life, as a guide to the insurance of lives, &c. &c. The nearest approximation to the truth in regard to facts or observed phenomena must obviously be deduced in this manner. It is the only accurate mode in which averages can be taken. Every practitioner, in all periods of history, has endeavoured to carry in his recollection the precise difference which he notices from day to day in the condition of his patients; but this must be far inferior to the record which he daily makes approximately by numbers, from which he can deduce his averages. Averages and numerical methods can in no case, however, afford more than an approximation to the truth; yet the approximation is closer than can be attained in any other manner. The history of disease has, indeed, benefited materially from them; and many of the results arrived at may be regarded as certain as the subjects above mentioned, which have received much elucidation from statistical inquiries. "Averages," as a recent medical writer has observed,

"may in some sort be termed the mathematics of medical science. The principal is one singularly effectual in obviating the difficulties of evidence already noticed; and the success with which it has been employed of late by many eminent observers, affords assurance of the results that may hereafter be expected from this source. Through medical statistics lies the most secure path into the philosophy of medicine." (*H. Holland, Medical Notes and Reflections*, Amer. edit., Philad. 1839.)

It need scarcely be said, that facts must be accurately observed before they can be made the basis of calculations; imperfect observation must be regarded as one of the main causes of the imperfection of medical science; — another and a not less important cause being the mode of making analyses which are incomplete or dependent upon facts entrusted to the memory. (Louis, *op. cit.*) It is clear, too, that any average deduced from a small number of observations may lead us into error. The tables of insurance of lives formed upon the observation of one or two years would certainly be fallacious; whilst we know that those formed from the calculation of a long series of years lead to satisfactory results.

Observed phenomena in disease furnish more certain facts for the numerical method than the apparent and often perhaps real results of therapeutical agencies. Therapeutics is confessedly the most difficult of all the departments of medical science, because in it is concentred a knowledge of every other; and it requires not simply observation, but the constant exercise of reason to rectify the erroneous impressions which imperfect observation or the apparent evidence of the senses often engenders. A glance at the history of medicine shows, that it has suffered more from faulty observation—false facts—than from false theories; for, after all, most of the theories have been based upon fancied observation.

A just appreciation of the effects of therapeutical agents, and the determination of their action, whatever that may be, are properly regarded by M. Louis as the most important, and doubtless the most difficult part of the method of observing. So many circumstances have, indeed, to be borne in mind in the estimate, that the inquiry has appeared to some to transcend the powers of the human mind. "We must compare together," says M. Louis, (*op. cit.*) "a great number of cases of the same disease of equal severity, some relating to subjects in whom the disease was left to itself; others of individuals to whom certain medicines were given. After doing this, we must study the action of the same therapeutical agent on those in whom the disease was severe, and on those in whom it was slight,—on those in whom the remedy has been used in large or small doses, at a period near to, or remote from, the commencement of the disease. This last circumstance is very important. So likewise we must mention whether the medicine is used alone or in conjunction with other remedies. But not only does this method require much labour; it also supposes a considerable series of facts, the connection of which is difficult, especially when treating severe affections in which we are accustomed to frequently make new attempts, and which will not allow of our remaining a mere spectator of the progress of the disease. For it must be evident, that we do not seek to know by approximation what remedies have *appeared* to be more or less successful, but to demonstrate in a rigorous manner, that a certain remedy, or certain method is useful or hurtful, and in different degrees, according to the manner in which we employ it."

The necessity for such repeated observations for any accurate estimate of therapeutical agencies has been appreciated by every able medical statistician. Even M. Louis himself has been censured by M. Gavarret, (*Principes Généraux de Statistique Médicale, ou Développement des règles qui doivent présider à son emploi*, Paris, 1840,) for having pronounced as to the limited efficacy of bleeding in pneumonia, erysipelas of the face, and cynanche tonsillaris, on the strength of one hundred cases of the first disease, forty-four of the second, and twenty-three of the third; and he lays it down as an undoubted principle, that every statistical inquiry, in order to furnish admissible indications, ought to consist of many hundreds of observations. Were this indispensable, it is obvious that it would be impracticable to arrive at any satisfactory knowledge in regard to the effect of remedies; for amidst the numerous shades of difference in the manifestations of disease, (some of which only have been enumerated above,) it would be difficult, if not impossible, from hundreds of cases of the same malady, to find a dozen that are circumstanced exactly alike; and that would consequently admit of unquestioned therapeutical deductions. The observations of M. Gavarret apply to cases, in which the calculation of the influence of multitudes of extrinsic and intrinsic causes are associated in producing the result; not to phenomena in health and disease, which require merely that the observations, without being very numerous, shall be frequently repeated. Hence, in part, why diagnosis is so much more easy, and so much more attended to and more capable of being appreciated—counted,—than therapeutics, which, notwithstanding, is the final object of the science of medicine;—the goal of every practitioner. As a matter of scientific knowledge it might be well to understand disease, even if we did not attempt to cure it; but as practising physicians and philanthropists, the alleviation and cure of disease is the grand desideratum. Yet it has been lamentable to witness the almost exclusive attention which has been paid by many of late years to diagnosis. In hospitals especially, the main object of the attending physician has too often appeared to be to discover the precise disease; and the treatment has been left to the *élève interne* or resident physician; — the former priding himself on his skill and attention to the *science*, whilst he leaves to the latter what he considers the *art*. Hæmatology has been attended to in the same manner. Blood has been drawn in disease, in order to detect, by the nicest evaluation, the ratio of its main constituents; and after this has been determined, but little care, in too many cases, has been paid to treatment.

The difference between the results afforded by statistics as applied to the establishment of the history and of the treatment of disease is well shown by many of the monographs on individual diseases that have emanated from the medical statisticians, from

those who rank themselves amongst the disciples of the numerical school. Take, for instance, typhoid fever, so well analysed by M. Louis and others. For the history, medical statistics has furnished us with most valuable information; for the treatment, we have little more than a detail of the methods of observers—often most discordant—nay, at times, diametrically opposed to each other.

This difference between the results of the numerical investigation of histories of disease and of therapeutical agencies must, we apprehend, continue. It may be lessened, but never perhaps removed. An accurate appreciation of facts—of numerous well observed facts—is essential to both; but it can never, it is to be feared, be rendered extensively available for the latter. A knowledge of the healthy and diseased functions derived from careful observation, and of the ordinary effects of therapeutical agents on those functions, obtained by careful and repeated observation, must be the basis of that enlightened theory, which necessarily leads to enlightened practice; and much mischief would result to both were we to discard all rational therapeutics, and restrict ourselves to mere observation. The complex functions executed by man are so modified by multitudinous external and internal influences that are inappreciable; so much agency is perpetually exerted by the *moral* over the *physique*, that no comparable facts can be obtained in sufficient numbers to permit of any accurate numerical deduction; and, accordingly, we must either treat disease in accordance with principles suggested by conjoined observation and reason; experiment for ourselves *ab initio;* or resign our faith to the asserted observation and experience of others; and of these which of the *legion* shall we select as masters?

ROBLEY DUNGLISON.]

STERILITY. (See IMPOTENCE.)

STETHOSCOPE, from στῆθος, *pectus*, and σκοπέω, *exploro, contemplor*,) is the name of an instrument invented by the late M. Laennec, to assist the ear in examining the acoustic signs of various diseases, especially of those of the chest.

The use and indications of the stethoscope have been so fully explained in the article AUSCULTATION, that it remains for us here only to study the stethoscope as an instrument, and the physical principles of its adaptation to the object to which it is applied. When we bring to the aid of our senses artificial instruments, we can neither perfect their construction nor fully avail ourselves of their uses, without a knowledge of the laws by which they assist our organs. No one can satisfactorily use the microscope or telescope without understanding the laws of optics; and we hold that the easiest, the most agreeable, and the surest road to a knowledge of stethoscopic phenomena, is through a study of acoustics. It was by a happy application of a general law that Laennec was led to the discovery of this instrument, and he never could have enriched his description of its use with such a number of interesting and valuable facts, if his experience had not been guided by a familiar knowledge of natural philosophy.

The first instrument used by Laennec was formed of three quires of paper, compactly rolled into a cylinder, and kept in that shape by means of paste. He afterwards tried various other materials, and found a cylinder of wood, with certain modifications, answer better than any other. He found denser bodies, such as glass and metal, less effectual; and a cylinder of gold-beater's skin, inflated with air, proved inferior to all the others. It will be found that these facts are in perfect accordance with principles which we can only glance at here; and that the superiority of bodies of moderate density, such as light firm wood, although opposed by what Laennec considered to be an axiom in physics, is really an illustration of an acoustic law, which has never, as far as we know, been accurately exposed.

The power of bodies to conduct sound varies according to the density of the medium in which the sound is generated—those bodies being the best conductors which correspond in density with the body communicating the sound. Thus the sounds produced by the vibration of air are best conveyed by air; and those of solids, by a rigid solid of similar density. On the other hand, air with difficulty receives the sonorous vibrations of very dense bodies; and the latter, in great measure, intercept the sounds of air; but rigid bodies of intermediate density will greatly facilitate the transmission of sound between these dissimilar media. Two examples will suffice to illustrate this principle. The common pitch-bar or tuning-fork, when struck, yields very little sound as long as it is held in the fingers, or placed in contact with metal only; but as soon as it touches a table, or especially a sounding-board, its sound becomes distinct and clear.* Again, a metal or even a glass partition between two rooms, much more effectually prevents the transmission of sound from one to the other than a partition of wood, even of greater thickness.

In acoustic instruments, we avail ourselves of the conducting power of similar bodies, and the reflecting quality of dissimilar substances, to direct sound into any particular channel. It is with regard to these principles, in the first place, and with a certain respect to portability and convenience, that the best stethoscopes are constructed. As the sounds which they have to transmit to the ear are various in origin and intensity, so these instruments have modifications in their make, which, with a view to avoid the multiplication of apparatus, were contrived by Laennec in a single instrument of convenient portability. Thus to convey the sounds originating in the denser contents of the chest, such as the heart, a cylinder of light but rigid wood, as free as possible from knots and inequalities, answers perfectly. To transmit the sounds produced in the more aerial contents of the chest, this cylinder is perforated longitudinally, so as to contain a column of air, which being perfectly closed from external communication by the ear at one end, and the chest of the patient at the other, readily conducts the sounds of the voice, or of the respiration, produced in the spot which the aperture covers. To concentrate the diffused sound of respiration, and

* Many other illustrations might be adduced; and we believe that the long sought-for explanation of the principle of sounding-boards of musical instruments is to be found in the same law.

to expedite the examination by making the stethoscope take in as large an extent of surface at a time as possible, the cylinder is hollowed out at the pectoral end into a conical cavity, the apex of which terminates in the central canal; so that all the sounds that enter the excavated end are reflected through this canal into the ear. To reconvert this into a simply perforated cylinder for the uses before mentioned, a perforated plug or stopper is adapted, of size and form exactly filling the conical excavation. The instrument last recommended by Laennec was a cylinder of walnut, a foot long and an inch and a half in diameter, with the longitudinal perforation three lines in diameter, and the excavation and stopper of a parabolic form, with a metallic tube to fix the latter into the central bore. For the sake of portability, and to render it applicable in a shorter form, the instrument is divided in the middle, with an excavation into which the stopper can be fitted as at the other end. We have found reasons, in both principle and practice, to prefer a conical to a parabolic cavity; and we would recommend, as the best and most easily used stethoscope, a cylinder of cedar nine inches long, of the diameter and bore prescribed by Laennec, with a conical excavation tapering at least an inch and three quarters, so that its sides do not subtend an angle of more than twenty-five degrees. The stopper must be made to fill this cavity completely, and it may be held in it either by a flute-joint at the base of the cone, or by a thin ivory or horn tube projecting an inch from the apex of the stopper and fitting into the central bore. The flute-joint is in principle the best of these, but as it is with difficulty made accurately, and from its requiring ivory or ebony ferules, is liable to get out of repair, the tube may be preferred. The general excellence of this instrument will depend on the smoothness and true turning of the interior, and the perfect adaptation of the stopper to the cavity; but to be fully available to the auscultator, the auricular end should be made wide or narrow, flat or concave, to fit comfortably to his ear. Generally it will be found useful to make this end slightly concave, and somewhat wider, by a ferule of ivory or ebony, than the general diameter of the instrument, or this width may be formed in the wood itself. A beginner should not choose a stethoscope hastily, but when one is found exactly to fit the ear, a more perfect tact will be acquired by keeping to the same instrument than by using a variety.

[Almost any of the stethoscopes, offered for sale, will answer the purpose of the auscultator, provided, that the ear part can be easily adapted to the ear. It is proper, however, to observe, that the writer has found those which are wholly conical, or which, in other words, consist of the funnel part only, the least satisfactory, in consequence of the confusion of sounds, resembling, in some measure, those that are heard when a hollow shell is applied to the ear. The instrument should always have, in addition to the funnel-shaped portion, space enough for an inch or two of tube which is perfectly cylindrical, in order that, by the concentration of vibrations, this source of inconvenience may be obviated. The length of the original instrument of Laennec rendered it inconvenient of application in many cases; and it was by no means easy to place the end of the instrument entirely flat on the chest, whilst the other was in apposition with the ear. Hence, the writer has, for years, used an instrument, which, like that of Dr. Billing, (*Principles of Medicine*, Amer. edit. p. 15. Philad. 1842,) is merely Laënnec's abridged. It is about four inches long.

At the meeting of the British Association at Manchester, in 1842, Dr. Williams presented a communication on the construction and application of instruments used in auscultation. (*Lond. Med. Gazette*, Dec. 16, 1842: or Braithwaite's *Retrospect*, vol. ii. Lond. 1843.) In this he states, that finding the considerable share which the solid walls of stethoscopes have in communicating sounds, and from experiment, that their efficacy depends chiefly on the formation of the pectoral end, by which they receive the vibrations, he had devised a form of instrument which qualifies them better, he thinks, for this purpose than any now in use. This consists in a bugle or trumpet end, the edges of which being made very thin, and applied flat on the walls of the chest, are most readily affected by their vibrations. An instrument thus constructed of a light rigid wood, such as sycamore, and tried with a test sound, will be found, according to Dr. Williams, superior for most purposes to the stethoscope hitherto used.]

For further information on the construction of the stethoscope, assisted by diagrams, see the writer's "Rational Exposition of Physical Signs," &c. second edition, 1833, pp. 52 and 184. [Amer. edit. Philad. 1830.] After trying many artificers, we have at last succeeded in finding one who makes stethoscopes with nicety; and to those who want a good instrument, we can, therefore, recommend Grumbridge, turner, 42, Poland-street, Oxford-street. Our limits do not permit us to describe other forms of stethoscopes that are to be met with. In all those which we have seen, acoustic rules are sacrificed to portability or elegance. That of M. Piorry, which is commonly used, is faulty in having the conducting power of the wood impeded by screws and a thick cap of ivory; besides which, the excavated end is generally very ill fitted. Although, when unscrewed, more portable than the other instrument, the trouble of screwing and unscrewing the several parts is enough to counterbalance this advantage. Our friend Dr. Stroud uses a caoutchouc tube, with an ivory funnel attached, like the flexible hearing trumpet. The flexibility of this instrument is certainly an advantage, but it is obtained at a great sacrifice of intensity and distinctness of the sounds, in consequence of the imperfect and irregular reflecting power of the interior of the tube. This flexible stethoscope separates the sound from the impulse of the heart more completely than any other.

[The author has frequently used the flexible stethoscope, but he greatly prefers the ordinary instrument where the sounds require acuteness of hearing. Dr. Williams has lately affirmed, that when tried by a test sound he has found it much inferior in conducting power for all the more delicate sounds of the breath and heart. Louder

sounds, he adds, such as those of bronchial or cavernous breath, and voice sounds, it exaggerates by the addition of a conchal echo, which renders it very difficult to distinguish them from each other. This objection has not, however, impressed the writer.]

Although, for general purposes, the common stethoscope fulfils sufficiently well its triple office, it might be well for the attainment of greater accuracy in physical diagnosis, if auscultators in hospitals would use separate instruments for the three classes of signs. 1. A solid cylinder of wood for the auscultation of the heart. 2. A metallic tube, half an inch in diameter, furnished with a wooden or ivory ferule at the pectoral, and an ear-piece at the other end, for the investigation of the respiration and vocal resonance of small spots. 3. A metallic tube, like the last, but with its pectoral end expanded into a tapering cone, for the same purposes as the stethoscope without the stopper. After a little practice, we have little doubt that these instruments would be more powerful aids than the common stethoscope, but we do not pretend to recommend them for general adoption. [See, farther, on the construction and application of instruments, Dr. Williams in *op. cit.*]

Before we conclude this article, we would say a few words on the advantages of mediate auscultation, and on the necessity of the stethoscope to those who wish to avail themselves fully of physical diagnosis in general practice. After what has been said by Laennec and others on this point, we should have hardly deemed it necessary to mention it here, were it not that several writers, otherwise advocates of auscultation, have spoken slightingly of the stethoscope. Could the naked ear be in all cases applied to the chest of a patient, the utility of the stethoscope might be more reasonably questioned. But it cannot be denied that immediate auscultation is in many circumstances impracticable,—in some cases being indelicate, in others disgusting, and in infectious disorders unsafe,—while these objections are not applicable to the use of the stethoscope. Further, if it be said, restrict the use of the cylinder to these cases, we reply, that unless we have more practice with it than can be obtained in these only, the stethoscope would be comparatively useless in our hands; for its indications, although decidedly more accurate than those of the unaided ear, unquestionably require more practice to obtain them.

But there are other circumstances which give to mediate auscultation a claim to preference. The unaided ear, although capable of perceiving very delicately the sounds produced under the surface to which it is applied, cannot isolate any particular spot; and the sounds transmitted by the parts adjoining the ear, the temporal zygoma, the mastoid protuberances, &c., as well as the adventitious noises liable to be produced by the friction of the hair of the head and face, are frequently mixed with and confuse the signs from the spot under examination. On the other hand, with the stethoscope, we can isolate any particular point; and, by tracing the sounds to their real position in the organs within, we can accurately determine their value as signs. This faculty is, in some cases, of great importance. It is only by its means that we can discern the limits between a natural resonance of the voice under the clavicles, beneath the scapulæ and in the axillæ, and the morbid resonance which an induration of the tissue of the lung produces in parts immediately adjoining these regions. The stethoscope, with the stopper, not unfrequently discovers a sound to be merely a natural resonance, which, to the open instrument, or to the naked ear, has the character of morbid bronchophony; and the variations in the form of the instrument furnish a means of distinction between the degrees of pectoriloquy more accurate than can be obtained by the ear alone. (See Auscultation.) The capability of the stethoscope to separate the sound from the impulse of the heart, and the facility with which it can be applied to the infra-clavicular and axillary regions, and to the examination of the sounds in the carotid arteries and abdominal aorta, which are not within convenient reach of the unassisted ear, are further and important advantages of mediate auscultation. In conclusion, we would express our conviction that although, with a view to expedition and convenience, immediate auscultation may be occasionally substituted, no one who has once thoroughly trained his ear to the use of the stethoscope will ever so lightly esteem its aid as again to abandon it.

C. J. B. Williams.

STIMULANTS, (from *stimulare*, to prick, to goad,) *Excitants*, are medicines which augment the functions peculiar to the different organs of the body, by a primary impulse on the sensibility and irritability of the part to which they are applied, extended to the whole system of the nerves. Every medicine, indeed, which communicates mobility, or increased action, to any organ, may, in strict language, be regarded as a stimulant; consequently, expectorants, emetics, cathartics, diuretics, emmenagogues, diaphoretics, and epispastics, are all stimulants; but their influence is chiefly exerted on particular organs, whilst stimulants, exclusively so called, are substances which excite the entire system.

All substances that operate as stimulants produce some effects in common. When administered in small doses, their influence is scarcely perceptible; they cause no obvious change in the condition of the organ into which they are received; but, nevertheless, their impression on the nerves of the part is communicated to the brain and spinal cord, the nervous energy is exalted, and their excitant property becomes evident in the increased action of the pulse. When administered in larger doses, they first impart a sensation of warmth or acrimony to the organs of taste; this is extended to the stomach; and the particles of the substance being carried into the blood, the impression on the nervous system is not only greatly augmented, but, every organized tissue sharing the impression, all the functions are exalted, and the whole system becomes preternaturally excited. In still larger doses, their effects assume the characteristics of disease. Besides producing such impressions on the vital energies, almost all stimulants possess some sensible properties in common. These impart, as already stated, a warm and acrid impression to the organs of taste; awaken the sensation of smelling in the olfactory organ; and, when applied to the surface, augment the sensi-

bility and the temperature of the part, and cause a greater flow of blood into its vessels than is consonant with their natural condition. The qualities producing these effects are regarded by several writers on Materia Medica as constituting the essential properties of every stimulant; but they are those chiefly found in stimulants obtained from the organic kingdom of nature, and belonging to that class of vegetable bodies termed aromatics, in which it is probable that the exciting agent is *volatile* oil. It must nevertheless be admitted, that there are even vegetable stimulants in which no volatile oil can be detected; but these furnish a principle analogous in its effects to volatile oil There are stimulants which have neither taste nor odour; as, for instance, caloric and electricity, as well as those of a mental description, such as the exciting passions; but, whatever may be the nature of the stimulant, the impulse communicated to the system differs rather in degree than in kind. In one respect, however, inorganic are particularly distinguished from organic stimulants; they have no principle in common to which their excitant influence can be referred.

Four changes in the condition of the body are obvious, on the administration of stimulants: — 1. a greater than usual susceptibility of impression in the nerves; 2. an increase of action in the moving fibres; 3. an acceleration of the beat, and an augmentation of the force of the pulse; 4. an elevated degree of the temperature of the body. These effects are displayed chiefly on the cuticular organ, and in the organs of digestion, circulation, respiration, and secretion, as well as on the cerebro-spinal centres; and if we examine any of the organic tissues during the operation of stimulants, we find that they are redder, hotter, and more sensitive than in the ordinary state of the habit. These appearances do not always depend either on the nature of the stimulant, or on the extent of the dose, but very frequently on the state of the body of the patient. Something, also, is due to the manner in which the stimulant is administered, whether simple or uncombined, or in a state of combination.

Stimulants differ greatly in the rapidity with which their effects are produced, some acting almost instantaneously, others requiring time to display their influence; and this difference does not depend on the nature of the part to which they are applied. In general, the degree of power is in the ratio of the rapidity of their action; and the permanency of the impression is more or less connected with the same circumstance. The operation, also, of all stimulants is followed by symptoms of collapse; and this result, in an especial manner, distinguishes them from *tonics*, and at the same time renders it extremely difficult to separate them from narcotics, which at first increase action, but soon afterwards exhaust both sensibility and irritability. To illustrate this effect of stimulants, it is requisite to have a clear conception of the nature of *excitement* and *collapse*; terms that are evidently relative to some standard or point which, in the healthy system, can be considered as neither.

With respect to excitement, "if," says Dr. Cullen, "we take the lowest, every higher degree than that must be called a degree of excitement; and if we take the highest degree, and consider the lower degrees which may take place while life still subsists, every lower may be called a degree of collapse." (Materia Medica.) In the opinion of the author of this article, *excitement* implies every condition of the nervous system in which the energy of the brain is greater than that which, in the waking state of a healthy man, is exactly adequate for the performance of the ordinary functions of the system; *collapse*, that condition in which the cerebral energy is so much diminished as to suspend the exercise of the functions of sensation and volition,—a state of defective activity of the brain, similar to that which causes sleep, only in an augmented degree. The function of the brain cannot be carried on without a sufficient supply of blood, which is essential for its support and continuance: a greater increase of the momentum than usual produces excitement; a diminished afflux, within certain limits, or an exhaustion of energy from previous over-excitement, is productive of collapse. In some instances there is much difficulty in distinguishing these states.

Let us now examine the effects of excitement on the different organs on which this class of medicines chiefly displays its influence.

1. On the **digestive organs** stimulants exert a primary action: a sensation of heat is experienced which is immediately referred to the stomach. The liver, the pancreas, the brain, and the spinal cord sympathetically share this local excitement: but the chief effect is felt in the stomach, the mucous membrane of which, could it be seen, would be found redder than natural, and more sensitive; whilst the capacity of the organ is diminished, owing to the contraction of its muscular coat. If the stomach be empty, a sensation of hunger is experienced; if the excitant be mingled with the food, the process of chymification is hastened; and this also is the case, if food be taken soon after a stimulant has been swallowed. This excitement, commenced in the stomach, is extended through the whole alimentary canal.

The effect of a stimulant on the primæ viæ is always in the ratio of the dose; small doses merely augment the energy of the digestive faculty; large doses, on the contrary, impair this, awaken a sensation of heat, thirst, and uneasiness in the gastric region, and suspend or render inefficient the action of the stomach; causing nausea and sometimes vomiting. But although these effects are the result of a very large dose even of a salutary excitant, yet the impulse which it communicates to the rest of the system is not always commensurate to the impression thus made upon the stomach; and many substances that display scarcely any obvious influence on that viscus, operate powerfully on the general habit. But if they quickly pass the pylorus without acting on the stomach, then their influence on the general system is less than when their impression is previously made on that organ. We must search for the cause of this in the function of the intestinal canal, and the nature of the stimulants which thus operate. The natural effect of the action of a stimulant on the intestinal canal is to increase its peristaltic and vernicular motion; thence the stimulant is carried forward, and it continues its impulse in its progress; yet this is too transitory

to be very influential. With regard to the nature of the stimulants which thus operate, the active principle is often so sheathed in other matters, that the digestive process is not able to evolve it until it pass out of the stomach. Some stimulants, also, of an organic nature exert little influence on the general habit until they are taken into the circulation; they may, therefore, be said to communicate their impulse directly to the heart and arteries, independent of any primary impression on the stomach.

The primary influence of stimulants on the digestive organs is, also, greatly modified by the condition of the stomach. If this be relaxed and thin, excitants appear to exert little action upon it; but small as the impression may be, the effect is salutary, the appetite is improved, and chymification proceeds with more regularity. If the capacity of the organ be considerable, and its parietes thick, stimulants produce a powerful impression on it: hunger is more urgent, the appetite is rendered voracious, and chymification accelerated. When the stomach is in an irritable state, every impression produced by an excitant is increased; the patient suffers from anxiety, hot eructations, tightness across the epigastric region, and a general uneasiness, which is referred to the viscus. If ulceration or open cancer exist there, all these symptoms, accompanied by acute pain and a burning sensation at the epigastrium, are experienced in an augmented degree. If no organic lesions are present in the organ, but the gastric nerves are in an asthenic condition, owing to softening or some similar affection of the brain or the spinal cord, then the impression of the most active stimulants is scarcely felt in the stomach; but should the nervous centres be suffering from irritation, in that case the stomach shares in their morbid susceptibility, and even the slightest excitant produces a serious effect on it. Something, also, depends on the state of the neighbouring organs, the morbid condition of which is more or less extended to the stomach, and consequently modifies the operation of stimulants received into it. On the other hand, the neighbouring organs, being more or less affected by contiguity when any excitant is taken into the stomach, have their secerning functions increased; but, at the same time, in making this statement, we must admit that this effect is not confined to the action of excitants on the stomach; for in whatever manner or on whatever part the impulse is first impressed, it is rapidly communicated to the neighbouring organs, and progressively to the rest of the system.

2. The influence of stimulants on the **circulating and respiratory organ** is a secondary effect of their impression on the stomach; thus when a stimulant is swallowed, it renders the pulse both quicker and stronger than before; and this excitement is extended even to the capillaries. Red blood is propelled into vessels not accustomed to receive it, and the skin appears, as it were, suffused with a blush; its temperature is elevated, and either sweating is induced, or the action of the kidneys or that of the uterus is augmented; or, if the dose of the stimulant be considerable, the brain feels its impulse, and restlessness, watchfulness, and cephalalgia supervene. These effects are undoubtedly owing, in a considerable degree, to the absorption of the excitant, or rather of its active principle, and to the impulse which it directly communicates to the coats of the vessels: they are necessarily proportionate to the dose and the nature of the excitant; but other circumstances, in some degree, also modify them. Thus on persons of a sanguine temperament stimulants act with more energy, as far as concerns the circulating system, than on those of an opposite frame of body, in whom their influence upon the heart and arteries is often scarcely perceptible. Indeed, there is no doubt that the circulating organs are more or less susceptible in different individuals, and, consequently, the variety of effects produced by the same stimulant substances, administered in the same doses and in the same manner, to different persons, are readily explained. One set of excitants, namely, the mental, display their influence in a striking manner on the circulation; thus blushing, palpitation of the heart, and that sensation of a glow of warmth overspreading the chest which often attends highly agreeable and pleasurable feelings, are merely the effects of the stimulant influence of these mental affections on the circulation.

As in the case of the digestive organs, morbid conditions of the vascular system necessarily modify the action of stimulants on this part of the body. Thus, in hypertrophy of the heart, every impulse of an excitant, however slight, increases the movements of that organ; both the momentum and the frequency of the pulse are augmented, the surface is reddened, and hemorrhages not unfrequently follow. When the hypertrophy is chiefly confined to the left ventricle, the administration of excitants is often accompanied with singing in the ears, weight of the head, epistaxis, and other symptoms of congestion of the vessels of the encephalon; and thence apoplexy is not an unfrequent attendant of free living in persons labouring under this affection of the heart. On the contrary, if the right ventricle be the part affected, the influence of stimulants is chiefly displayed on the pulmonary circulation.

In febrile states of the habit, in which the circulation is rapid, and the animal temperature greatly elevated, stimulants precipitate still more this increased action, and exasperate every symptom which constitutes the disease.

3. That stimulants affect the **respiratory system** is evident; indeed, the natural consequence of an accelerated action of the heart and arteries is an increase in the movements of the thorax. The result of a greater number of inspirations and expirations, occurring in a given time, is a more rapid change than ordinary in the blood circulated through the pulmonary vessels; it is exposed more frequently to the action of the air, becomes more arterialized, and displays a more vivid redness when drawn from the arm than is customary. If stimulants be administered during febrile states, this condition of the pulmonary system is augmented; and the air expired from the lungs seems almost burning hot. If the mucous membrane of the bronchial tubes and cells be inflamed, stimulants oppress the breathing, and excite a dry cough; and if the inflammation extend either to the pulmonary tissue or affect the pleura, the consequences of their administration

are almost immediate; the cough becomes hard, excites violent pain, and the expectoration ceases. This influence of stimulants on the pulmonary organ points out the advantages to be derived from their employment in those states of the chest in which the bronchial tubes are choked with mucus, and the debilitated state of the frame renders it impossible to clear them by the effort of coughing: in truth, expectoration is merely the effect of the influence of an excitant on the lungs in a state of disease.

4. With respect to the influence of stimulants on **the secerning system**, we have already stated that an excitant taken into the stomach increases the action of the capillaries, and rouses the activity of both the secreting and the exhalant organs. This, however, never occurs until the excitant is carried into the circulation, and is immediately applied to the glands. It is difficult to trace the causes of the apparent selection which occurs: one set of excitants, for instance, augmenting the secretion of the kidneys, another that of the salivary glands; a third the elaboration of bile in the liver, and a fourth the cutaneous exhalation; but every day's experience demonstrates the fact. The skin, in particular, is highly susceptible of the impression of stimulants taken into the blood; the capillaries act with redoubled vigour; and diaphoresis quickly follows. It is only, however, within a certain limit of excitement, one considerably short of inflammatory action, that these effects follow; when the stimulant is too powerful, secretion is impeded; thence we find that some volatile oils, when taken in a large dose, if they do not immediately operate as purgatives, cause most distressing effects on the urinary organs. As it is also unquestionable that to a certain extent the natural conformation of an organ modifies the action of stimulants upon it, so if the skin be thick, firm, and well nourished, a sudorific effect is readily obtained; whereas this is slowly induced, and the secretion itself is imperfect, when it is thin, soft, and pallid. The condition of organs also, when altered by disease, modifies greatly the action of this class of medicines; and this is particularly true with respect to the skin and the kidneys. In febrile affections attended with cutaneous eruptions, exciting medicines, instead of producing diaphoresis, augment the tension and the heat of the surface; and, in the same state of the habit, the kidneys become morbidly irritable, and their secreting function is suspended; if stimulants be now administered, the irritation is augmented, and the organs are occasionally attacked with inflammation. On the contrary, when the kidneys are in a state of atony or paralysis from affections of the brain or spinal cord, and their secreting powers languish, then stimulants tend to re-establish the function of the organs, and the flow of the urine is more or less abundant, according to the supply of fluid received into the stomach.

5. In reference to the **Nervous System**, it is well known that no exciting substance, in a sufficient dose, can be taken into the stomach without primarily exciting the nerves of the viscus, after which the impulses thus received are rapidly transmitted to the rest of the frame, developing vital energy in the various organic centres to which the nerves relate. It is true that we cannot explain this power of transmitting impressions inherent in the nerves; and we must acknowledge that an acquaintance, however intimate, with the structure of the nervous tissue affords us no information.

On the brain itself the influence of stimulants is obviously manifested by the perceptions becoming more vivid, the imagination more prolific with ideas, and those of a more brilliant and exalted character than usual. Indeed it cannot be denied that the employment of stimulating substances, within a moderate limit, is often followed by the happiest inspirations, and the most delightful sensations; but it is, also, well known that this excitation of the mental faculties, when stimulants are taken in the evening, is productive of agitated and sleepless nights; thence the medicines belonging to this class were denominated exhilarants by the ancients; and, even in the present day, powders, electuaries, and aromatic spirits composed of stimulating ingredients, are administered to dissipate melancholy and renovate the spirits. Another proof of the influence of excitants on the cerebral functions, is the awakening of memory: many events and circumstances effaced from recollection; verses, anecdotes, and facts long forgotten, again present themselves to the mind when under the operation of excitants. Even circumstances which occurred in a state of high excitation, and which were completely forgotten in the interval, are again remembered on the recurrence of the same state. A curious illustration of this fact is recorded by Mr. Combe. A porter, who when drunk left a parcel at a wrong door, on becoming sober could not recollect at what house he had left it; but the next time he got drunk, he at once called to mind the house, and went and recovered the parcel. In the state of inebriety, however, the influence of stimulants on the brain is more generally manifested by vertigo, temporary delirium, and a change of perception, than by a restoration of memory.

Whether the cerebellum be affected by excitants in the same manner as the brain, is uncertain; but there is no doubt that many stimulants affect, in a special manner, the medulla spinalis: the susceptibility of the sensitive nerves of the skin is increased, the respiration is quickened, and the muscular system displays an unusual aptitude for action. It is necessary here to remark that, although this power of augmenting the general sensibility of the body is common to all excitants, yet it is possessed in a higher degree by some than by others. Upon the whole, however, we may conclude that the influence of stimulants is more or less evidenced on every part of the nervous system, by the greater susceptibility than usual to impressions on every part of the body, and by a higher degree of intellectual energy, displayed not only in the acuteness of perception, but in the facility of comparing, separating, and arranging our ideas. These phenomena, it must be admitted, are not always sequences of the administration of the same stimulants, neither in intensity, nor at different epochs, in the same individuals,—results which can only be referred to altered conditions of the organs receiving and transmitting the impressions; and thence we are authorized in asserting the influence of the condition of the

nervous system in modifying the action of stimulants,—a fact of great practical importance. It is difficult to trace the alterations in the nervous tissue which produce these modifications; and we even hesitate in according with the opinion that a less natural susceptibility of impression is to be attributed to a defective development of the volume of the nervous centres; neither can we admit that an unusual bulk of brain and enlargement of the nervous fibrils are likely to produce a higher degree of excitement on the administration of stimulants. It must, however, be admitted that the changes on the nervous system produced by disease modify, in the most striking manner, the action of stimulants.

In an irritable state of the brain, manifested by general morbid susceptibility, tremours, and agitations, with irregular muscular contractions, delirium, and maniacal hallucinations, or great mental exaltation, the administration of stimulants either exasperates these symptoms, or, producing sanguinous congestions, causes a new train of symptoms equally unfavourable. If one portion only of the cerebral pulp or of the meninges be affected, the perturbation is confined to one or a few only of the senses; or if convulsions occur, they are limited to some particular muscles. Stimulants in such cases often induce epilepsy, or, if the patient be already subject to its attacks, augment the violence of the paroxysms; and the same occurs when the spinal cord or its theca is the subject of irritation.

If the excess of stimulus be always hurtful, in a moderate degree it is salutary; and, consequently, we are in the daily habit of employing excitants mixed with our food, and rely on their salutary influence, under certain circumstances, as remedial agents. With regard to the state of the body in which they are useful as remedies, we may advance the following as a general principle,—namely, that it is that state in which powerful and sudden impressions on the system are required; in which the functions of the brain and the nervous energy are diminished, and in which the impulse of the blood on the brain, necessary for its healthful action, is defective—in truth, one of direct debility of the brain. That this condition of the brain depends on a deficient impetus of blood to that organ, may be inferred from the fact that a state closely resembling it is induced by pressure on the carotids; but, when this impetus is excessive, so as to produce convulsions, these are subdued by whatever diminishes the action of the heart — for instance, bloodletting. They have also been stopped by compression on one or both carotids. The renewal of impulse, when it is absent or defective, is to be obtained by increasing the general momentum of the blood; an effect most rapidly induced by the application of stimulants either to the nerves of the stomach, or those of the Schneiderian membrane, or of other parts in which their influence can be directly impressed. Some objections may be raised against the explanation of the mode in which the increased momentum is produced, by those who contend that the brain exerts very little power over the action of the heart and arteries; but when we reflect upon the influence which passions exert over the heart during perfect health—when we consider the magnitude of the cardiac nerves, and the sympathy that exists between the heart and other organs in relation to its momentum, we shall not hesitate to admit that excitants, operating on the blood-vessels, produce their effects chiefly through the medium of the nervous system.

With respect to the nature of the substances operating as stimulants, it is necessary to remark that their distinction from tonics is not solely in degree, but also in the character of their effects. Thus stimulants augment the mobility of the system, tonics the strength of the muscles; stimulants exhaust the excitability, tonics, within a certain limit, maintain it; the action of stimulants is immediate, powerful, and transitory, that of tonics slow, almost imperceptible, progressive, and permanent. The necessity, therefore, for separating these two classes of medicines must be obvious.

Stimulants may be arranged under three distinct heads: *organic products*, *inorganic substances*, and *mental affections*.

1. The most important of the organic products employed as stimulants is undoubtedly volatile oil, whether in its uncombined state, or as separated from the plants containing it, or as it exists in combination with other principles in the roots, wood, barks, flowers, fruits, and seeds of many vegetables.

The **uncombined volatile oils** are chiefly obtained from plants belonging to the natural orders Umbelliferæ, Myrtaceæ, Aurantiaceæ, Rutaceæ, and Labiatæ. Those procured from the umbelliferous plants, namely, the oils of caraway, anise, dill, fennel, and carrot, are secreted in the seeds of the plants, and deposited in small cells or *vittæ* in these organs. The melaleuca cajuputi, one of the Myrtaceæ, which yields the cajuputi oil, contains it in the leaves; whilst in those well-known members of the natural order Aurantiaceæ, the citrus *aurantium* and citrus *medica*, the uncombined oil which they yield is found in the cells of the rind of their fruits. It is the product of the flowers of lavandula *spica*, and rosmarinus *officinalis*; and of the whole plant of ruta *graveolens*, and the following Labiatæ, namely, mentha *piperita*, mentha *viridis*, mentha *pulegium*, and origanum *vulgare*. From all of these plants it is procured by distillation with water, the oil and the watery vapour passing over together and afterwards separating, and the oil either collecting on the surface or settling at the bottom, according as its density is less than or exceeds that of the water. This is not the place to enter into the consideration of the chemical properties of these oils; it is only necessary to remark that, although they are all insoluble in water, yet they are readily rendered soluble by combining them with sugar, or as an *oleo-saccharum*, and they may thus be prescribed in conjunction with aqueous fluids.

All these uncombined volatile oils operate at first as direct stimulants on the tissue with which they are in contact, whether introduced into the stomach or applied to the surface of the body; but their influence is soon extended over the body, both by nervous sympathy and by absorption into the circulation, and they can be generally detected in one or more of the secretions. When the dose of the oil is moderate, and its acrimony sheathed

with mucilage or other demulcents before being swallowed, the stimulus proves salutary; the digestive function is promoted, the action of the heart and arteries is moderately augmented, and the secreting faculty both of the skin and the kidneys favoured. Although they are all more or less general excitants, yet the volatile oils are individually determined to particular parts of the system, and display their influence specially upon distinct organs: thus, whilst the oil of anise operates as a sudorific, that of dill produces an antispasmodic effect. But in whatever manner they operate, the volatile oils are too violent in their action to be administered in the simple form, or uncombined with some material which can obtund or sheath their acrimony. The best form for internal administration is that of an oleo-saccharum dissolved in any aqueous infusion or decoction. Externally, volatile oils operate as counter-irritants, and relieve deep-seated inflammation; whilst in cases, such as tooth-ach, in which they can be directly applied to the part, they exhaust the nervous excitability and thus allay pain.

Many vegetable stimulants owe their efficacy to volatile oil, although it cannot be readily separated from their other components. Thus we find it in the roots of the Asistolochia *serpentaria*, in combination with a bitter principle, gum and resin; in the rhizomes of the Acorus *calamus*, ginger and turmeric, Curcuma *longa* with fecula; in the wood of sassafras, and the barks of Drymis Winteri and cinnamon, with tannin and gallic acid; and in that of Canella *alba* with fecula; in saffron, the stigmata of Crocus *sativus*, with a peculiar colouring matter which chemists have named polychroite; in the clove, allspice, laurel-berries, the cardamom and the nutmeg, chiefly with fecula, tannin, and gum; and in the cubeb, the fruit of Piper *cubeba*, with resin, gum, and extractive. In all these the volatile oil is the efficient principle. It is separated by the digestive function of the stomach when these medicines are given in substance, and is afterwards taken into the circulation: thence its primary influence is exerted on the coats of the stomach and intestinal canal to which it is applied, its secondary on the capillary system, and the cerebral and rachidien centres. When the action is intended to be confined to the digestive organs, either uncombined volatile oil, as an oleo-saccharum, or those substances containing it in combination with tannin and the bitter principle,—namely, the roots and barks above enumerated,—should be selected. When the stomach is suffering under that chronic debility which is characterized by sickness and occasional vomiting, and in all cases of deficient action of that organ, particularly when it is accompanied with cardialgia and flatulence, these aromatic stimulants are indicated. It is, however, important to discriminate that pain which is the result of spasm, and that arising from inflammatory action, in dyspeptic affections; and even when the disease is grafted upon a hypochondriacal condition of the habit, the uncombined volatile oils should not be employed. In affections, also, of the intestinal canal, when no inflammation is suspected, as, for example, flatulent colic and cholera and atonic gout attacking the stomach, the warmest of the uncombined volatile oils may be prescribed, even during the utmost violence of the pain. In Asiatic cholera these oils have been strongly recommended, but the pathology of the disease is still too obscure to enable us to decide on the propriety of their employment, although in general atony of the bowels, producing either obstinate constipation or passive diarrhœa, the addition of aromatics, more especially the uncombined oils, in conjunction with purgatives in the one case and astringents in the other, by rousing the nervous energy, is productive of the best effects. In the administration, however, of these agents in gastric and intestinal disease, it is of importance to ascertain the exact condition of the abdominal viscera, and most particularly that of the whole mucous membrane of the alimentary canal. We should be satisfied that no ulcerations, nor scirrhous or cancerous tendency exist in any portion of the canal; and if vomiting or gripings be present, that these are not symptomatic of cerebral congestion or irritations of the encephalon or of the spinal cord; and at the same time the state of the liver, the pancreas, and the spleen must be carefully investigated. Much caution is also requisite, in prescribing any of the aromatics, when the tongue displays that red and glazed state which denotes subacute inflammation of the mucous membrane of the stomach,—a not unfrequent cause of dyspepsia.

In looking at the peculiar determination to distinct organs produced by some of the combined oils, we are enabled to select the substances containing them for the relief of particular symptoms, when the general state of the habit does not contra-indicate the employment of stimulants. Thus, in those dyspeptic affections in which the circulation is languid with a dry harsh skin; or in cases of remittent and malignant fever, when the powers of life sink and the skin is hot and dry; or in pustular eruptive fevers, when the eruption suddenly recedes; or in protracted intermittents, especially when these are combined with cough; the serpentaria root is better calculated to fulfil the intentions of the physician than any other of this class of stimulants. If the surface be kept warm, it rarely fails to excite the action of the cutaneous capillaries; and while it promotes diaphoresis, it supports and supplies energy to the general system. In such cases the best form of administering the medicine is tincture, as proof spirit takes up both its volatile oil and bitter extractive. On the same principle the volatile oil of cubebs is determined to the kidneys, and probably produces its beneficial influence in gonorrhœa both by stimulating the kidneys and augmenting its secretion, and acting directly on the urethra during the excretion of the urine; thus overcoming the disease by setting up a new action in the affected part. When this action on the urinary organs does not take place, cubebs excite great irritation and fever, and paralysis is sometimes the result. In a case which fell under the care of the writer of this article, in which the extent of the dose was ʒi, so much febrile irritation was excited that the life of the patient was in danger.

All of the aromatic stimulants are admirable additions to tonics when judiciously prescribed, and some of the most important of the class owe their excellence to a natural combination of this

description; as, for example, Winter's bark and Calamus aromaticus, the latter of which is one of the best additions to cinchona bark and sulphate of quina in intermittents. Several of the aromatics, nevertheless, cannot be combined with cinchona or the salts of quinia, as, for instance, cinnamon, cloves, and pimento, on account of the precipitates which they throw down, — a disadvantage from which the uncombined oils are free.

As external stimulants, all the uncombined volatile oils may be employed, the extent of their rubefacient effect being easily regulated by the quantity of bland oil used for diluting them.

Such are the stimulant properties of volatile oil, both in its uncombined and combined state; the list of substances yielding it, contained in the British pharmacopœias, might be greatly abridged, and yet ample means afforded for fulfilling every indication for which vegetable aromatics can be required in the treatment of diseases.

Many vegetables owe their stimulant influence to **acrid fixed oil,** which exists in the plants in a state not in all cases quite evident, although in some it seems to be deposited in distinct cells. This acrid principle is apparently mixed with fixed oil if the parts of the plants containing it be submitted to the operation of expression, but it is perhaps in every instance separate from it during its existence in the plant: it is usually more or less volatile. All the peppers, mustard, and pellitory, derive their stimulant property from an acrid principle of this description. In black pepper it is combined with fecula, uric and malic acids, and piperina; and its stimulant powers, whether internally administered or externally employed as a suppurative, are solely due to this acrid principle. When separated, this oil is too pungent to be tasted with impunity; it reddens and inflames the skin, and thence we can readily trace the cause of the long-continued insupportable burning sensation which it excites when taken into the stomach. It rapidly increases vascular action, and powerfully excites the sexual organs. The effect of pepper as an antiperiodic has been attributed solely to the piperina; but the writer of this article accords with Magendie in thinking, that something is due to this stimulant principle, as alone it has cured intermittents. It has not generally been employed as a therapeutical agent; but pepper in substance is given in the form of powder, in doses of six, eight, or ten grains.

The same remarks apply to mustard and pellitory root; both of which, however, are employed almost exclusively as local stimulants. The chief advantage of the mustard cataplasm is in the promptness of its action, and the facility of regulating it. The use of pellitory is confined almost exclusively to cases of paralysis of the tongue and the internal organs of deglutition, arising from circumstances affecting partially the nerves of these organs. A small portion, more or less bruised according to the power of mastication enjoyed by the patient, is chewed as constantly as the sensibility of the mouth will admit, and the saliva ejected.

There can be no doubt that *camphor* is properly placed in this class of remedies; but much difference of opinion exists regarding the mode in which its stimulant influence is exerted. Its first effect, in a full dose, is undoubtedly derived from its stimulant power; this might, indeed, be assumed from its reddening and causing heat and increased action in the part when it is applied to the skin; and it is rendered evident, also, by the warmth which is felt in the throat and at the epigastrium in swallowing it. Its influence on the gastric nerves is propagated to the brain, the spinal cord, and the whole ganglionic system; and, during this time, the heat of the surface is diminished, rigors sometimes occur, and vertigo with perverted vision supervenes. Were our observations to proceed no further, camphor might be regarded as a simple narcotic, not affecting the heart and arteries; but a secondary effect—one, undoubtedly, of increased action—soon displays itself: the pulse becomes strong, frequent, and vibrating; the temperature of the body is elevated; the eyes glisten, and cephalagia occurs. From these effects we may conclude that camphor operates, at first, solely on the nervous system; and that it is not until it is taken into the circulation, that it stimulates the vascular organs. Its influence as a stimulant is much less permanent than that of aromatics, as it passes rapidly out of the habit by the cutaneous exhalants, producing its excitant effects in transitu. The action of camphor is also greatly modified by the dose of the medicine. In moderate doses, namely, from five to twelve grains, it softens and fills the pulse, and promotes diaphoresis, mitigates pain, dissolves spasm, and seems to rouse the nervous energy without quickening the pulse; thence, in combination with antimonials it may be administered even in diseases of excitement: but when its stimulant property is required, the dose should not be less than a scruple; and it may be combined with aromatics, opium, or tonics, as the indications direct. In such combinations, its influence in checking the progress of gangrene, and in supporting the powers of the habit, in confluent small-pox, measles, and other eruptive fevers, when they assume a typhoid character and the eruptions recede, has been amply demonstrated. Professor Hallé informs us that it acts as an antiperiodic when it is administered in combination with nitrate of potassa, in the intervals of intermittent fever. As an external local stimulant or rubefacient, camphor is in very general use when dissolved in oil or soap liniment; nevertheless, when dissolved in proof spirit and applied to a hot and inflamed surface, instead of stimulating it causes an agreeable sensation of coolness,—a circumstance depending on the great volatility of the camphor; whereas, when dissolved in fixed oil, its volatility is restrained, and its stimulant effect secured. Another method of employing camphor as an external stimulant is as a fumigation. The patient is covered with a blanket pinned close round the neck, and from half an ounce to an ounce of camphor is thrown on a hot iron plate placed within the blanket. The effect is copious perspiration.

Owing to the insolubility of camphor in water, aqueous fluids are unfit vehicles for its exhibition, unless means are adopted to keep it suspended in them. The best method of effecting this is by dissolving the camphor in fixed oil, then forming this solution into an emulsion by triturating it with gum and water, or the almond emulsion. It has also been formed into a soap by means of

liquor potassæ, or triturated with soap, and thus rendered miscible with water; or it may be dissolved in milk in the proportion of ℥ss of the camphor to f.℥iv of milk and f.℥viiss of distilled water, as recommended by Dr. Cassils, of Kendal. (Edinburgh Med. and Surg. Journal, vol. viii. p. 124.)

One of the most powerful of the vegetable stimulants is **strychnia**, an alkaloid,* the active principle of Strychnos *nux vomica*, the seeds of which contain in it combination with igasuric acid, as an igasuriate. Its first obvious effect when taken into the stomach in a moderate dose, namely, one-tenth of a grain, is an augmented energy of the digestive function, without much change on the pulse; the vigour of the cutaneous function is also increased, and perspiration flows freely. By degrees, however, as it accumulates in the system, the respiration becomes oppressed, and the respiratory muscles suffer a clonic contraction. This extends to the rest of the system, and violent twitchings and tetanic contractions supervene. In addition to these symptoms, the surface of the body becomes morbidly sensitive to the slightest impressions, even the motion of the air, as in hydrophobia; whilst a sensation of heat, prickings, formications, and other uncomfortable feelings, are experienced in the limbs. These symptoms increase at one moment and subside in the next, keeping pace, as it were, with the changes which supervene in the power of the irritations impressed on the medullary matter of the spinal cord. From these symptoms, as well as the fact ascertained by experiment, that strychnia produces no effect on the system when the spinal cord has been previously destroyed, it is evident that it acts directly on the motor tract of the spinal marrow;† and when the dose is sufficient to destroy the animal, death soon follows the clonic spasm of the respiratory muscles, and the deficient decarbonization of the blood in the lungs.

The employment of the extract of nux vomica, and of the powder of the seeds, was formerly common in pyrosis, and its influence in changing morbid into healthy action in the digestive organs was well ascertained; but the introduction of the administration of strychnia in paraplegia is due to Dr. Fouquier, of the Hospital de la Pitié, in Paris; and the expectations of its powers raised by the result of his practice have been fully verified: strychnia is now, therefore, generally regarded as a most valuable stimulant in paralytic affections, especially those of the lower extremities. With respect to the mode of prescribing it, on account of its great insolubility in water and the variation of activity according to the greater or less ascescency of the stomach during its employment, the author of this article has proposed to administer it always in the form of an acetate, which is readily produced by dissolving one grain of the alkaloid in a fluidrachm of distilled vinegar. Six minims of this solution, containing one-tenth of a grain of strychnia, is the dose of the medicine to be given at first. It must be gradually increased until the tetanic twitchings appear, which generally occur before the dose amounts to thirty minims, equivalent to half a grain of strychnia. When the powder of nux vomica is given, the dose may be gradually increased from five grains, until fifty be taken in the course of a day; or if the extract be preferred, two grains may be first prescribed to be taken at night and in the morning, and one grain added every day or every second day, until the specific effects of the remedy display themselves with sufficient intensity to lead to a salutary result. If strychnia be employed in cases where there is much irritability of stomach, instead of being swallowed, it may be sprinkled on a denuded surface in double the dose requisite when internally administered.

Besides the use of strychnia or its acetate, or the extract of nux vomica, in paralysis, it has been found useful in several other diseases. M. Frisch, a German physician, affirms that he has cured ague in robust persons, when sulphate of quinia failed, by adding to this salt the powder of nux vomica in doses of four or five grains; and Dr. Bardsley has found strychnia equally serviceable in amenorrhœa and chronic diarrhœa. (Hospital Facts and Observations, &c., by James Lomax Bardsley, M. D. p. 57.) When overdosed, the fatal effect which has followed seems to proceed chiefly from the poison exhausting the irritability of the heart. The first symptom characterizing an overdose, or the result of its poisoning influence, is tremour; this is followed by stupor, which is quickly succeeded by tetanus, stiffness of the muscles of the neck, trismus, severe pain under the ensiform cartilage, opisthotonos, laborious respiration, and fatal asphyxia. M. Donné has proposed iodine as an antidote in such cases; and the results of his experiments on dogs afford strong reasons for trying it on man.‡ [See Tetanus.]

The stimulant influence of **alcohol** in all its modifications and combinations has been known almost from time immemorial. When alcohol, diluted and uncombined, is applied to the living system, it acts upon the nervous energy, augmenting the tone of the part, diminishing the capacity

* Strychnia, according to the analysis of Liebig, consists of

Carbon,	76.43	or 30	equiv.	183
Hydrogen,	6.70	" 16	"	16
Nitrogen,	5.61	" 1	"	14
Oxygen,	11.06	" 3	"	24
	100.00			237

It is procured by precipitating a concentrated decoction of the seeds of nux vomica, or St. Ignatius bean, with acetate of lead; decomposing the acetate thus formed with magnesia, and treating the precipitate, well washed and dried, with strong alcohol. By repeated solution and crystallization it is procured in the form of minute, white, elongated, tetrahedral prisms, terminated by a pyramid, permanent in the air, and inodorous, but so intensely bitter as to impart a sensible bitterness to 506.400 parts of water.

† Fodéré found, that on exposing the spinal cord in the loins of an animal to which strychnia had been administered, he could arrest the tetanic convulsions by making pressure on the anterior segment of the spinal cord.

‡ As the advantage, however, arises from a chemical change effected on the strychnia by the iodine, it cannot prove useful if the poison be absorbed; but it is more probable that it operates solely through the intestinal nerves. Post-mortem examinations display the venous system of vessels gorged with blood, whilst the arterial is nearly empty, and the arteries contracted to nearly one-half their usual diameter. Scarcely any traces of inflammatory action have been detected even in the stomach.

of the blood-vessels, and adding to their power of carrying forward the blood which they contain. But this effect is modified both by the strength of the alcohol and the susceptibility of the part to which it is applied: if the sensibility be considerable, and the alcohol strong, the state of augmented tone, and the contraction which renders the surface pale, are of short continuance; the vital energy is rapidly exhausted, and inflammation is the consequence. The stimulant property of alcohol thus becomes obvious to our senses. When taken into the stomach in large quantity and pure, its primary influence is experienced on the organ itself; its mucous membrane is inflamed and its vitality destroyed: this shock is communicated through the nerves to the brain; and the person often dies before there is time for absorption to have taken place. In animals killed by injecting alcohol into the stomach, Mr. Brodie found on dissection every appearance that indicates strong inflammatory action, and blood extravasated between the tunics; but, except a gorged state of the vessels, no appearances of any injury to the brain were observed; thence dissection strengthens the opinion that the impression is wholly on the nerves. When the alcohol is somewhat diluted, it acts with less energy, and merely causes ebriety. The first impression, in this case, is one of augmented energy; the mental function acts with unwonted power; fancy is awakened, and creates, from uninterrupted associations, new and often brilliant combinations; and at this moment, imagination luxuriating unrestrained, the poet pours forth his most harmonious and sublimest strains. By degrees, however, this blissful sensation vanishes; all control of the will as well as reason is suspended; and, instead of agreeable conceptions, ideas crowd into the mind in the most incongruous order; vertigo supervenes, and delirium precedes a state of exhaustion, which at length terminates in collapse and sleep resembling that of apoplexy, and not unfrequently proves the prelude to death. In general, however, nature adopts this method of restoring exhausted excitability; but, after the repose, the shock given to the nervous system is rendered obvious in the tremulous hand, the unsteady limb, the rigors, the nauseated stomach, the irascible temper, and the completely overpowered state of the system which the individual experiences on awaking. That all these symptoms depend more on the impression made on the nerves of the mouth, the gullet, and the stomach, and its transmission to the brain by nervous sympathy, than by absorption, is evident from the influence of a small portion of wine or of alcohol in causing intoxication, if it be allowed to pass slowly over the sensitive extremes of the nerves of the tongue and fauces in its progress to the stomach; and, also, by the sudden sobriety which often follows the act of vomiting. The repetition of such impressions, however, affects seriously the powers of life; cancer of the pylorus, abscess of the liver, delirium tremens, palsy, dropsy, epilepsy, mania, and a long train of evils, attack and soon subdue the strongest constitution. It is true that some habitual drunkards have lived to a good old age; but this is an exception to a general rule—

> "Perhaps some doctor, of tremendous paunch,
> Awful and deep, a black abyss of drink,
> Outlives them all; and from his buried flock
> Retiring, full of rumination sad,
> Laments the weakness of this latter time."
>
> THOMSON'S SEASONS—*Autumn*.

But notwithstanding these frightful results of the dietetical abuse of alcohol, it is, when temperately indulged and discriminately prescribed as a medicine, a most salutary stimulant.

As a medicinal excitant, alcohol in some respects resembles a narcotic in its operation; its use is more or less followed by sedative effects; but its stimulant influence is too great to allow it to be employed as a narcotic. In its diluted state it is serviceable in those fevers, and those periods of fever, which indicate much depression. Great attention is necessary in determining the degree of dilution which is always requisite: as a general rule, one part of ardent spirits to five of water, and the mixture acidulated with lemon-juice and sweetened, is a mixture of a proper strength, and forms an excellent substitute for wine. In this degree of strength, it may even be prescribed in some diseases of excitement, if no vital organ be affected, and the powers of life are sinking.

In dyspeptic states of the stomach, although often recommended, alcohol is often pernicious. The symptoms of dyspepsia sometimes depend on a state of subacute inflammation instead of debility of the organ; thence only one opinion can be formed respecting the propriety of prescribing stimulants. If alcohol, simply diluted with water, produce these effects, we may also look for them from its combination in wine, beer, and cider.

In regarding the therapeutical influence of wine, we must consider both the chemical properties of the kind of wine to be prescribed, and the condition of the habit of the patient. With respect to the former, sweet wines, such as mountain, constantia, tent, lisbon, &c. although they do not intoxicate so quickly as some other wines, yet, owing to their imperfect fermentation, promote acidity, and therefore they should not be prescribed in any case when the stomach is in a low state of vitality. The brisk and sparkling wines, the produce of Champagne and Burgundy, intoxicate sooner than dry or still wines, owing to the carbonic acid which they contain; but their effect is more transitory, and the subsequent exhaustion less than that caused by other wines; thence they are salutary stimulants in those diseases which are termed nervous, when taken in moderation; and no opinion is worse founded than that which regards them as injurious to gouty habits. The light wines of the Rhine and the Moselle are less likely than any of the others to influence injuriously the nervous system: they are less inebriating and possess diuretic properties, and although acidulous, yet they do not disorder the stomach so readily as the stronger wines, both because the acid which they contain is the tartaric, the least fermentable of the vegetable acids, and also because their alcohol is intimately combined with the other principles of the wine. The strong wines, as port, sherry, madeira, and the aromatic spirituous wines of Burgundy, are the least wholesome, owing chiefly to the uncombined brandy which is

mixed with them for the purpose of securing their exportation, and their powerful intoxicating properties. All of them, also, contain volatile oil, which displays narcotic properties in the nervous system, and induces a tendency to apoplexy.

With respect to the second object of consideration,—the state of the habit in diseases which require the stimulus of wine,—we may venture to affirm that wine, under proper management, is well adapted for the advanced stages of continued fevers, and every disease in which the powers of the constitution fail. Its exciting powers are of primary importance, and it is grateful to the palates of most patients; but various circumstances are requisite to be attended to in its administration.

1. It is more necessary and safe if during health the patient has been accustomed to take wine, than if his habits have been abstemious.

2. It is indicated when, in the advanced stage of fever, the pulse is frequent, small, and compressible; if there is low muttering delirium, and subsultus tendinum.

3. It is also indicated when there is a strong instinctive desire for it; on the contrary, its use should not be urged when there is no such desire.

4. Its effects should be watched: if it do not disorder the stomach, or augment the heat of the skin, but fill the pulse and lessen its frequency, mitigate delirium, and remove restlessness, it is not only proper but absolutely requisite.

5. In contagious fevers, with a languid pulse and oppressed spirits, wine may be administered in an early stage. It should be given in small quantities, frequently repeated, as long as it seems to answer the intention of its exhibition; nor should it be rapidly withdrawn, but gradually diminished as the febrile symptoms abate, and the system displays more susceptibility of its impression.

6. Claret and Rhine wines are more proper than the stronger wines in the earlier, but not in the later or sinking stages of fever. The lighter wines generally tend to open the bowels, the stronger to check diarrhœa; but sometimes the opposite is the case.

7. With respect to the form of administering wine, it is generally most grateful to the sick when warmed, sweetened, and slightly acidulated; but to many patients it is most grateful when diluted with cold water.

Wine proves hurtful in neuralgic and rheumatic affections, and, like every remedial agent, is beneficial or injurious, according to the degree of skill, discrimination, and judgment which directs its administration.

These remarks are applicable to **ether** and its preparations, which differ from wine in their operation chiefly by the rapidity with which their effects are propagated over the system. It is probable that ether is absorbed in its state of vapour, and applied directly to the nervous centres. When taken into the stomach in moderate doses, twenty or thirty minims in a glass of water, it stimulates the gastric nerves, and has a powerful influence in checking vomiting. In malignant fevers it aids in allaying subsultus tendinum and hiccough; and when prescribed in larger doses, on the approach of the intermittent paroxysm, it often succeeds in preventing its accession.

In treating of **electricity** as a stimulant, it would be out of place here to enter into any investigation of the causes of its phenomena; its influence as a therapeutical agent in the removal of disease is our object. In whatever form it be employed, whether as voltaic or common electricity, when it is applied to the animal system in a moderate degree it increases excitement; in a large quantity, it destroys life. It operates equally on the sensibility and the irritability of the system, is quickly propagated, and excites the action of the most distant parts. It differs from other powerful stimulants in not being followed by those secondary effects which are the result of the excitant influence of almost every other stimulant. It is indicated only in diseases of debility, and it requires to be continued for many weeks in order to secure beneficial effects from its use. Much, also, depends on the mode of applying it. In all cases the isolation of the patient and the *accumulation* of the electrical fluid on his body should be first tried; then the *aura* used; after which *sparks* may be taken; and, lastly, when the system has accommodated itself to the stimulus, *shocks* may be given. The necessity of proceeding in this cautious manner is obvious: in delicate and nervous habits a strong shock may not only induce syncope, pain, and vomiting of blood, but it may further so exhaust the strength as to accelerate and even cause death. (Percival's Essays, vol. i. p. 393.)

Electricity has been found a useful stimulant in glandular affections. In recent cases it operates by exciting the capillary action and reducing the swelling; in the more advanced, by promoting suppuration. On the same principle much confidence is placed on it in amenorrhœa; it produces a current of blood to the uterus, and stimulates the secreting powers of that organ. It is especially indicated when atony of the uterus accompanies a pale leucophlegmatic condition of the habit. The shocks should be passed directly through the part. When, on the other hand, there is plethora, with rigidity of fibre and a high sanguine complexion, electricity is hazardous in amenorrhœa, unless preceded by bleeding, purging, and other antiphlogistic measures. In every case, before determining on the employment of electricity on the female habit, it should be ascertained that pregnancy is not present, as either miscarriage or premature labour, according to circumstances, and the death of the fœtus, may follow its use. In passing shocks through the uterus under any state of the organ, much caution is requisite in regulating its force: if the shocks are too powerful, danger may result; if too weak, no benefit will accrue from their use.

The beneficial influence of electricity has often been observed in paralysis in all its forms, if it be not complicated with determinations to the head. Thence it is more useful in old than in recent cases, in partial than in general paralysis, and in paraplegia arising from the poison of carbonate of lead, than hemiplegia following apoplexy. In the most favourable cases for its employment it must still be cautiously applied, and the remark of Dr. Percival should always be kept in recollection,

"that few cases which resist the power of small and repeated shocks, yield to great and terrifying ones." Rubefacients aid considerably the beneficial power of electricity. In asphyxia, gentle shocks may be passed through the region of the heart. In deafness from atony of the auditory nerve, sparks should be taken from the internal part of the meatus by means of a metallic conductor passed through a glass tube: the effect is swelling of the part, with an increase of ceruminous matter, which is followed by an improvement in the faculty of the organ. In amaurosis from mere defective sensibility of the optic nerve, much benefit may result from taking sparks from the eye, directed through the back part of the head, following the course of the optic nerve; but if the cause be a tumour pressing on the nerve, either at its origin or in its course, no benefit will follow the use of electricity. In some cases galvanism may be substituted for common electricity, but in general electricity has succeeded where galvanism has failed. See ELECTRICITY and GALVANISM.

We have already treated of the stimulant influence of caloric. See BATHING.

Iodine is a powerful stimulant, whether it be employed in its simple or uncombined stage, or as it exists in many preparations. Its great utility depends on its entering the circulation and exciting the capillary system. Its primary influence, however, is exerted upon the stomach, a fact which has been fully ascertained by the appearance observed on that organ in persons who have been poisoned by it: indeed, the powerful manner in which it attacks the skin might have enabled us to prognosticate a similar effect when it is introduced into the stomach. Like some other medicines, it accumulates in the system; and, therefore, the continued employment of it, even in small doses, has occasionally proved hurtful. Its absorption is demonstrated by the facility with which it is detected in the blood, the urine, the perspiration, and other secretions; thence its stimulant influence is extended to every part of the frame; the absorbents are urged to unusual activity, and not only diseased but healthy parts are carried off by its means; the mammæ in women and the testicles in men waste: in truth, no gland is exempt from the influence of iodine. There is a remarkable discrepancy, however, in its action, which was first observed by M. Lugol,—namely, that women labouring under scrofula, instead of becoming emaciated, gain flesh. In overdoses it operates as a poison, causing heat and a sensation of weight at the epigastrium, pain at the lower part of the sternum increased on pressure, cardialgia, burning heat of the skin, excessive thirst, and frequent purging of dark bilious matter; the pulse is weak and tremulous; great restlessness and palpitations supervene; with frequent syncope and extreme exhaustion.

The principal diseases for which iodine has been advantageously administered are bronchocele, scrofula, amenorrhœa, chlorosis, dropsy, and every form of disease arising from or connected with diminished capillary action. The activity of the medicine is modified by its combination with other substances; as in the hydriodate of potassa, the iodurets of mercury and of lead, and ioduret and hydriodate of iron. The first is the least active of these preparations, and is chiefly employed as a vehicle for augmenting the solubility of iodine in aqueous fluids: the iodurets of mercury and of lead are more powerful stimulants than the iodine alone, and require to be cautiously administered in doses at first not exceeding the sixth of a grain; on the other hand, the combination with iron, which was introduced to the notice of the profession by the writer of this article, diminishes the irritative action of the iodine, whilst the iron being rendered soluble, and in a state to be readily converted into the protoxide, is carried into the habit with the iodine, and aids its deobstruent influence by giving tone and support to the system.* It is admirably adapted for chlorotic affections, and cases of glandular obstructions, connected with diminished power and a leucophlegmatic state of the habit. On account of its deliquescent property it cannot be administered in substance; and when dissolved it is converted into a hydriodate, in which form it may be administered in doses of from two to six grains three times a day. The influence of both its components is rapidly visible on the habit, by the improved colour of the skin, the increase of appetite, exhilarated spirits, and invigorated strength of the patient; and so quickly does it get into the system, that in twenty-four hours after the first dose has been taken, both the iron and the iodine can be detected in the secretions. It is incompatible in prescriptions with alkalies and their carbonates; the metallic salts; all vegetable infusions and decoctions containing tannin and gallic acid; the preparations of opium, henbane, and conium; the alkaloids and their salts, and chlorine. It has one advantage over all the other preparations of iodine,—it does not produce emaciation, or that wasting of glandular bodies, which renders the closest watchfulness requisite in their administration.—[See EUTROPHIC.]

The stimulant influence of all the preparations of **mercury** has been long known and acknowledged. In whatever manner they are introduced into the body, whether they be taken into the stomach or applied by friction to the skin, they excite powerfully, and set up a febrile condition of the system, evidenced both by the state of the pulse and the nerves, and by an augmented energy in the whole secerning organs. This action, like that of every other energetic stimulant, when carried beyond a certain point, or when long continued, debilitates, and, consequently, emaciation is a constant attendant of a mercurial course. In producing their effects, mercurial preparations,

* The ioduret of iron is prepared by placing one part of soft tempered iron-wire in a hollow porcelain vessel with a considerable quantity of distilled water, and adding five parts, by weight, of pure iodine, and then subjecting the mixture to heat, constantly stirring until the solution is accomplished and the liquid is nearly clear. The solution is then to be filtered and immediately evaporated to dryness in a flask, which must be broken as soon as the ioduret has crystallized, and the preparation directly put into a well-stopped phial. It is a protoioduret, containing one equivalent of each of its components. When well made, and well preserved from the air, it dissolves entirely, and affords a pale greenish-yellow solution; but when not well preserved from the air, a portion of the iron is converted into the peroxide of the metal, and a sesqui-ioduret is formed, so that when it is rubbed up with water the peroxide remains insoluble. [For one of the best modes of preparing it, see *Pharmacopœia of the United States*, Philad. 1842.]

whether oxides, chlorides, cyanides, or iodides, are decomposed, and the mercury, in a metallic form, is either thrown out of the body by the skin and lungs, or, under certain circumstances, is deposited in the glands and the bones. The first of these facts is demonstrated by the amalgam formed between the exhaled mercury and gold and silver coins worn in the pocket of a person under a course of mercury: the second has been confirmed by the discovery of metallic mercury in various parts of the body, in *post-mortem* examinations. Amongst other well-authenticated proofs of the latter, there is a pelvis of a young woman who died of syphilis, preserved in the Lubben cabinet of midwifery, which is infiltrated with metallic mercury.

The stimulant influence of mercurials is much modified by the manner and the doses in which they are administered, and to a certain extent by the nature of the preparation employed. In large doses, given at distant intervals, mercurials operate as local stimulants, first on the liver and pancreas, by exciting the orifices of their excretory ducts, through which the impression is conveyed to these glands; and, secondly, on the exhalants of the alimentary canal, thereby unloading the vascular system and giving a new impulse to the circulating powers. In this case no primary excitement is communicated to the capillary system. When smaller doses, repeated at short intervals, are administered, the mercurial is absorbed, and being directly applied to the capillaries, the whole glandular system is excited; and the salivary glands being more susceptible of impressions than those of the rest of the body, salivation is the consequence. When this high degree of irritation is carried to excess or long-continued, it is apt to be followed by a state of exhaustion which sometimes proceeds rapidly to a fatal termination; or when that condition of the nervous system which has been denominated hysterical, exists, particularly if the patient be exposed to sudden alternations of heat and cold, the ordinary febrile symptoms resulting from mercurial action are attended by dry cough and tightness across the præcordia; and an eruption closely resembling eczema appears. At first a redness is diffused over considerable portions of the surface; this is followed by crowded minute vesications, accompanied by a stinging sensation, and this continues after the vesications; dry and extensive exfoliations of large flakes of the skin occur; the eyes and palpebræ are completely denuded of their hairs; the head swells; the whole body exhales a fetid odour; and a degree of exhaustion, which tends to the fatal termination, generally supervenes. (See article Eczema.) This affection was first noticed, as a result of the action of mercury, by Mr. Alley of Dublin, (Essay on a peculiar eruptive disease, arising from the exhibitions of mercury, by George Alley, Dub. 1804,) and afterwards ably investigated by Dr. Moriarty, (Description of Mercurial Lepra, by D. Moriarty, Dub. 1804,) Dr. Spens, (Cases, &c. by Thomas Spens, M.D. Edin. Med. and Surg. Journ. vol. i. p. 7,) and others. All temperaments, it is stated by those who have written on the disease, are liable to this species of eczema, but the experience of the author of this article is at variance with that opinion; and he believes that it is peculiar to that state of habit which is termed *hysterical*, occurring in a sanguine temperament.

In no circumstances, not even in the treatment of syphilis, is the introduction of mercurials into the habit required to be carried so far as to risk the appearance of these effects. Salivation is not essential, and can be regarded as a mere proof that the system is fully under the influence of the mercurial action; to throw in more is merely raising a higher degree of irritation, which is not only unnecessary but hurtful. Too profuse salivation has induced epilepsy, and occasionally led to that fatal erethismus which sometimes occurs when mercurials appear to act as poisons on the system, in which the use of the stimulant must be discontinued, and the patients exposed freely to a cool atmosphere, whilst the strength is sustained by a liberal allowance of mild but nutritive diet. On this account, mercurials should be introduced into the system gradually, and the mildest forms of the preparations first employed. The efficacy of the remedy undoubtedly depends on its exciting power, but this should be maintained only in a moderate degree; and it is of importance that the excitement should not be disturbed by that of any other stimulus, dietetical or medicinal; thence the necessity of dieting patients during a mercurial course. If wine or other stimulants be allowed, the peculiar action set up by the mercury may be so modified as to prevent it from overcoming that induced by the virus of syphilis; a rule which is applicable, perhaps, in regulating the employment of all other stimulants. It is proper to remark here, that the degree of the febrile action induced by mercurials does not always depend on either the extent of the dose or the nature of the preparation; two grains of calomel will cause salivation in some persons, whilst in others no effects can be produced by the largest doses, long continued, until fumigations are resorted to; and even these have been resisted. A knowledge of the circumstances on which these anomalies depend is important: they may be arranged under those which refer to the body,—temperament, idiosyncrasy, and sex; and those extraneous to it,—climate, and the nature of the preparations employed.

1. With respect to temperament, the sanguine and choleric are more susceptible of the mercurial action than other individuals: if the remedy be given for the cure of syphilis, great caution is necessary not to bring the habit suddenly under the full influence of the medicine.

2. Some idiosyncrasies are occasionally met with which prevent the free use of mercurials; and as this may occur in reference to some preparations and not to others, it is proper, when syphilis is the disease, that a person who seems to suffer in this manner should try other preparations before his system is pronounced incapable of bearing mercury, and he is thereby deprived of the only chance of being cured.

3. With regard to sex, women are more easily brought under the mercurial influence than men; and as it promotes the uterine secretion, the use of mercurials should be suspended during the continuance of the catamenia. In pregnancy, also, their employment requires the utmost caution.

They do not, however, materially interfere with lactation; and therefore, when infants are affected with congenital syphilis, the mercurial influence is readily communicated to the system of the child by the milk of the mother.

4. As climate renders the human habit highly susceptible of the impression of all medicinal agents, a smaller quantity of mercury and a shorter period for its application will suffice to cure syphilis in a warm than a cold climate; and, for the same reason, this stimulant is more beneficial when employed in summer than in winter. Sydenham sent his syphilitic patients to the south of France.

5. In reviewing the comparative merit of the various preparations of mercury, it would be out of place here to enter into pharmaceutical details. Among the *protoxides* the *blue pill*, when properly prepared, is the mildest of those which certainly mercurialize the habit. It seldom incommodes either the stomach or the bowels, unless much acid be present, in which case it is apt to gripe and purge. From the mildness of its operation, it is admirably adapted for the naturally delicate and those debilitated by previous disease. But in some persons, however, it proves too active, and requires the addition of opium, or the administration of a few grains of rhubarb, in the morning, to communicate tone and prevent griping. It gradually displays its influence by affecting the gums, when given in doses of five or six grains night and morning.

The *hydrargyrum cum cretâ*, in doses of a scruple to half a drachm, is sometimes substituted for the blue pill when much acid is present on the stomach, but its action is slow and uncertain.

The *grey oxides*, although precipitated from active salts, yet are mild preparations. They incommode the stomach and bowels less than the blue pill, and, being more oxidized, they act with more certainty; but they are not much employed, except for fumigations.

The *peroxides*, constituting the red precipitate *per se* and the precipitate with nitric acid, operate with too much acrimony to be used internally, inducing griping, diarrhœa, and tenesmus. They are, consequently, used only as topical excitants.

The *chlorides*, *calomel* and *corrosive sublimate*, are also most active stimulants. The protochloride, calomel, in doses of four or five grains, frequently operates topically, stimulating the orifices of the gall-ducts, and, by thus throwing much bile into the intestinal canal, causing purging. In smaller doses, it brings the habit under the mercurial influence more rapidly than the blue pill, and it is even more manageable. Its stimulant influence on the capillaries greatly aids the action of other remedies; as, for instance, the diaphoretic powers of antimonials, and the diuretic of squill and foxglove; it aids, also, the force of the milder purgatives, whilst it moderates the acrimony of the more drastic. The best form of administering it is that of pill combined with opium.

The *perchloride*, *corrosive sublimate*, is the most active of all the mercurial salts, but it frequently gripes, even when administered in very small doses, and is supposed to have the power of causing cough, hemoptysis, and phthisis. It is, nevertheless, one of those preparations on which experience has taught us to rely in cases of syphilitic eruptions, especially those which assume the characters of psoriasis or of lepra; and from the rapidity with which it brings the habit under the mercurial influence, it proves, as Mr. Pearson has remarked, often beneficial at the commencement of a course of mercury. The dose of the perchloride should not exceed, at first, one-tenth of a grain; but, if it be guarded by opium, it may be gradually increased to half a grain, twice a day. A good vehicle for administering it is nitric acid, in which the salt dissolves without undergoing any chemical change; and in this form it may be given in conjunction with decoction of sarsaparilla or of elm-bark, in cases of syphilitic eruptions. In such case that attention to diet, which has been already noticed, is most essential, little benefit following the use of the perchloride if the patient is permitted to indulge in his usual diet, and to use, even moderately, either wine or spirits, or any fermented liquor; he should be restricted to milk and farinaceous matters.

These remarks are applicable to the remaining mercurial preparations, the iodides and cyanides, which are gradually coming into general use; the iodides in particular, as they are equal in stimulant power to the most active of the old preparations, and possess, besides, other advantages. From the influence of the iodine which they contain, they are likely to supersede the perchloride as an internal remedy. [See EUTROPHIC.]

The only other material stimulants which require to be noticed are **ammonia** and its **carbonates.** In the state in which the former is medicinally employed, it excites powerfully the living solid, inflaming and causing vesication or suppuration, according to the nature of the surface or tissue to which it is applied. When very largely diluted, and taken into the stomach, its primary stimulant impression is made on the nerves of that organ, and the impulse is rapidly propagated over the system; but its effects are transitory; thence it is, like ether, regarded as a diffusible stimulus. It is indicated in those diseases and stages of the habit in which there is an evident deficiency of nervous power, and where it is important to rouse the nervous energy without affecting, in an equal ratio, the sanguiferous system. In prescribing it, the only object to be kept in view is not to administer it in doses sufficient to exhaust the excitability. The carbonates operate in a similar manner, but with less energy. The dose of the liquor ammoniæ is from ten minims to half a drachm; that of the subcarbonate from five to fifteen grains; both should be involved in some bland mucilaginous emulsion. The ammonia possesses one advantage over the carbonates—it may be prescribed in conjunction with muriate of lime and the salts of baryta, which are precipitated by the carbonates.*

Some consideration is due to **mental stimulants,** which are too much overlooked by the physician. The effects of all the exciting passions closely resemble those that follow the impression of a powerful material stimulant; the action of the heart and arteries is suddenly augmented; the animal temperature is elevated; per-

* Nothing is more likely to prove injurious than applying a bottle of liquor ammoniæ to the nostrils of persons who are in a state of syncope. The life of a medical man was nearly sacrificed to a rash act of this kind.

spiration flows freely, demonstrating the direct influence on the capillaries; the face glows, the eyes sparkle, and the respiration becomes quicker and fuller. The mental functions of the brain are not less excited than those of the body: the imagination takes a more excursive range; the pleasurable scenes of former life are again presented to the memory; the future teems with gay and delightful anticipations; every task seems easy, every labour light; whilst the most difficult and momentous schemes appear already accomplished, and crowned with the most brilliant success. But, besides these effects, the excitement of some passions, especially *joy*, quickens the corporeal sensibility; every object makes a stronger impression on the organs of sense; the eye sees more distinctly, the ear is more acutely alive to sounds, the taste and the touch are delicately sensitive, and every bodily movement is more prompt and energetic. It is unnecessary here to enter into any metaphysical conjectures respecting this influence of the intellectual essence, connected with our existence, on the material part of our frame; the effects of its excitant power are sufficient to enable us to trace its importance as a therapeutical agent.

The condition of the habit in which the exciting passions, particularly joy, may be employed as a remedy, is that which is characterized by languor and debility, in such diseases as melancholia, hypochondriasis, dyspepsia, and chlorosis; and many cases might be detailed to display their beneficial influence on those afflicted with these diseases. (Lory de Melancholia, tom. i. p. 57.—Trellianus, lib. ix. p. 17.) The application, however, of such agents requires the utmost judgment and discrimination: a sudden impulse of joy has made so powerful an impression on the nervous and irritable frame of delicate persons, as to produce epilepsy, and even death. The influence of mental excitants in such cases, like the stroke of a flash of lightning, whilst it illuminates, destroys its victim. (Haller's Physiology, vol. v. p. 501.)

The knowledge of this stimulant influence of mind on body is also important in pointing out, to the student and the inexperienced practitioner, the necessity of guarding those weakened by disease from indulging in impetuosity of feeling, whether during the progress of the malady, or in convalescence. The fatal consequence of such a state of excited feeling was once witnessed by the writer of this article. A gentleman in the advanced stage of phthisis was visited by an old friend, whom he had not seen for many years; the conversation turned upon an event in which the poor invalid felt deeply interested; in relating it he became greatly excited, rose from his seat, and displayed an unusual impetuosity of manner; but he had scarcely concluded the narrative ere he sank into his chair and instantly expired. It is easy to conceive that in such a state of excitement the effects would be felt chiefly upon the thoracic viscera; for, even in a state of health, impetuosity causes an unusual glow of warmth in the præcordia, the pulse beats quickly, and a peculiar sensation is experienced, which is referred, and not without reason, to the heart.

Such is the nature of those stimulants which are so manageable as to be fitted for therapeutical purposes; their importance as remedies is undoubted; but the very nature of the substances belonging to this class renders them more liable to be abused than those in any of the other classes; we shall conclude this article, therefore, with a few remarks upon the cautions requisite to be kept in view during their administration.

It is scarcely necessary to caution against the general employment of stimulants in febrile affections marked by a quick and full pulse, with much heat of body: in truth, it is only in the latter stage of fevers, when the diminished action of the heart is manifested by a fluttering pulse and a cold clamminess on the skin, that stimulants are advisable: they rouse again, not only the nervous energy, but also that action of the capillary system without which the powers of life cannot be sustained. Great discrimination, also, is requisite in determining the exact period when they are demanded, even in this stage of fever; and there is, perhaps, less risk in permitting the prostration of strength to proceed for a short time, than to hazard their administration on the first indications of the approach of collapse: even when the circumstances which demand the employment of wine in typhus are fully developed, much caution is requisite. When the debility seems to yield to the free administration of wine, the observing physician will often find sufficient reasons for suspecting that the temporary vigour that it apparently bestows is succeeded by a greater degree of debility, and, consequently, that the utmost danger may result from persevering in the use of stimulants. When petechiæ appear, or when there is protracted diarrhœa followed by sudden collapse, wine and other stimulants are not only admissible, but are remedies upon which we must rely for the safety of the patient; and this is also true when the tongue is coated with a brown fur, the teeth and gums are covered with sordes, the skin is hot and dry, and when subsultus tendinum and low delirium are present, with a rapid, small, compressible pulse.

Stimulants have been found beneficial in those affections of the chest which are accompanied with spasm, as, for example, the latter stage of hooping-cough. In bronchitis and similar affections, although, during the continuance of the inflammatory action, when the cough is dry and the expectoration difficult, stimulants would be productive of the greatest mischief, yet in the advanced stages, particularly in peripneumony, their administration is demanded, not only to aid expectoration, but to excite the capillaries so as to relieve the engorged state of the pulmonary tissues. On the same principles, also, camphor and sulphuric ether prove successful in relieving the urgent symptoms in some varieties of dyspnœa, whilst they are as injurious in others. It is in those cases in which effusions into the air-tubes take place, consisting of either a redundancy of the natural secretion, or frothy mucus the result of previous inflammation, that we may most confidently anticipate advantage from the administration of stimulants. In softening of the muscular tissue of the heart, they prove serviceable in renewing the vigour of the ventricular action, and rendering the contractions more steady and regular. Stimulants, however, are not only contra-

indicated, but are directly injurious, wherever there is reason for suspecting hypertrophy of one or both ventricles of the heart. When the hypertrophy is confined to the left ventricle, their administration is followed by vertigo, dimness of sight, singing in the ears, weight in the head, and epistaxis; or, if this do not occur, by congestion of the encephalon and apoplexy.

In hysteria, epilepsy, chorea, catalepsy, tetanus, neuralgia, and, under some circumstances, in hypochondriacal and maniacal affections, stimulants are clearly indicated. In these cases, however, the state of the brain and the spinal marrow must be clearly ascertained; morbid dissections having demonstrated that many affections which are frequently regarded as altogether nervous, are connected with and dependent upon abscess, ulcerations, tumours, or depositions of blood in the substance of the brain, or collections of fluid in the ventricles; sometimes on a similar affection of the spinal cord or its tunics. Wherever these are suspected, there can be only one opinion respecting the impropriety of the administration of stimulants.

In many instances of paralysis, especially in that of the lower extremities, constituting paraplegia, experience has fully demonstrated the utility of strychnia and other stimulants; but, at the same time, circumstances may exist which contraindicate their employment, and nothing is more necessary than a sound judgment and a cautious diagnosis in such cases. The employment of external stimulants is less hazardous; but the result of their employment, not excepting electricity, has been disappointment.

From the state of the nervous centres closely resembling that which produces paralysis, the skin often loses its natural qualities, becomes pale or discoloured, soft and scaly, or covered with crusts. In this condition stimulants prove serviceable, by throwing the blood upon the surface and exciting generally the cutaneous capillaries. It is essential, however, to distinguish between this state and that in which inflammatory pustules and tubercles appear upon the skin, the disposition to which is undoubtedly increased by exciting medicines.

In many painful affections, in which it is necessary to exhaust the sensibility of nerves, the topical application of stimulants has been found beneficial; as, for example, toothach from caries, whitlow, and paronychia; the various species of erythema, and in some of those of herpes. In malignant sore throat, capsicum and some other stimulants form the bases of the most useful gargles.

Many stimulants are employed as condiments; some of them are our daily beverage; and the general predilection of all nations for diffusible stimulants, particularly wine and ardent spirits, is sufficient to demonstrate the caution requisite in their employment as remedial agents. It is of the utmost importance, also, that the student should clearly understand the distinction between stimulants and tonics, or those medicines which simply increase action and those which are capable of producing a permanent augmentation of power. It is true that the excitement which stimulants afford to the nervous system, in a debilitated state of the body, gives a temporary impulse to the power of the digestive organs and consequent increase of strength to every part of the frame; but this effect is merely temporary: and the continued employment of the stimulant, instead of maintaining this condition of the habit, is followed by the directly opposite state, that of exhaustion; indubitably proving that action is not strength. The combination, however, of stimulants and tonics aids greatly the power of the latter; the former calling forth, as it were, the tone which the latter renders permanent.

A. T. Thomson.

STOMACH, ORGANIC DISEASES OF.—The term organic disease, as it is used in this article, comprehends alone the morbid affections which involve *profound* alterations of structure in the stomach, as distinct from those pathological states in which structural changes are imperceptible, or are only slight and transitory. The important affections which fall under the latter description are treated of in this work in the several articles, Gastritis, Indigestion, &c.

In this acceptation the term organic disease has been employed for a long period, and is generally received at the present day. Its strict limitation, however, is not without ambiguity, on account of the great advancement which pathological anatomy has made in modern times, and in particular because the doctrines of some influential writers have asserted for it a position in medicine which it is not likely to retain. When we consider the comparatively short period within which it has become a branch of science, and the copious fruit it has yielded, it seems indeed only difficult to imagine the bounds of its application. Previous to the time when Bichat's researches gave a new direction to physiological study, the lesions of structure were not at all investigated. Descriptions of morbid appearances were occasionally recorded, but they refer almost exclusively to the surface of organs, and notice merely their alteration in volume, form, and colour. But the analysis of the tissues soon made it apparent that a rich mine of pathological discovery remained unworked in their morbid anatomy, and the attention of most of those who pursued medicine with scientific views was soon directed to this subject. To their labours is to be ascribed the unprecedented progress which medicine has made within the last half century, and the partial remodelling which has taken place in its principles and practice. The effects of disease have been investigated not only in the interior of organs, but in every variety of tissue which contributes to their formation; morbid products have been discovered and classified, and the minutest alterations have been observed, insomuch that it would seem that the researches of anatomy have approached the verge of what is cognizable by the senses, in tracing the organic changes caused by diseased action. But notwithstanding this, the fundamental dogma of the school of Bichat and Reil (viz. that vital actions are ultimately referable to the organization of matter) is warmly maintained, and applied to pathology by some who are desirous of basing the latter altogether upon anatomy. They assert that every morbid action is primarily caused by an organic change, and they consequently admit no definite distinction between diseases which exhibit lesions of structure, and those in which none can

be discovered, every disease having thus in their doctrine, the nature of an organic disease. (*Rostan*, Cours de Médecine Clinique, tom. ii. p. 6, et passim.) This appears to us to be an abuse of pathological anatomy. We shall not, however, discuss this matter further here, as our object in alluding to it is mainly to fix the value of the term, which, as we have said, has been somewhat embarrassed by being mixed up with those theoretical subtilties. But these have not attached any uncertainty to its meaning (particularly when applied to the stomach) in practical medicine, in which it unequivocally signifies the diseases of that organ which are obviously connected with structural lesions.

Organic diseases of the stomach may, for the sake of description, be conveniently divided into the diseases in which the parietes, or the separate tunics which enter into their composition, become altered in structure, and those in which the entire viscus suffers a pathological change. To the first class belong cancer or scirrhus of the stomach, ulceration, hypertrophy, and atrophy of the tunics, and softening. The second comprises the alterations in volume of the whole organ; viz., its enlargement and contraction. This division is as precise as the present state of the subject will admit of, and seems to be founded on natural distinctions. The lesions comprised in it possess different degrees of importance, and we now proceed to notice them separately, in the order in which they are enumerated. We shall treat of them in as practical a manner as possible, and shall observe brevity on many of the subjects, to avoid the repetition of matters which are amply discussed in this work, in articles specially devoted to them, viz. Atrophy, Hypertrophy, Scirrhus, Softening, Ulceration, &c.

I. **Cancer or Scirrhus of the Stomach.**—This formidable malady has for its essential character the growth of a morbid product, usually called scirrhus, upon some part of the parieties of the stomach, which, being once developed, advances until this viscus becomes disorganized, and in its course produces a slow succession of distressing symptoms, and eventually a fatal termination. Its history had been traced with considerable accuracy long before anatomy had given any light to pathology, and it seems to have been among the first internal organic diseases which attracted notice. Some have asserted, not unreasonably, that it was described by Hippocrates under the name of μελαινα; and although this, from want of anatomical evidence, cannot be proved with certainty, it will appear, on reference to the brief but graphic description which he has left us of the disease represented by this term, (De Morbis, lib. ii. sect. v. *Chardel*,) that it corresponds closely with that of cancer of the stomach. Galen also must have had this disease before him, when he observed that the growth of certain tumours in the stomach sometimes obstructed or even interrupted the passage of food, inasmuch as organic obstructions of this viscus are almost invariably of a cancerous nature. And, as before necroscopic inspection had revealed its nature, its formidable symptoms had given it a place in medical writings, so at the earliest period at which this was practised, we find an account of it. Antonio Benevieni, who is cited by Lobstein as the first author that was specially occupied with pathological anatomy, makes particular mention of scirrhus of the stomach. (De abditis nonnullis ac mirandis morborum et sanationum causis. Florent. 1507.) Afterwards Hildanus, Morgagni, Lieutaud, and Haller, noticed its external anatomical characters with reference chiefly to its obstruction of the alimentary canal. At the commencement of the last century the subject of scirrhus and cancer was much discussed in the schools. Then only the identity of this morbid structure as invading the stomach, with that which produces the long known cancer of external parts, became fully recognised, and from this period it formed an ordinary topic in every collection of medical observations. Some interesting facts are recorded in these, but the history and pathology of the disease were advanced but little by them, as the theory of medicine was still fettered by narrow speculations, and the only method which was employed to investigate cancer was to reduce it to the dogmas of the humoral pathology. At the beginning of the present century this had given place, and amongst the first benefits which accrued to medicine from the enlightened spirit of observation which succeeded, is to be reckoned the ascertaining of the physical properties of the anormal tissues, inclusive of scirrhus and cancer. This, the result of the researches of Bayle and Laennec, was the chief step in our knowledge of the pathology of cancer of the stomach, as it at present stands. It is also to be acknowledged that in this as well as all other diseases of this organ, the science is greatly indebted to the labours of Broussais. His writings and the agitation of his doctrines challenged for the stomach an importance in pathology which has directed to it the attention of the distinguished men whose labours constitute the richest materials of modern medicine.

History.—Cancer of the stomach is a disease very insidious in its commencement, and chronic in its course. Few cases come to a termination in a period shorter than six months from the time at which the organ first exhibits signs of being affected, but for the most part it entails upon the patient a protracted train of suffering not unfrequently of several years' duration. On comparing the numbers of males and females affected by it, the former greatly predominates. The stomach of the latter comparatively enjoys an immunity from cancer, which observation has been confirmed by the rare occurrence of the disease at the great hospital Salpêtrière at Paris, which is tenanted by old females. This difference as to the sexes seems to depend on the greater exposure of men to some of its causes, such as the habitual use of ardent spirits, and still more to the greater frequency in them of deep moral emotions of a gloomy character, which are observed to exert a peculiarly injurious influence upon the digestive organs. In the female these are less prevalent; besides, in this sex the genital system suffers those physical effects of moral emotion which in man bear upon the digestive system; and, in agreement with this, it is found that cancers of the mamma and the uterus fully compensate for the lesser number of cancers of the stomach in the female than the male sex. It is a disease of mature age, and seldom manifests

itself before thirty or after seventy. We believe there is no authenticated case on record in which it occurred before puberty, which observation, it may be remarked, is an additional indication of the influence which moral causes exert in its production. Some authors affirm that the temperaments have a different predisposing influence with respect to it, and that the lymphatic and sanguine are more liable to its invasion than the bilious and nervous. If this be on the whole founded in fact, the preponderance is not very great. As far as our own observation extends, individuals of dark hair and eyes possess a greater immunity neither from this disease nor from pulmonary tubercles (with respect to which the same difference in the temperaments has been asserted), than those whose complexion is of an opposite character.

In detailing the symptoms of cancer of the stomach, it is convenient to consider its progress as having separate periods or stages. Chardel (Monographie des Dégénerations Skirrheuses de l'Estomac, Paris, 1808) conceived this plan, and in his description marked three periods. Succeeding authors have observed it likewise, but as we think, with greater insight into the pathology of the disease, they have recognised but two. The latter division will be followed in this account of the symptoms which we shall give very succinctly, as we shall notice some of them separately in adverting to the diagnosis afterwards.

First period. — There is but little perceptible difference between the earliest features of this disease and those of common nervous dyspepsia. As in the latter, flatus, acid eructations, and weight at the epigastric region are commonly its first symptoms, accompanied, however, by a greater degree of general languor than that which attends on any form of dyspepsia. No uncommon attention may be paid to these, until considerable pain begins to be felt in the region of the stomach, especially after meals, and pressure in the epigastrium detects soreness. On some occasions it has commenced by a sensation quite the reverse of pain, which consisted of an indescribable tickling of an agreeable nature, occurring when the stomach is empty. But sooner or later pain at length arrives; at first it is confined to its own seat, and disturbs the patient only at intervals, but in a little time it becomes very oppressive, and shoots from the stomach into the back and loins down the thighs. The animal spirits sink more or less, and often the individual is known to express his consciousness that he is the victim of some profound disease. Nausea sets in, and the food is rejected, mixed with quantities of ropy mucus, by which the pain and oppression are relieved, so that in the beginning the patient rather desires vomiting, and sometimes uses artificial means to provoke it. When the process of digestion is past, much mitigation of all the symptoms ensues, during which a comparative calm and even cheerfulness prevails in the mind of the patient. He learns to pay the greatest attention to his diet, from the peculiar distress experienced after eating any substance which causes flatulency. On this account he avoids feculent vegetables, highly seasoned puddings and other dishes, and prefers small quantities of solid meat. Yet the appetite is sometimes but little impaired, but it cannot be indulged to satisfaction from the aggravation of the symptoms which full meals induce. Feverish excitement rarely occurs at this period, neither is any remarkable thirst present, but occasionally spirituous drinks are taken with avidity for the purpose of helping the torpid digestion, and by this means mitigating the pains, which are more severe when this process is slowly and laboriously performed. A sensation of dryness and of constriction in the throat (more permanent than what is called globus hystericus) is not uncommonly an additional source of distress and alarm. The bowels are habitually costive, and the use of laxatives becomes indispensable. These are followed by temporary relief, for the same reason as the vomiting, viz., by the evacuation of the fæcal and gaseous accumulations which oppress the stomach by their distention. While the disturbance of the digestive organs is manifested in this manner, the tongue varies little from its natural appearance; it rarely presents any saburral coating or redness, as in inflammatory affections of the digestive tube. Occasionally it is chopped, and lies flat and flabby in the mouth, and sometimes an excessive development has been observed in the fungiform papillæ which are situated at its base.

So far the absence of some of these symptoms may cause variety in this account of the disease. But an observation of still more practical importance is presented in the fact, that in this first period the whole suite of phenomena has been known, under the influence of some cause, evident or undiscovered, rapidly to vanish, and continue suspended for a term of several weeks or months. This inconstancy may appear incompatible with the nature of an organic disease, and thus lead the patient, and even the physician, to form prognostics more favourable than are destined to be realized. The occurrence of this respite is the more usual event, but whether it takes place, or that the symptoms proceed without remission, a time arrives, the term of which it is impossible to assign, at which the malady takes firm possession; and its phenomena, although they may be still ambiguous as diagnostics, are no longer inconstant in their progress. They all at this period take on an increased activity, and henceforth the patient is never left entirely without suffering. The unfavourable change is now and then connected with some imprudence of the patient, but for the most part it supervenes without any evident exciting cause. Its phenomena constitute the second stage.

Second period.—Before the confirmation of the symptoms which marks the commencement of this stage, the nutrition is seldom remarkably affected; but now a visible wasting sets in, and as the malady advances, increases to a frightful degree of emaciation. The pain and weight in the epigastrium in a certain degree become constant; they are aggravated, however, at a particular period after meals, and spontaneous pains of a lancinating character are added. It occasionally happens that the appetite still remains, yet the wretched patient fears to satisfy it, and even prefers to suffer hunger rather than the pain produced by the entrance of food, or by the rejection of it, which he knows will ensue; for the vomiting no longer affords relief as at the beginning, but now much increases the distress.

At length a tumour appears in the epigastric region, which may be detected by accurate touch a considerable period before its external progress produces a visible elevation of the abdominal parietes. Pressure on the tumour does not aggravate the pain immediately, but often it causes great distress to the patient to recline upon the side which is most remote from it. This is evidently owing to the stretching of the irritated viscera by the weight of the tumour, as may be inferred from observing that the patient usually lies upon that side on which the latter least depends.

To the foregoing causes of distress are added sleepless nights. Suffering now becomes habitual, and leaves its impress strongly marked upon the countenance by a peculiar contraction of the features—(the French call this painful expression "*face grippée*")—which is often rendered more ghastly by a dun discoloration of the skin. Nothing is more harassing than the vomiting, which is almost inevitably brought on by the smallest quantity of food. It has been observed that a remarkable anomaly sometimes occurs in the action of the stomach: amongst different articles introduced into it at the same time, it retains some and rejects others, exhibiting thus a kind of election as to the vomited matters. A stronger instance still of this is related, in that the food of the preceding day was vomited, whilst that latest swallowed was retained and digested. But besides the food, various other matters are thrown up from the stomach. Of these the most common are fluids, containing a dark substance like coffee-grounds, uncoagulated blood, a thick porraceous matter, or finally, a dark green serum.

The breath exhales a foul odour, which is disgusting to the patient himself. Towards the latter periods, aphthæ appear in the pharynx. Dropsical effusions occur in the peritoneum and general cellular tissue, which may conceal the extreme marasmus which would be otherwise visible. The constipated state of the bowels gives place to a diarrhœa, which hastens the close. When this symptom is present, a weak febrile action occurs; but independent of it, the disease runs its course without any exaltation of the pulse, loading of the tongue, or feverish heat. At the last, so much debility seizes upon all the functions, that the pains and vomiting cease, and death arrives without any struggle. In some cases it is preceded by delirium.

Pathology and Causes.—As the essential element of this disease lies in the organic lesions to which it gives rise, a description of these is the first consideration in its pathology. Their situation and extent are various. At one time the stomach is found lying in its natural position, unaltered in its size and external appearance; while in others these relations undergo the most important changes: its volume may be uncommonly enlarged, or it may be shrivelled up into a small compass. Instances are on record in which the parietes of the entire viscus were engaged in the cancerous development, but these are exceedingly rare. For the most part its seat is circumscribed, and it occupies in preference,—1st, the pylorus; 2d, the cardia; 3d, the body of the stomach.

1. When it is situated at the *pyloric extremity* of the stomach, this part is changed in a greater or less degree. On inspecting it from without inwards, the peritoneal coat is generally seen in its normal state of smoothness and transparency, and through it appears a dull white mass, forming a tumour of considerable magnitude. It extends from the pyloric orifice, where it is thickest, for some distance towards the body of the stomach, but it is seldom found to encroach upon the duodenum. The cellular tunics are so confounded in the foreign tissue which forms the tumour, that they cannot be distinguished in the midst of it; they form the original nidus of it, and are incorporated in its growth. The muscular tunic is also embedded in the mass, but is generally transformed into mere fibrous bands, or so atrophied as to be difficult of recognition. Cases, however, are recorded in which this coat has not only been spared, but found hypertrophied to a considerable degree. (*Laennec, Louis, Prus.*) The appearance of the mucous membrane varies according to many contingent circumstances; but the state of that part of it which bounds the cancerous tumour internally depends much upon the extent to which the latter is developed. If it has produced no lesion of continuity by its internal growth, the mucous membrane is generally united firmly to it as far as it extends, and in the most central part of the area occupied by the tumour a depression is often found, which has been compared to the round mark left by the blow of a hammer on a piece of lead. In many instances, however, the mucous membrane is found to have yielded by ulceration before the advance of the cancerous mass, which then presents itself at the internal surface of the stomach, with the appearances peculiar to itself.

The intimate structure of the cancerous deposit possesses considerable variety in this as in other situations of the body. Its incision by the scalpel most usually shows it to consist of a firm homogeneous substance of a white colour, resembling the section of a potato, from which this variety was called by Recamier *solanoïd*. In other instances fibres in a concentric arrangement are observed to pass through the mass, which the same pathologist, under these circumstances, would propose to call *napiform*, from its resemblance to the fibrous texture of a cut turnip. Not unfrequently the denser cartilaginous variety which has been more especially known under the name of scirrhous, is found to constitute the mass wholly or in part. Again, it is found in a softer condition, formed by a pulpy substance, having a lobular disposition, and traversed copiously by dark veins, by the rupture of some of which the softest portions of the mass are occasionally found infiltrated with blood. This is the description of cancerous formation to which Laennec gave the well-known name of encephaloid or cerebriform matter. In other cases a viscous jelly has been observed to form some part of the tumour, and this has been found situated in cells, occurring for the most part in the cartilaginous variety; whence it has been considered by some pathologists to be the latter in a state of diffluent softening. All these varieties occur in cancerous masses; and it is to be remarked that they may be combined in the same pyloric tumour, forming separate portions of it, or it may be mingled together so as to lose their distinct

character. They are all referable to some of the varieties of carcinoma, which Dr. Carswell has classed under the two species, which he has denominated *cephaloma* and *scirrhoma* in the Article Scirrhus. We refer to this for the anatomical and physiological history of these heterologous tissues.

2. *The cardia* is the situation in which, next in frequency to the pylorus, the disease occurs. The structural changes differ from those of the pylorus only with respect to their conformation and their relation to the neighbouring viscera. The cancerous mass is seldom voluminous in this situation, but the disorganization extends generally for some space along the lesser curvature and into the œsophagus. Instead of the loose tumour which the pyloric extremity presents when it is the seat of the disease, rarely any morbid appearance is to be seen until by opening the stomach it can be inspected from within. It is then perceived that a greater or less narrowing has taken place in the cardiac orifice by the deposit of the foreign substance. The latter is disposed in various ways; at one time it forms an annular circumscribed stricture, occupying precisely the orifice; at another it projects internally, having burst through the mucous membrane, and presents a cauliflower fungus. Such a vegetation has been known to hang loosely from the edge of the orifice into the stomach, like a valve, so as to prevent the rejection of its contents by the act of vomiting.

3. *The body of the stomach* is, in comparison with the other situations, rarely the primitive seat of cancer. It is, however, by no means uncommon for the affections of the cardiac and pyloric orifices to spread for some space, and involve the adjoining portions of the organ; especially the lesser curvature, which is sometimes found disorganized through its whole extent. In this case the gastro-hepatic epiploon with the lymphatic glands and the vessels contained in it often partake in the disease; as, in like manner, if the greater curvature be much engaged, the greater omentum may be found in a state of scirrhous degeneration.

Independently, however, of disease of either the cardia or pylorus, the cancerous structures in the various conditions above recounted are occasionally observed in the body of the stomach. It is here more especially that a variety which is properly called primitive cancerous ulcer (to distinguish it from those ulcerations which occur in previously existing cancerous deposits) is found. This form of disease commences and runs its course without any antecedent deposit of cancerous structure which can be discerned; yet, as it spreads, its edges are distinguished by a scirrhous hardness, and upon its surface grow fungus vegetations which partake of this character. There is, moreover, another form which is in a measure peculiar to the body of the stomach, being rarely met with at the pylorus or cardia. We allude to a hard circumscribed condition of the parietes, caused by what is called *atrophic* cancerous degeneration. The area which this occupies appears contracted, and the mucous membrane involved is condensed and puckered into hard ridges or star-like streaks. The scirrhous substance does not undergo softening as the other varieties; the alteration which time induces is rather to contract it, and give to its texture a more gritty hardness. It seems to be a laminar deposit of the cartilaginous structure, properly called scirrhus, and it is said to be accompanied with lancinating pains of a more intense description than any other variety of morbid product.

The lesions thus detailed are those which are immediately connected with the pathology of cancer of the stomach: we have now to advert to some variations of these which are of minor interest in this regard, but yet are worthy of attention as connected with some striking phenomena which occasionally complicate the disease towards its termination.

The usual course which the cancerous mass takes in its progressive development, as above remarked, is towards the interior of the stomach. Exceptions to this rule sometimes occur, in which a contrary direction is chosen, and then this morbid product exhibits its well-known characteristic of propagating itself from one surface to another, which is unconnected with it, either by continuity of tissue or analogy of organization. From this it results that other organs are involved in the morbid appearances by a process which is sufficiently evident from an examination of the lesion. In its outward progress adhesions are contracted between the peritoneal coat of the stomach and that of the adjacent organ, and the cancerous matter is deposited in the latter, while its proper tissue is absorbed, apparently by its advancing pressure. This is most frequently observed in the liver, the middle lobe of which is often found firmly united to the pyloric end of the stomach by a cancerous mass, which had originally spread from the latter. A similar propagation of it takes place to the other neighbouring organs, the spleen, pancreas, colon, &c.

Many of the morbid phenomena depend upon the degree in which softening has proceeded in the cancerous formation. This process is for the most part slow in its arrival, and partial. Instances, however, are known in which it pervaded the entire thickness of the mass, and induced rapidly fatal peritonitis by its perforation. (See Perforation.) But this is rendered a rare occurrence by the adhesive union, which is usually established between the stomach and adjacent viscera before perforation can ensue. The same provision, however, which prevents this accident, gives occasion for the softening cancerous mass to pursue its course into the adherent organ: in this way the liver has been found deeply corroded, and forming a cavity continuous with the stomach, the parietes of which were in this place destroyed, and their edges adherent to the liver. In an instance which is on record, a cancerous mass above the cardia propagated itself into the right lung, and excavated it into a profound cavern, in which food was found lodged. Still more striking consequences are exhibited in some rare cases in which the softening cancer proceeds to a perforation, while the stomach is united by adhesion to the anterior wall of the abdomen, or to some of the intestines. In the former instance an external fistula is formed, and the food having free egress escapes in the abdomen. In the latter, the contents of the stomach and of the intestine pass reciprocally into each other by the perforation: on

the one hand, fæcal vomiting occurs as a consequence; and vice versâ, the aliment passes from the stomach through the opening, directly into the intestine, and is voided without having undergone the action of its natural passage.

These are the organic lesions directly connected with this disease which post-mortem examination discovers. Besides these, it is to be remarked that other organs are found simultaneously with the stomach to be the original seat of cancerous deposits, of which the most frequent are the liver and pancreas. Finally, we must not omit to observe that the morbid appearances of several other diseases, which are known occasionally to complicate its course and termination, are revealed by dissection. Amongst these may be enumerated inflammation of the lower portion of the small intestines, peritonitis, bronchitis, tubercular disease of the lungs, and of other organs.

In pursuing the pathology of the disease, it will be useful to subjoin to this account of the anatomical lesions some remarks with reference to the influence of these in the production of the symptoms as above detailed, and to notice here some variations in the latter, which are more or less explicable by the former. The connection between some of the phenomena and the organic lesions is direct and obvious, in others obscure. In adverting to some instances in which it may be recognised, we shall consider in what manner the stomach is affected by the morbid product as to its functional and physical relations, and then notice that constitutional depravation which it gives rise to, called cancerous cachexy.

a. Doubtless the organic lesion produces a prejudicial effect upon the functions of digestion and general nutrition, and must in this manner contribute materially to the cachectic emaciation. This would be anticipated, on considering the malignant character of the disease, and the primary position which the stomach holds in the digestive apparatus: and it seems proved by the fact that the emaciation is a more prominent feature of cancer when seated in the stomach or intestines, than in any other organ of the body. Some cases, however, are occasionally met with, which show that its influences in this respect are not so great, or at least so general, as would be suggested by these considerations; for such must be the inference drawn from cases on record, in which little diminution of the appetite and no emaciation took place, while the stomach was profoundly disorganized by cancerous deposit. In these instances the disease was situated at the pylorus and the lesser curvature, leaving the larger end of the stomach untouched. (See *Chardel*, p. 39; and *Abercrombie*, Diseases of the Stomach and Intestinal Canal, p. 61.) This is an interesting remark, inasmuch as the latter is the part of the stomach in which the functions of chymification and absorption are mainly performed; and it permits the conclusion, that unless cancer either invades these parts, or becomes a focus of irritation for the entire organ, these functions remain comparatively uninjured. *b.* In its physical relations the chief pathological considerations are the mechanical obstacles which the cancerous products afford to the passage of the aliment. These exist when the disease is situated at either of the orifices, and they become the source of some of the phenomena which are most pathognomonic of the malady. When they occur at the cardia, the food being hindered in its entrance into the stomach, is rejected shortly after deglutition. But if the pylorus be the seat of the obstruction, the alimentary mass is retained in the stomach for a period of two or three hours during the process of chymification; at the end of this, in its progress towards the intestine, it meets the pyloric obstruction, and then vomiting is set up. The amount of obstruction which is presented varies from the smallest contraction of the dimensions of the orifice to a total occlusion. It appears self-evident as a general rule, that the constancy of vomiting is in proportion to the obstruction; but exceptions to this occur of such a nature as make it manifest that the mechanical obstacle is but a part of the conditions on which this symptom depends. The most obstinate vomiting has been observed in cases where a pyloric tumour was so situated as to produce little or no contraction of this orifice: and, on the other hand, its calibre has been found greatly diminished in instances in which vomiting rarely happened during the course of the disease. These different facts demonstrate that other conditions conspire with the mechanical obstruction, and modify its effect in producing vomiting; the most obvious of which is a state of congestive irritation in the organ. Cardiac obstruction gives rise rather to a regurgitation of the food than the proper act of vomiting; but notwithstanding this, it is the cause of deeper distress than that of the pylorus, as, on account of the food not reaching the stomach, the pangs of hunger may be added to the other sufferings of the disease, and the slow progress of the latter may be anticipated by a deplorable death from inanition. *c.* Its propagation to other organs, and the pathological complications which their affections furnish, constitute another class of phenomena entering into this malady. To this may be referred the jaundice, which is not an uncommon occurrence, particularly in the advanced periods of the disease: it owes its origin for the most part to direct disease of the liver, but it may be also produced by the pressure of a cancerous tumour of the stomach upon the bile-duct. The anasarcous infiltrations have been simply referred to the debility of the last periods of the disease, which undoubtedly contributes in many cases to their production; but they have been observed in others where the strength was as yet little broken, and the vigour of the circulation undiminished. On this account we must look to other sources in order to give a sufficient explanation of them; and these are presented to us in the obstructions of the venous circulation, which are caused alike by morbid states of the liver, and by the direct pressure of a pyloric tumour upon the trunks of the venæ portæ and cavæ. These vessels themselves may also be the seat of cancerous deposits, as in the remarkable case detailed by Reynaud, in which obliteration of the right branch of the vena porta and the inferior vena cava was produced by a foreign substance (apparently encephaloïd) deposited within their cavity. (Journal Hebdomadaire, 31 Oct. 1829.) *d.* Cancerous *cachexy* is the term which designates the special alteration

of the whole system sooner or later consequent upon the disease in whatsoever part of the body it is situated. It comprises all the effects of the morbific influence which it exerts on the general constitution, distinct from its local ravages, or the sympathetic derangement which these give rise to in other organs. When fully developed, it is characterized by a peculiar livid colour of the skin and the mucous membranes, emaciation, friability of the solids, and diminution of density in the liquids, but more particularly of the blood. To the change which it produces in this fluid is to be ascribed the facility with which hemorrhage occurs in advanced cancerous deposits, and the liquid uncoagulable character of that which is occasionally vomited during the latter stage of cancer of the stomach. It is to be observed that the full manifestation of the constitutional cachexy is less frequently met with in cancer of the stomach than elsewhere; because, as it would seem, the lesions of this organ are more injurious to the vital economy, and so anticipate the time in which the general system becomes fully subjected to the malignant influence of the cancerous disease. Finally, we would remark that this constitutional condition receives additional interest, if we may contemplate it as having any connection with the facts mentioned by Dr. Carswell relative to the presence of carcinomatous substance in the blood. (See Scirrhus.)

The essential nature and the origin of cancer of the stomach are points to which all other matters in pathology are secondary. As the elementary morbid product of which it consists is identical in this and in other organs, the question of its origin here involves that of cancer in general. Many doctrines have been from time to time promulgated on this mysterious subject, but have successively fallen into merited neglect, being founded on crude and insufficient observation. In the present day it is studied in a manner which promises more fruit; but it must be confessed that modern researches, while they have exposed false views, have done little more: the origin of cancer still lies covered by the veil which keeps from our penetration the secret operations of nutrition and special secretion. The reader is referred to the article Scirrhus for an account of the subject, which is carried as far as the actual state of knowledge permits. We only desire to express here our full accordance with the author in renouncing two modern theories on the subject; one of which assumes it to be a degeneration of a pre-existing tissue, and the other (chiefly supported by Andral), which maintains, that in its essence it differs nothing from hypertrophy and induration of the submucous cellular tissue.

It is a generally admitted fact, irrespective of any theory concerning its essential nature and origin, that the deposit of cancer in the parietes of the stomach is preceded by an irritation in this organ. Much diversity of opinion exists concerning the nature of this irritation, and it is well known to be the doctrine of Broussais that it is of an inflammatory nature; he has in fact maintained that cancer is a direct product of inflammation. It is a question of very difficult solution to decide in what manner this irritation differs from inflammation; but that it does so is not doubted by any pathologists who confine the latter term to its ordinary signification. Without offering any opinion on this subject, we merely notice it in this place for the purpose of adverting to a practical point connected with it, which is deserving of notice; namely, whether the irritation which precedes it (whatever be its kind or degree) originates in the mucous membrane, or has its primary seat in the subjacent cellular tissue, where the foreign substance is found deposited. To determine this directly, the stomach should be inspected in its first stage, while it yet retains the earliest appearances of the disease. But opportunities of post-mortem examination are rarely presented until a long continuance of the disease has produced great alteration, so that immediate proof is wanting of the relative condition of the tunics at its commencement. The mucous membrane has, however, been found in its physiological state at a time when the subjacent texture was filled with the cancerous product. Recamier has observed the latter developed to several lines, or even an inch in thickness, while both the mucous and peritoneal coats were in a healthy state and glided without any adhesion over the engorgement. (Recherches sur le Traitement du Cancer, t. ii. p. 44. Paris, 1829.) This proves, according to him, that the latter was not of an inflammatory nature in these cases; and he infers, à fortiori, that as the tunics were not in a pathological state at an advanced period of the subjacent deposit, they had not been so at an earlier. M. Andral has examined this question with his usual sagacity, and has fully shown that such negative facts are not to be received in evidence. In adducing his arguments we should state, that although we have not adopted the opinion with which this eminent pathologist has connected them, (namely, that scirrhus and cancer is a mode of induration of the cellular tissue,) yet, as we recognise the fact that such a condition is frequently a *nidus* for its deposit, and moreover agree with him that it is preceded by irritation, they are equally applicable to the notion we entertain as to its origin. He first illustrates the fact, that in irritations of the intestinal, bronchial, urethral, and conjunctival mucous membranes, and of the skin, the subjacent cellular tissue is frequently involved. He then passes in review some instances in which these mucous surfaces became free of the inflammation, while the subjacent tissue still remained the seat of organic changes which had occurred during its subsistence. Of this a familiar example presents itself to us in stricture of the urethra; this is a circumscribed hypertrophy of the submucous cellular tissue, which for the most part supervenes at a period when the inflammation of the lining membrane of this canal is receding. Finally, M. Andral deduces arguments of a still closer analogical application from observation of certain conditions of the gastric mucous membrane itself: he has been able to follow the different degrees by which it returns to a healthy aspect after inflammation, and he has observed in many instances that the submucous tissue still remained morbidly affected. His observations and reasoning appear to us satisfactory as to the general principle: while, therefore, we draw a broad line of distinction between scirrhus and hypertrophied cellular

tissue, which he identifies, we are enabled to enter fully into his conclusion, viz. that cancer may arise in the submucous cellular tissue of the stomach, subsequent to irritation originally seated in the mucous membrane. We add, that Chardel arrived at a similar conclusion from the study of the anatomical lesions, (Op. cit. avant propos. p. 11); and his opinion is so much the more entitled to regard, as it was expressed before it became a subject of doctrinal emulation in the schools.

We shall, lastly, advert to that branch of the etiology of the disease which includes its *occasional* causes. The concurrence of all observers places as the foremost amongst these, the operation of depressing moral emotions; and it may be indeed stated, that the influence of the mind upon the animal economy is not so prominently displayed by any other chronic malady. Corroding cares, caused by reverses of worldly circumstances and disappointment, concealed grief, and protracted terror, are the conditions of mind which are more particularly connected with its origin: so commonly does it partake of their influence, that few cases occur in which some of them could not be discovered, were it always possible to fathom the moral history of its subjects. With reference to this, it is worthy of remark that during and subsequent to the French revolution the disease was common in France, and it seems probable that many of the numerous cases, which Chardel's monograph contains, were caused by "the reign of terror." This was the malady of Napoleon: when he arrived at St. Helena he was in the possession of perfect health, and it was two years afterwards that the first indications appeared of this disease, which slowly consumed his life in a period of three years and a half. We allude to his case as an example of these conditions acting probably at a maximum; yet we have seen the same causes produce similar effects in individuals who occupied the other end of the scale of moral power. The mode of action of this class of causes it is very difficult to explain, and according to the present strict method of investigating medical doctrines, it seems rather to be drawing more than is warranted by the actual data, to offer any decisive opinion with respect to it. It cannot, however, be reasonably doubted that their direct action is on the nervous system, and we feel much inclined to assent to the opinion which Lobstein has ventured to put forth concerning their remote effect. He affirms that moral emotions give rise, first to a defective innervation; secondarily, to a perverted nutrition, in which consists the elementary change which produces organic products of an anomalous nature. (Anat. Pathol. tome i. p. 557.)

There are various phenomena connected with the healthy action of the economy, *the cessation* of which may become occasional causes. Some of those are of a physiological nature, as the menses; others are pathological, but are so habitual or periodic that they become, as it were, grafted on the constitution; to these belong hæmorrhoids, sweats in different parts, as the feet and axillæ, headachs, periodic gout, &c. The suppression of these has been known to originate cancer in the stomach as well as in other parts of the body, and with these may be classed the existence of a syphilitic taint in the system, under the influence of which, if not this, a disease in almost all respects similar has been known to arise. It has also been clearly traced, in some instances, springing up as a consequence of hereditary predisposition.

Other causes are to be enumerated of a more definite and local character; amongst which is to be first mentioned the long-continued use of ardent spirits. It is incontrovertibly established by a collection of many facts that this disease is frequently brought on in those who become addicted to the inordinate use of spirituous liquors; it is not, however, so clear that the entire effect of these is owing to their local action as a stimulant to the stomach, which some are ready to maintain. Several considerations with respect to individuals of this class seem to oppose this, and we are disposed to think that this cause acts, in part at least, upon the nutritive function in a manner analogous to the first set of causes, either by a prejudicial effect upon the nervous system or directly upon the blood. But whether its action be general, or merely local, or that it partake of both, it is certain that this effect of habitual drinking is much promoted by the depressing passions. These act in the relation of a predisposing cause to determine this effect from the former; and unhappily amongst the poor, the influence of both is too frequently found in concert, from the prevalence of ignorance, and of the desperate delusion which tempts the wretch blindly to have recourse for solace to the ruinous habit of drinking.

Continued pressure on the epigastrium, or mechanical injury of this part by any means, are also to be reckoned amongst the causes of this disease. Chardel relates two cases, which exemplify the effect of such causes: the one of a hatter, whose particular province obliged him to press the abdomen against a board; a cancerous tumour formed in this man's stomach, which ultimately broke through the abdominal parietes by the formation of a gangrenous slough at the epigastrium: the other case was that of a coachman, in whom the disease occurred consequent upon the kick of a horse received at the lower part of the chest. (Op. citat.) Haller has recorded one of similar import in the instance of a young man, who in a drinking revel received a kick in the belly from his drunken companion, and afterwards became affected with a lingering and ultimately fatal illness, which was proved on dissection to be caused by an extensive cancerous disorganization of the stomach and omentum. (Opuscula Patholog. Lausan. 1755, p. 49.) These cases are illustrative of the effect of mechanical injuries of the epigastrium in giving rise to cancer of the stomach, a result, besides, which ample evidence has established. While, therefore, it is fully acknowledged as an occasional cause, the explanation of its action is not so easy as may at first appear, inasmuch as, for several reasons, it seems evident that its influence is not to be directly referred to its immediate irritation of the parietes of the stomach. First, because, as Chardel observes, the cancerous product resulting is not found to occupy the part of the stomach which receives the direct mechanical impression, namely, the anterior wall which lies against the epigastrium, but manifests the same election as to situation (the pyloric or cardiac ex-

tremities) as when it arises from other causes. Moreover we remark that mechanical irritants acting, though with considerable force and permanency, *merely on the walls of the stomach*, do not produce cancer. Thus we find, in a case noted by Baillie, in which five halfpence were lodged in the stomach for some time, and had formed a pouch by their pressure, "the coats of the stomach were thinner at that part, but were not inflamed or ulcerated," (Morbid Anatomy, 1793, p. 92); and in another recorded in the Medical Commentaries, two pistol-bullets were lodged in the organ, previously the seat of cancer, for two months, apparently without any effect. (Vol. iv. p. 154.) A third, more curious than either, is the singular case narrated by Tonnelier, and witnessed by Laennec, of a girl, who, with the purpose of poisoning herself, swallowed an ounce of arsenic, but unexpectedly recovered. Again, a year afterwards she took poison, and this time died. On post-mortem examination, beside the effects of the recent poison, a cyst was discovered of the size of a goose-egg, which had been obviously just detached from the parietes of the stomach near the pylorus: on being opened, it was found to contain an ounce of arsenic. (Auscult. Médiate, vol. ii. p. 634.) These cases afford examples of the action of powerful mechanical and chemical irritants *immediately* upon the stomach; yet by none of them was displayed any disposition to the formation of cancer. The question then recurs undecided—in what manner do pressure and contusion in the epigastric region act, in occasioning cancer of the stomach? Chardel thinks that their injurious operation can only be accounted for by their mechanical disturbance of the process of digestion. It is an inquiry of much interest; and while we abstain from expressing a decided opinion, we beg to suggest it as an important consideration, how far it is to be referred to a lesion of innervation, caused by a *mechanical shock* on the solar plexus. If such an explanation should be accepted, it would place epigastric contusions and moral emotions in the same class of causes, and permit us to express their mode of action similarly.*

The abuse of certain therapeutic agents must not be omitted amongst the occasional causes of this disease. Those medicines are to be reckoned as such, which while they are exhibited for the sake of their specific effect, depress the animal system, and at the same time act locally on the organ. Preparations of mercury and arsenic are especially alluded to; and it must be confessed that the effects of the former in inducing that condition of the system which is favourable to the development of anomalous products, have not been hitherto sufficiently regarded; they begin, however, to excite general attention. The fear of this disease forms also one of the chief reasons for vigilance in using arsenical medicines in minute doses. Their exhibition should be strictly watched, that the constitution be not kept too long under the influence of this mineral; which, as would appear from the case cited by Laennec, has not the power of originating the disease by its local effects, unless the economy be previously deteriorated by its general influence. Finally, with respect to inflammation, (without reverting to the question as to whether it may be an occasional cause of cancer of the stomach,) it is of the utmost importance to be aware that it frequently accompanies its commencement, complicates its course, and hastens its termination.

Diagnosis.—Accuracy of diagnosis is the foundation of good practice in all diseases, but if it be required in the practitioner on one occasion more than another, it is when engaged about the diseases which are deemed incurable, because upon it so much depends. On the one hand, the mistaking of a disease beyond the resources of medicine for one in which these might be applied with success, subjects the patient to illusory hopes, and treatment that might have been spared, or that may even hasten the unlooked-for termination. On the other, the pronouncing a disease to be incurable, which in reality may not be so, is a still more grievous error; for this cuts off from the patient resources which had been available, were they not interdicted by ignorance of the nature of the disease; not to speak of the loss of reputation which accrues to the practitioner, if the course of nature or the application of another's skill discover his error, by restoring to health the patient whom he had doomed to the grave. These remarks are worth attention in connection with the disease before us, to which they are obviously applicable with reference to its incurable nature; but they are so equally with respect to its diagnosis, concerning which we should greatly miscalculate, were we to estimate its facility by merely regarding the profound organic changes and the prominent features of its history, as we have endeavoured to trace them. No general description could comprehend all the diversity which its symptoms may present; more particularly, however, we wish to direct attention to this fact, that its most striking phenomena may be simulated in the course of some diseases which have a totally different origin and issue. For the purpose of elucidating its diagnosis, we shall now compare it with the affections which present similar phenomena: this can be effected most conveniently by noticing these affections in connection with the symptoms of cancer of the stomach which constitute the resemblance between them. This method also affords us the opportunity of noticing some diversities of these symptoms, which were reserved for consideration in this place, as they are chiefly important with reference to the diagnosis.

a, Vomiting.—It may be in general stated, that

* The above was written before we met with M. Recamier's opinion on this subject, and we are gratified at finding that it is expressly similar to that which we have proposed. He brings forward several arguments of a positive as well as negative import, against the notion of cancer being developed in the stomach by the mere irritation of the viscus from local violence, and proving that the operation of the latter is to be referred to "*nervous commotion.*" He cites two facts which seem decisive. One person received a blow in the pit of the stomach, which was followed by violent pain and anxiety in this region, yet the individual stated that he had been scarcely touched by the blow. Another was only frightened by a gesture imitating a blow, which however was productive of the same anxiety and "malaise." In both individuals *an organic affection of the stomach was consecutively developed.* "Such examples at the same time manifest this," adds this experienced and judicious author, "that general commotions of the system exhibit their *local* power in proportion to the *local* predominance of nervous susceptibility."—Op. citat. tome ii. p. 45.

when vomiting occurs immediately after deglutition, the disease is situated at the cardia, and that when a period of two or three hours elapses, its seat is at the pyloric extremity. No relation which can be with certainty relied on, appears to exist between the intensity of this symptom and the extent of the cancerous deposit which causes the obstruction; for besides the latter, the state of general irritability of the organ influences it in a degree little inferior; and this is often observed to be greater at the first period of the disease than later, when much disorganization exists. Much diversity is to be remarked in the different stages of the disease with respect to the character of the vomited matters. In the beginning they consist of large quantities of ropy mucus, and of this mingled with the aliment in different stages of digestion. Afterwards they become mixed with secretions of dark-coloured fluid, in which a sediment forms like the grounds of coffee. These, with a muddy liquid of the colour of chocolate, and occasionally blood, are the fluids thrown up from the stomach, which are regarded as characteristic of the confirmed and later periods of the disease.

Nevertheless, it is to be remembered that this symptom may occur under every variety as a phenomenon of other diseases; so that neither its constancy or periodic recurrence, nor even the quality of the matters vomited, can with certainty assign it to cancer of the stomach. Added to this, other semblances of the disease may coexist with it, which tend to heighten probability to its highest pitch, and yet it may be unconnected with it. This is strikingly illustrated by two cases related by Louyer Villermay. One, a man aged forty, whilst a prey to profound grief, became affected with nausea, weight and shooting pain in the epigastrium; to these were added, while his strength declined daily, vomitings after every meal. After a month's treatment this man recovered. The other case was a youth aged twenty-one, who had many of the preceding symptoms, and in addition to these, the vomiting continued for nine months, and the matter rejected was of a blackish colour. The application of blisters and other remedies completely restored his health. Chronic gastritis, affections of the liver and gall-ducts, are some of the other various sources whence it arises. Certain forms of hysterical disease exist, also, in which a constant vomiting often prevails as the principal symptom for months; in one instance of this kind within our observation, it continued unappeasable night and day upwards of two years. An infinite variety of cases are also on record of nervous or spasmodic vomiting which for obstinacy might be compared with that caused by the most profound organic lesion. A most remarkable instance of this is related by Morgagni in the case of a lady of Padua, who was affected with this symptom from her birth. It came on two hours after dinner daily, and during pregnancy at the age of thirty-four it became much aggravated; and thence it continued unremitted until her death, which happened twenty-four years afterwards. No organic disease was found in the stomach, but it was small and contracted near the pylorus, so as to appear divided into two parts. Vomiting, with a long succession of symptoms which were mistaken for the effects of organic disease, were caused, in a singular case recorded in the Mémoires de l'Académie Royale de Chirurgie, (Tom. i. p. 702,) by hernia of the stomach between the recti muscles. The patient, a young surgeon, underwent the most severe sufferings, chiefly from the unconquerable obstinacy of the vomiting, and found no relief from a great diversity of treatment, until at length, hearing a description of this rare affection from Garengeo, he thought that he recognised the source of his own disease, whereupon he applied a proper truss, and from that hour was cured.

Finally, with regard to bloody vomiting, and especially the fluids resembling chocolate, if these coincide with other prominent features of the disease, it cannot but be considered a symptom of ominous import. Yet in proportion as it merits this character in its true connection, caution should be exercised not to assign it a false value in cases where it is not really indicative of this disease. The other conditions under which blood may be vomited are its metastasis from hæmorrhoids, retention of the menses, or any suppressed discharges. Falls and contusions not unfrequently give rise to hæmatemesis which continues long after all their other effects have subsided. It may be caused by hemorrhage from the posterior nares, which has been found to pour its blood into the stomach, and to be rejected from thence at intervals of a melænic appearance.*

b. Tumour.—On referring to the anatomical relations of the two orifices, it is scarcely necessary to remark, that when a tumour, externally perceptible, is developed by the disease, the pylorus is its probable seat. We say probable, because, although a rare case, a cancerous growth situated in the body of the stomach may attain to such a form and size as to be felt through the parietes of the abdomen; and it is conceivable that even a cardiac tumour might be detected by the touch, under the ensiform cartilage, in an individual with a short breast-bone. The characters belonging to a pyloric tumour are more or less distinctive. It is felt, for the most part, rather on the right of the median line, lying obliquely from right to left, with its most prominent part two inches below the lowest rib. It is movable by the hand, so as to allow of being pushed considerably out of the position it occupies; and it possesses, moreover, a spontaneous motion, which affords a diagnostic mark with respect to it of peculiar value; under the influence of this, it may be placed one day in a different situation from that of the preceding, and it sometimes even retires so deep, as to be no longer distinguishable by the touch, which circumstance has been known to create some embarrassment.

The presence of the tumour is the least equivocal sign of the disease; but yet the diagnosis can by no means be reposed upon it with an unreserved confidence; for, in the first place, extensive cancerous disorganization has been found at the pylorus as well as in other situations of the stomach, after death, which had previously escaped the most accurate investigation. Its thickness may be

* See this origin indicated, case by Manchart Misc. Acad. Nat. Cur. dec. iii. and iv. (*Archiv. Générales*, Oct. 1833;) also by Dr. Graves, Dub. Med. Journal, vol. i. p. 297.

too small, or take an internal development, or its situation may be entirely confined to the posterior part of the pylorus. Any of these conditions may prevent it from being recognised; moreover, other abdominal tumours frequently present themselves, from which it requires not a little discrimination to distinguish it. It is unnecessary here to do more than indicate that these may be constituted by any of the following, namely, tumours situated in the liver, the pancreas, the omentum, the mesentery, the colon, the abdominal parietes, and by aneurisms of the aorta. Two cases are before us which illustrate this double source of fallibility here referred to, that is, with regard to the presence and the nature of the tumour. The one was that of a man who died of pulmonary inflammation of five weeks' standing. He was under the observation of Dr. Graves for seventeen days preceding his death, and during that time no phenomenon was remarked, capable of exciting the suspicion of organic disease of the stomach. This organ, on dissection, externally presented the appearance of an hourglass contraction, but on opening into its cavity, a morbid growth of a medullary structure, equal in size to a large mushroom, was found projecting internally from the greater curvature, about midway between the two orifices. (Dublin Medical Journal, vol. ii. p. 175.) The other case, occurring under the same physician, in the Meath Hospital, was one in which a fistulous opening permitted the food to pass out from the stomach through the abdominal parietes; and no doubt was entertained but that this remarkable phenomenon depended upon the softening or ulceration of a cancerous mass, its ordinary source. On dissection, however, it was shown to be caused by the bursting of an encysted abscess of the peritoneum at once into the stomach and externally through the walls of the abdomen.

Cancerous growths of the cardiac orifice become also frequently objects of exploration; and as obstructions in this situation are in the majority of instances caused by tumours of this nature, their diagnosis is of fearful interest, both on account of their ominous character, and of the dysphagia resulting from them, which occasionally proceeds to such a degree as to occasion death from inanition. As the various abdominal tumours complicate the diagnosis of disease of the pylorus, in like manner cardiac cancer may be simulated by morbid products within the thorax of a very different origin. Innumerable instances are on record in which enlargements of the bronchial, œsophageal, and the other lymphatic glands of the mediastinum have caused dysphagia, and ultimately, as its consequence, death. (De Glandulis Thoracis Lymphaticis atque Thymo, Specimen Pathologicum. *F. W. Becker*. Berol. 1826, p. 56.) The same results may be derived from abscess situated behind the œsophagus, and from aneurism of the thoracic aorta. In these doubtful cases the principal method in use for exploring the state of the cardia is the introduction of the probang, but when this is called for, it is commonly as much for the purpose of endeavouring to overcome the obstruction as to establish its diagnosis. Under such circumstances, however, this means of examination requires to be employed with great caution, and this more especially with reference to the possibility of interfering with an aneurismal tumour. The utility of this admonition is testified by a case published by Mr. Porter, of a man, who, amongst other distressing symptoms, had nearly complete inability of passing any food into the stomach, and frequent vomiting; for these a probang was introduced, without meeting any decided obstacle, but without relief. Death suddenly occurred six days afterwards, and *post-mortem* examination disclosed a large aneurism of the aorta, which had burst into the œsophagus. (Dub. Med. Journal, vol. iv. p. 206.)

c. Emaciation, pain, &c.—Cachectic emaciation is common to this with many other chronic diseases; it is, however, to be noted, that as far as this symptom depends upon cancerous development it is unaccompanied by febrile action. This observation serves to distinguish it more especially from that which attends upon tubercular phthisis, as hectic fever is more or less prevalent from the time that emaciation sets in in the latter disease. But notwithstanding this, in individual cases of cancer of the stomach which are complicated by a catarrhal affection, so much resemblance may exist in many of their features to phthisis as to embarrass the diagnosis at the first examination; at the present day, however, in which the resources of auscultation and percussion are becoming fully recognised, this difficulty cannot exist long.

The pain belonging to this disease is peculiar, and a difference has been even remarked with respect to it as occurring at the two orifices. When the cancer is seated at the cardia, the pain is described as a tensive circumscribed sensation about the pit of the stomach, striking through to the back, and exciting a feeling of incipient suffocation, which is aggravated on taking food, and relieved by vomiting. (*Pemberton*, Practical Treatise on various Diseases of the Abdominal Viscera, fourth edit. 1820, p. 128.) The pyloric affection gives rise to pain less confined to one spot, but rather producing a dragging sensation (as the patient sometimes expresses it) over the upper part of the abdomen. But, besides these local peculiarities, the lancinating pains which are common to cancer in all situations must not be omitted, nor yet a characteristic circumstance which is still more properly diagnostic of this terrible disease, namely, that the pain does not immediately respond to pressure upon the morbid product, as does the pain of inflammation, but allows a sensible after-period to elapse, when it occurs, as it were, by a spontaneous reaction. It is here, however, important to observe, that on collating the history of several cases of *simple* ulceration of the stomach, with reference to this symptom, no difference sufficiently distinctive could be established between it and that of cancer.

The dark colouring of the skin is one of the most characteristic signs of the cancerous cachexy, yet it is so often absent in this disease that it cannot be depended on as a symptom of negative import.

Terminations.—When it once becomes established that the stomach is the seat of cancer, the only question which the prognosis admits regards the duration of the malady, for no other hope grounded on experience can be entertained but that it must inevitably terminate, sooner or later,

in death. We are aware that some, in contemplating the cicatrices of ulcers of the stomach, which have been found in a few rare cases, have been led to express a less rigorous conclusion; we cannot find, however, that this is countenanced by the healing in any instance of ulceration of the stomach which could be demonstrated to be connected with a cancerous deposit.

We have referred to the intermission which occasionally takes place in the early periods of the disease, and to the progressive manner in which its course proceeds, when these being passed away, its symptoms are all established; but with respect to the disease in general, it is not possible to assign any period of time as the term of its duration. This is obvious, when we reflect upon the diversities in the power of resistance to morbid action which the various constitutions exhibit, and the other contingent affections which modify this malady. To the slow exhaustion of the vital powers produced by the disease itself, the weakening effect of the constant vomiting is added, and not unfrequently the deficiency of actual nutrition. The fatal period is at one time brought on suddenly by the softening and breaking up of the cancerous mass, and the consequent hemorrhage; at another, it is hastened by the occurrence of perforation and communication with the peritoneum, which is, however, rare, from the protective causes before explained. Moreover, the affections above indicated, as complicating its latter stages, the diarrhœa, inflammations of the peritoneum, lungs, and the liver, are all influential in its termination. Finally, observation confirms that the disease of the pylorus lasts a considerably longer time than that of the cardia.

Treatment.—It is obvious that since this disease, when decidedly formed, is one which does not yield to the resources of medicine, the most practical considerations which it presents to the mind of the physician are those attempted to be illustrated in the foregoing part of this notice of it, which conduct to correct notions of its nature and its diagnosis. These, in the first place, suggest the responsible part which he performs towards the patient in pronouncing positively upon its existence; and, secondly, when it is recognised beyond doubt, they should dissuade from the employment of untried experiment in its treatment, which must necessarily fail, and not only disappoint hope, but tend to hasten the unavoidable period. This remark would much misrepresent our meaning, were it conceived that it contains any pretext for omitting the assiduous application of means: the first part of it is intended especially to convey a warning against a too hasty conclusion in any given instance that we have to do with an incurable disease; while the second is directed against an abuse of therapeutic agents, which might bring them into unmerited neglect were not the period in which they are unavailing plainly pointed out. In the confirmed disease, medicine, with its present resources, can only be applied with a palliative view. In the early period, however, while there is yet ground for hope that the malady has not become irreversibly fixed, or when some doubt exists in the diagnosis between it and other organic affections, the treatment should be directed with perseverance to combat it radically. But the line of demarcation must be very obvious before we give up the latter, hopelessly to resign the treatment to the former; and on this subject there may exist some danger of reposing too much reliance upon the minutiæ of diagnosis. The following remark of a modern writer expresses appropriately our meaning, coupled also with a statement which may not be altogether unwarranted. "Our predecessors, who were less acquainted than we with the fatal progress of organic lesions, succeeded perhaps oftener than we do in palliating the symptoms and prolonging the life of the patients, by applying themselves incessantly to oppose the most obvious symptoms. Their attention was not entirely preoccupied, like that of the anatomist-physicians of the present day, with the incurability of the local lesion which is the source of the disease." (*Gibert*, Revue Médicale, Juin, 1833, p. 375.

The first care which should engage the physician in entering upon its treatment, is to investigate its occasional cause, and, if this be possible, to have it set aside. Moral causes are at once the most frequent and the most difficult to remove; but until this be, in some part at least, accomplished, little success need be expected from any remedial measure; while, on the other hand, a decided improvement has been often observed to follow upon a change of circumstances which has alleviated mental depression. If the malady be observed to spring up simultaneously with the cessation of the menses, or of any other discharge or pathological condition which had become habitual, in case it be not possible to restore these, it would be a most advisable step to effect a substitute for them by the employment of some derivative plan, as issues, blisters, or local bleedings. Pains should be taken to examine into the probability of a syphilitic taint having got entrance by any means into the system: it is a fact of a most interesting nature, that some cases presenting the characters of an advanced stage of this disease have been known to yield to a mercurial treatment, which had been undertaken as a last resource, on discovering that the patient had been either mediately or personally exposed to venereal contamination. Hereditary predisposition should also be inquired into,* and idiosyncrasies dependent upon temperament, or other conditions; and if any source of this nature be detected, appropriate attempts to obviate its influence by a total change of circumstances should form a consideration in the treatment of primary importance.

The main principle to be observed is the abstraction of every condition which tends to cause or maintain a state of irritation in the stomach. It will be readily seen that, in pursuit of this, the regulation of the diet is to be chiefly relied on, and this, in fact, demands, from the earliest suspicion of the disease, the attention of the practitioner even more decidedly than medical agents. At this period he should impress the patient's mind with the necessity of submitting himself to a peculiar regimen, from which the latter ought not to suffer himself to be tempted on any occasion to depart. The object of this is to regulate

* See *Recamier*, op. cit. tome ii. p. 48, for some remarkable instances of the influence of this, and the attempts proper to counteract it.

in such a manner both the quantity and quality of the food, as that every thing of an exciting nature should be steadily renounced. It seems certain that this disease owes its chief progress to the physiological congestions which occur during digestion, in accordance with the law, that the functional action of an organ becomes a source of irritation to it when in a morbid state; all the symptoms are aggravated during the continuance of this process. This is the explanation of Chardel's remark — "La digestion finie, ordinairement *le calme renait*." Our aim should be to preserve a state of as great quiescence in the organ as is possible, consistently with affording sufficient nutriment to the system. With this view the patient should deny himself the use of solid meat; and, in cases where excessive irritability of the stomach prevails, animal food should be altogether dispensed with. However, as the object is to spare the organ, not to reduce the system, this is not in all cases advisable; and in individuals of a lymphatic constitution, in whom the more animalised materials of the blood are deficient, it is contra-indicated. Nutritious broths, made without spice or vegetables, answer well for such; they should be taken rather in small proportions, oftener repeated, than much at one time. All the varieties of boiled vegetables should be inflexibly refused. Where animal food in other forms is judged inexpedient, jelly may still be used, and this will be advantageously interchanged with the bland gelatinous substances, arrow-root, sago, tapioca, &c., which, being at once nutritious and unexciting, are valuable adjuncts to the patient's diet-list. With respect to the choice of these, experience must decide, as that which is adapted to the stomach of one does not agree with a second, and too frequently it will be impossible to find in any of them articles which fulfil our end. Few cases occur in which milk does not serve, and, when it agrees, it should constitute a large portion of the aliment. If, as sometimes happens, it sours upon the stomach, this may be obviated by the addition of lime-water, in the proportion of one-third. (Dict. de Sc. Méd. t. iii. p. 631.) Asses' milk has been endured on the stomach in cases where all other substances have been vomited. The patient must be inhibited the use of wine and spirits; it is sometimes, however, deemed necessary to allow some stimulant potion of this nature on account of painful digestion; and in such a case light table-beer should be preferred to alcoholic liquors, which, whatever impression they make for the time, invariably promote the progress of the malady. The meals should be taken at a fixed hour; irregularity in this matter increases irritability in the stomach; nor is it unworthy of being noted, that slowness in mastication has the effect of making substances, otherwise difficult, pass through the digestive process with much less irritation. We would remark, finally, that the beneficial effect of a rigorous regimen, in this first doubtful period, will mainly depend upon the constancy with which it is persevered in. We have seen a decided improvement which had followed upon its adoption speedily lost, because the patient permitted himself to indulge in a slight relaxation upon some incidental occasion. On the other hand, the example of the eminent anatomist Beclard affords much encouragement (if not in cancer, yet in simple ulceration) to a steady perseverance. Having become affected with an organic disease of the stomach, manifested by unequivocal symptoms, he determined on treating it by a rigorous diet, little short of abstinence, from which he did not suffer himself to swerve until, after a considerable period, the symptoms disappeared. He recovered perfectly, and afterwards his death took place from an acute disease of the brain, consequent upon erysipelas; post-mortem examination displayed the cicatrix of a large ulceration in the stomach.

The use of local bleeding by leeches is found beneficial when there exists evidence of more than ordinary gastric irritation, and for the relief of excessive weight and pain in the epigastric region. It may be sometimes preferable to apply them beside the spinal column, about the first lumbar vertebra, in which situation acute shooting pains often occur. General depletion can never be requisite in this disease, and care should be taken in the use of leeches that they be not applied in number sufficient to give rise to a very prejudicial debility. Small blisters on the epigastrium repeated at intervals, or kept open by an irritant ointment, may be in some cases attended with benefit, in others setons applied in this situation, or at the back, merit the trial more. Not unfrequently, however, the weakness and irritation consequent upon the derivative means will be found to interdict their use. The state of the bowels will demand the continued attention of the physician: they are seldom free from constipation, and the accumulation and distension of flatus, together with the weight of the alvine contents consequent upon this condition, give rise to considerable distress. Aperient medicines can seldom be endured by the stomach, and drastic purgatives of every kind, especially such as contain mercurial preparations, should never be exhibited. The daily use of emollient injections, on the whole, fulfils this indication better than the habitual use of any laxatives; but as those lose their efficacy in time, it will be expedient at occasional intervals to assist them by a purgative or turpentine injection. In certain cases, however, gentle laxatives, composed of senna, manna, rhubarb and magnesia, or castor oil, do not disagree with the stomach, and then their use may be conveniently alternated with the enemata. Emetics are to be deprecated as injurious in any stage of the disease. The antispasmodics, as castor oil, ether, valerian, ammonia, assafœtida, &c., which afford relief to the flatulence and pain in nervous dyspepsia, should never be exhibited for the same purpose here; their use, it is to be remembered, is invariably followed by irritation, which by no means compensates for their temporary effects of this kind; and besides the object is better fulfilled by the seasonable application of narcotics.

The administration of narcotics should not be left over to that latter period, when they are indeed indispensable, but when their alleviation of the worst symptoms is in proportion to their oppression of the sensibility of the brain. It will be very advantageous to procure their sedative action for the stomach from the first suspicion of organic disease, and they may be properly used at

the same time as the rigorous regimen and derivative treatment. Recamier's plan of exhibiting the extract of cicuta, while the patient observes a severe diet (Callisen's *cura famis*), seems to be more appropriate in this disease than in the scirrhous engorgements, where he employed this combined treatment with decided advantage. (Op. cit. tome i. p. 476.) (See Scirrhus.) Opium, the extracts of cicuta, hyoscyamus, aconite, belladonna, and stramonium, have been each lauded at different times; a variety of circumstances may incline the physician to the choice of one of them rather than another, but it seems that the general suffrage of modern practice remains only with the three first. The salts of morphia are preferred by several before any other narcotic, as producing the sedative effect with the least local and general excitation. The acetate may be given in the dose of a quarter, third, or half a grain. The solution of the muriate, in the proportion of five grains to an ounce of distilled water, is considered to be equal in strength to the common tincture of opium. In some instances where a tendency to acescence in the stomach exists, alkalies and absorbents may be advantageously given in combination with narcotics; for this end we have used the following formula:

℞ Extracti conii maculati
——— hyoscyami nigri ãã. gr. i.
Oxydi bismuthi, gr. ii. M. ft. pilula quotidie bis terve sumenda.

The sedative effects of the prussic acid in gastrodynia may also commend its trial: it is conveniently conjoined with a light tonic infusion as a vehicle, as that of chamomile, calomba, rhubarb, or cascarilla.

Finally, we would repeat our former observation, that the treatment here detailed is applicable to the cases where, the symptoms plainly indicating an organic disease, we are compelled to apprehend the coming on of cancer, rather than to those in which its presence is too obvious to be mistaken. Where the constitution is sinking under this disease fully developed, the medical art can do nothing more than attempt the palliation of its appalling symptoms, and it affords for this object scarcely any resource but a free use of anodynes. An opium plaster, or one composed of extracts of belladonna and cicuta, with a little camphor, applied to the epigastrium, may procure temporary relief. If diarrhœa supervene, it should be opposed by astringent opiate injections. In the case of impending inanition from the rejection of all kinds of food by the stomach, some support may be derived from the use of nutritive injections, and the application to the abdomen of large poultices of bread and milk. The anodynes fail at length in procuring rest, and towards the close the disease triumphs wholly without control.

II. **Ulceration.**—In noticing this and the remaining organic diseases, we shall not pursue the systematic method which we observed in cancer of the stomach. These affections are of great interest and have been much studied of late, but to the present time they have been handled by writers rather in the form of essay than of regular treatise; and this appears to us to be still the best adapted to the measure of our knowledge of them. Besides, much information with reference to them is contained elsewhere in this work, as their consideration belongs in many respects as much to other articles as to this.

Ulcerations of the stomach are less diversified in their anatomical characters than those situated in other parts of the alimentary canal; all the varieties which it is of any pathological interest to remark, may be comprised under three heads, as follows:

1. The form which is more especially called the simple ulcer. This is a solution of continuity which extends more in breadth than in depth, being seldom found to engage any of the tunics beneath the mucous membrane. Its shape and extent are various, but it is more usually found to affect a roundish form than any other. The edges are formed by the mucous membrane smoothly eroded, and are not elevated above the rest of its surface; the base or ground is uneven, and often studded with minute vascular eminences, or small patches of the mucous coat which had been isolated in the midst of the ulceration. Over the parts of the stomach which are not engaged in the latter, more or less vascularity prevails, and according as this is the case, the ulcer presents different shades of colour. This is a form which is either acute or subacute, and it corresponds to the ulcerations which occur in the lower third of the ileum, and in the colon, but does not embrace the patches of agminated glands, which are so conspicuous in it, when it occupies those situations. It may be present in any part of the organ; more commonly, however, it is found on the greater curvature and the cul-de-sac. The slight erosions which are occasionally found on the surface of the mucous coat in fevers and other acute diseases are reckoned by some pathologists to be a variety of it, while others with equal reason consider those as not produced by true ulceration, but rather as connected with the diseased condition which gives rise to the softening of the tunics. We have placed this variety first because it presents the simplest form of ulceration, not with reference to its frequency: it is, in fact, comparatively seldom met with, inasmuch as, however frequent in the intestines, ulceration is not a common consequence of acute inflammatory action in the stomach.

2. Ulcers of a small extent, with a defined circular area, and edges somewhat raised above the level of the rest of the internal surface. The base may be formed by the cellular tissue, or it may have eroded through this and the muscular layer, so as to lie upon the peritoneal covering. Its size varies from that of a split pea to a shilling, and it more frequently occurs singly than in number, although occasionally a succession of them seems to take place, in which case they may be presented in different degrees of development, some showing a tendency to form cicatrices. This form of ulceration is for the most part primarily seated in the glands of Brunner, which occur singly in different parts of the stomach, but chiefly along its curvatures and towards the duodenal end. It arises at one time on their surface by their direct irritation and ulcerative absorption, while at others it seems to succeed upon their internal swelling from obstruction to their follicular orifices.

3. Circumscribed ulceration of a decidedly

chronic character, with much thickening over its base and edges. It varies in extent from the size of a shilling to that of a crown-piece or larger; it may occur in any part of the stomach, and involve the different tunics to a greater or less degree; yet for the most part, as it proceeds, in depth, its ground becomes overlaid with a thickened cellular substance which also occasions the elevation of its circumference. Its origin does not differ obviously from the last form, but its course is more chronic, and although generally solitary, it is more extensive in its disorganization. Some pathologists are not disposed to admit the separation of this from ulcers of a cancerous nature, regarding the thickened and indurated cellular tissue as a mode of scirrhous formation. It appears, however, manifest to us, that an ulceration with these chronic features is not unfrequently met with, which is entirely devoid of the cancerous character; and with regard to the thickened condition of the tunics which it originates, it seems that it is strictly analogous to the callous edges and base which are found upon certain old ulcers of the leg. We see the latter every day removed by stimulants, escharotics, or pressure; and cicatrizations have been found to ensue upon the former. This at once affords a strong argument, and is an important practical reason for not generalizing them under the same head as the intractable scirrhus. Yet it is to be observed that by this distinction we do not deny that this form of ulceration of the stomach may degenerate into a cancerous disease by the deposit of foreign tissue, as happens in like manner occasionally to some ulcers of the skin. For the purpose of distinction, then, it would be advantageous to designate all the forms which are free from any foreign complication by the term *simple* ulceration, although this is in a peculiar manner applied to that first described, because it is generally confined to the mucous membrane.

The inflammatory origin of ulceration of the stomach appears to be undeniably established. Accurate investigation has evinced that the ulcerative solution of continuity is preceded on all occasions by more or less hypertrophy and hardening of the mucous membrane in which it arises. In those ulcers which are consequent upon an acute inflammation, this is less obvious than in chronic cases; and on the other hand also, in some of the most chronic forms occasionally little alteration is found in the parts surrounding the ulcer. Yet these appearances are so commonly found, that it gives room for the inference that ulceration is a change which has a secondary relation to foregoing inflammatory alterations in the stomach. The mucous coat, or the glands connected with it, are invariably the primary seat of the ulceration, which is a distinguishing circumstance between the simple ulceration and those forms depending upon the development of foreign structures. In the latter, which have their seat generally in the cellular tissue subjacent, the ulceration is for the most part propagated from this to the other tunics; but although these may suffer in simple ulceration, their destruction is secondary to that of the mucous membrane, in which it always commences. It is obvious likewise, that as it commences by inflammatory action, its extension, whether in breadth or depth, is to be ascribed to the occurrence of the same condition, which is from time to time kindled in the part.

The inflammation which attends ulceration is of an extremely low character; on some occasions it is not indicated either by its symptoms during life or by the appearances after death, and the high free inflammation of acute gastritis never terminates in ulceration. It is true that it occurs in certain forms of fever, which, with reference to the general system, is an acute disease. This, however, does not form an exception to the remark, as it has been proved by the investigations of Krimer and Schrœder van der Kolk, and is sufficiently evident from daily experience, that in fevers of this kind in which the general nervous influence is weakened, the inflammations which arise are of a very imperfect character. (Die Darmgeschwüre dargestellt von Dr. J. Fr. H. Albers, Leipzig, 1839, s. 68.) It is also a remark of great interest, that if the nervous influence of the part becomes prejudicially affected during the subsistence of this low and chronic form of inflammatory action, the ulceration may lose its simple nature, and assume a cancerous character.

The symptoms attending upon the early stages of ulceration are rarely of a more alarming nature than those which are characteristic of functional derangement of the stomach. Flatulence, acidity, anorexy, oppression of the stomach after eating, and pain, are the ordinary indications which it presents in the commencement, and these are common to it and the dyspepsia which takes its origin from a different source. It is when the pain becomes the prominent symptom that a more serious affection is indicated, its character also being different from that of gastrodynia. In its degree and duration it varies considerably, but it is usually of a dull oppressive description, yet occasionally sharp and rather approaching to soreness. In many cases it is complained of only after eating, and continuing with much severity while digestion is going on, subsides when that process is completed. A frequent expression of such patients, says Dr. Abercrombie, is, "I should be quite well if I could do without eating."- (Op. cit. p. 17.) It affects others more permanently, but in all it is aggravated on taking food, on which account the patient acquires a dread of his necessary meals, sometimes rendered the more distressing by the circumstance that the appetite remains nearly unimpaired. Occasional nausea is apt to occur from the commencement, but vomiting is not usual until the decided establishment of the disease. Great uncertainty, however, prevails with regard to this symptom; in some it occurs from the beginning, but without constancy, and may yield to a regulation of the diet; in others it is more permanent, and entirely uncontrollable; while cases are not wanting in which the disease ran its course to the last period with little or none at all. A similar diversity exists in the substances rejected by vomiting; these consist at one time of ropy mucus or various secretions, at others of a brownish fluid; and on some occasions blood in considerable quantity is thrown up. Dr. Abercrombie illustrates the variety which occurs in this and the other symptoms by several in-

teresting cases, which serve to exhibit the insidious nature of the disease, and the impossibility of finding limits which would exactly define the features of its history. But their general outline is sufficiently distinct, and permits us to perceive the similarity which it bears to the phenomena of cancer of the stomach. The important practical question contained in the latter remark has received the attention of M. Andral; and his consideration of it leads him to the conclusion, that neither simple ulceration nor the other lesions resulting from chronic gastritis are to be distinguished from cancer of the stomach, except where abdominal tumour, the least ambiguous sign of the latter, is present. (Clinique Médicale, t. iv. p. 432.)

It is, however, needless to state that the issue of simple ulceration of the stomach is not to be regarded in so hopeless a light as that of those which are connected with foreign degeneration; but although this is so, it must be added that a favourable termination is rather to be counted an exception. Four modes of termination have been observed, in the consideration of which we are led to some interesting points of its pathological history.

1. Like other chronic diseases, it may terminate by the gradual exhaustion of the powers of life. In such instances it gives rise to a protracted train of suffering, and is generally complicated at an earlier or later period by other affections, as dropsy of the abdomen, or anasarca, disease of the liver, intestines, pancreas, or spleen.

2. It may prove fatal by a hemorrhage proceeding from the ulcer. The hæmatemesis resulting is sometimes at first inconsiderable, yet by its uncontrollable continuance or frequent recurrence it wears out the patient; in other instances it comes on suddenly and extinguishes life rapidly by an overwhelming effusion. This termination has been observed to occur most frequently in the large chronic ulcers with much thickening. It is ascribed either to erosion of vessels by the ulcerative process, or to exhalation of blood from the surface without any lesion of continuity in these. The latter has been very seldom directly observed in simple ulceration, and analogy seems to teach us that the pouring out of blood from the superficial capillaries is the more usual mode of its occurrence.*

3. It may produce perforation of the stomach, and give rise to peritonitis, which proves rapidly fatal. (See Perforation, Peritonitis.) Some modifications have been noted with respect to the manner in which this occurs. At one time the disease proceeds to the gradual erosion of all the tunics in succession, and the forming of a direct opening between the stomach and the peritoneal cavity. This is infinitely more rare in the stomach than in the small intestines, in which situation the observations of modern pathologists have shown it to be by no means an unfrequent accident, especially at the close of certain forms of enteric fever. For the most part when the stomach is thus directly perforated, the ulcer is of a small extent, and belonging to the second variety we have above described. Several observations are recorded by ancient and modern authors which rendered the opinion more or less prevalent that such perforations were produced by the eroding action of intestinal worms. In some instances lumbrici have been found lying near the perforation in the stomach; in others, as in the case related by Dr. Crampton, (Irish Med. Trans. vol. i. p. 29, New Series,) they had apparently passed through the opening into the peritoneal cavity. Gaultier de Claubry has described an appearance in which this origin was more strongly suggested than by their situation in either of the other localities. He has seen the stomach and intestines perforated in several places by lumbrici, which were so impacted in the openings as to require force for the purpose of withdrawing them. (Guersent, Dict. de Méd. art. *Vers.*) At the present day, however, this opinion seems entirely discarded, and the presence of worms at or near the perforation is regarded as a mere coincidence. In some instances the ulceration has not penetrated the entire parietes of the viscus, but resting upon the serous or muscular tunic, perforation suddenly occurs by the rupture of its deepest part during efforts of vomiting, coughing, or other forcible exertions of the muscles of the abdomen. A modification of this happens where the ulcer, having eroded the stomach and united it by its edges to a neighbouring organ, this union is torn by a similar shock. Cruikshank relates a remarkable example of this in the case of a lady in whom an illness, fatal in two or three days, ensued upon a fit of vomiting, which, as it was afterwards found, had separated the adhesions of a large ulcer from the left lobe of the liver. (Anatomy of the Absorbing Vessels of the Human Body. London, 1786. p. 113.)

4. Finally, simple ulceration may terminate by cicatrization. The occurrence of this condition has been a matter much debated by pathologists. Some assert that cicatrized ulcers are seldom if ever met with in any part of the digestive canal, (*Louis, Albers, Lesser*); others affirm that their anatomical researches have demonstrated that their occurrence is not exceedingly rare. (*Cruveilhier, Scouttetten, Prost, Trousseau.*) Albers supposes that these opposite statements concerning a matter of observation are explicable by the fact, that different conditions of the digestive tube were contemplated by the observers on either side, (Op. cit. p. 120); that the attention of one party was particularly directed to the ulcers connected with foreign degeneration; while that of the others was engaged about the simple forms of ulceration. In whatsoever manner this may be reconciled, too many cases amply authenticated are on record, to leave any doubt that ulceration of the stomach may heal by undergoing cicatrization. The importance of this conclusion in its pathology is manifest: a practical distinction arises out of it between the simple ulceration and that connected with foreign structure; and it affords a ground for hope in undertaking the treatment of these affections, which its absence should entirely take away. The cicatrix which was found in the stomach of

* We were much confirmed in this opinion by once observing the sudden effusion of blood which took place from the whole surface of a large ulcer at the nape of the neck, (which had been artificially produced by an escharotic application,) on the use of a douche over the head and back. The form and aspect of the ulcer was like the third variety above described.

Beclard has been already referred to; it was situated at the lesser curvature, near the cardia, and was about an inch in diameter; its surface was depressed, and traversed by a few cellular bands, one of which passing through its centre divided it into two lacunæ, whose base rested upon the peritoneal tunic. This example of cicatrization is cited by authors as a proof of the efficacy of a resolute adherence to a severe regimen in its treatment. Recamier has recorded a case which equally deserves attention on another account. A woman, twenty-six years of age, presented symptoms of a profound organic disease of the stomach, viz. pain, vomiting some hours after meals, and progressive emaciation. From inquiry into her husband's health, this physician was led to suspect the possibility of the disease being connected with a syphilitic taint, and accordingly recommended a mercurial treatment by frictions, and a milk diet; under this she gradually improved, and in four months entirely recovered her health. Six years afterwards she was attacked by pulmonary phthisis, and died. Examination of the body displayed, besides tubercular cavities in the lungs, a cicatrix in the stomach, of the size of a crown piece, resting upon the pancreas, to which it adhered; and the stomach immediately around it was formed into folds, like those of the mesentery. We recite this case, not only on account of the extensive cicatrization of which it affords an example, but more especially for the sake of the instructive lesson which it contains in the consideration of the occasional cause of the disease and of the success of the appropriate treatment. It evidently shows, says Recamier in his comment upon it, that even in an extreme instance of such a disease, we may have a hope of obtaining a cure, provided a cause be recognised which can be advantageously combated, such as the syphilitic taint. (Op. supra cit. t. ii. p. 55.) This important remark is illustrated with equal force by the history of a case related by Andral, in which a train of the most profound symptoms, in every respect characterizing this disease, had brought a lady, after four months' illness, to the verge of the grave; when at this point the detection of an ulcer in the throat, possessing a venereal aspect, together with the account of former suspicious circumstances, suggested to the physician (M. Andral's father) the possibility of the disease of the stomach having a syphilitic origin; whereupon, as every mode of treatment had entirely failed to arrest the progress of the disease, he acted upon this, as a last resource, and exhibited mercury gradually, both internally and by inunction. Some amendment was perceptible even from the commencement of this treatment; and ultimately, from its continuance, the patient, who had been to all appearance in the last stage of this disease, was perfectly restored to health. (Clinique Médicale, t. iv. p. 470.)

The ordinary treatment of simple ulceration of the stomach consists in regulation of regimen, local depletion, and counter-irritation, together with the conservation of as great a state of calm with respect to the function of the stomach and the general system, as possible. It is unnecessary to enter into the detail of the means by which these ends are to be procured, as this would be but a repetition of those which are described under cancer of the stomach. The treatment exposed in that place is, in fact, given more with the aim of combating the disease here described than cancer; and any success which it promises is almost entirely grounded upon the similarity of the phenomena presented by the two affections, which in many cases permits us to encourage a hope that we have to deal with the least formidable.

III. **Hypertrophy and Atrophy of the Tunics.**—An organic change, consisting in a mere increase or diminution of nutrition, is occasionally met with in the stomach, which may involve its tunics either separately or entirely. Its most frequent seat is the mucous membrane, but it has also been observed to occur in the subjacent textures; with the exception of the peritoneal covering, which is not affected with any structural alteration, properly limitable to the gastric portion of this serous membrane.

1. *Hypertrophy* invades the mucous membrane of the stomach either partially or generally, and may induce various modifications of form and colour. For the most part this membrane preserves its smooth and uniform aspect, but receives an increase in its density, as well as in thickness, so as to admit of being raised upon the scalpel in flakes from the subjacent tissues. Occasionally it is found developed in round eminences of various sizes, from that of a split pea to a large filbert, which appearance has been called mamillated (Fr. *mamellonnée*). The colour of the hypertrophied part is at one time that which is proper to the rest of the membrane; but this is not common, as it usually presents different shades of brown, slate-colour, or even black; and in some rare instances it is disposed in circumscribed patches of a milk-white colour, similar in appearance to those lymphy exudations which are occasionally found incorporated in serous membranes; but on examination by incision, according to M. Andral, they prove to be nothing but the mucous membrane in a state of hypertrophy, and altered in colour.

To this condition are to be referred the polypous growths and vegetations of different sizes and shapes which are met with from time to time in examinations of the stomach. Considerable variety exists in the instances of excrescences of this nature, which are recorded by authors; at one time they are attached by a pedicle, and represent pyriform polypi; at others they resemble mushrooms, or present a foliated appearance like the *book* portion of the ruminating stomach; but whatsoever diversity of conformation such productions exhibit, they are constituted by the mucous membrane in a state of hypertrophy, and differ from its ordinary form chiefly by taking a projecting development in isolated points. Their internal texture occasionally is contrasted with the remainder of the villous coat by a different degree of firmness or of softness, and also by a greater development of the blood-vessels, which are sometimes varicose, and so abundant as to give them the appearance of erectile tissue. In respect to the difference of texture in these productions, observers have denominated them vegetations, excrescences, polypi, fungus, &c. We cannot, however, follow M. Andral in comprehending under the same class any tumours which partake of a

scirrhous nature, as those seem to us to depart entirely in their pathological characters from the others here detailed, which are, according to him, simple developments of the hypertrophied mucous membrane. (Précis d'Anatomie Pathol. t. ii. p. 49.)

The muscular tunic also undergoes the change of hypertrophy, which may be confined to a portion of its fibres, or extend over the whole. But little notice has been taken of the occurrence of partial hypertrophy, although it is probable that it is more common than the silence of pathologists would account for. This remark appears to be warranted by the fact that the fibres of this tunic, altered in thickness and colour, are not unfrequently distributed through a scirrhous degeneration of the cellular membrane, but have generally been mistaken hitherto for fibrous productions of the substance in which they were found imbedded. (Clinique Médicale, t. iv. p. 411.) General hypertrophy has been observed to pervade the muscular tunic of the stomach by M. Louis, who has furnished an accurate description of it, as well as of the lesion with which it was connected in the cases in which it occcurred. It gave to the parietes of the viscus a double thickness and considerable increase of density, both of which conditions varied in the different parts of the stomach, but were greatest towards the pyloric extremity, in which the muscular fibres become interlaced in a cancerous degeneration. In the midst of this, however, they preserved their state of hypertrophy, but assumed a bluish, semi-transparent appearance.

This condition of the muscular tunic has been almost invariably found to occur in cancerous disease of the organ, and for the most part in cases where a contraction of the pyloric orifice existed. On this account M. Louis suggests that it may depend in the relation of effect upon the latter in the same manner as hypertrophy of the muscular parietes of the heart is caused by a contraction of the orifices of this organ. But he affirms this rather from analogical reasoning than on direct evidence, as a sufficient number of cases have not yet been collated with reference to it, to prove that it stands always in connection with a contracted state of the pylorus. The same observation applies to the conjecture of M. Prus, that it owes its origin to the constant vomiting attending upon organic disease, which, by increasing the muscular efforts of the stomach, causes this tunic to assume an excessive development. It appears, however, very probable that both conditions more or less contribute to produce this effect.

The cellular tissue which separates the tunics from each other is also not unfrequently the seat of hypertrophy. It then becomes condensed and deprived of its areolar structure, and may give so much firmness to the parietes of the stomach as to prevent them collapsing upon each other, as happens in the natural state of the organ. For the most part it occurs in the tissue subjacent to the mucous membrane, but it may involve that also which separates the peritoneal from the muscular coat, and penetrate between the fibres of the latter.

We have before adverted to the opinion of some pathologists, which has attached in modern works considerable importance to the hypertrophied condition of the cellular tissue; namely, that scirrhous and cancerous products are constituted by it, in a certain stage of development. It is certain that some varieties of these foreign structures bear much resemblance to it, and it even appears to us a tenable opinion that there is a gradation connecting them together, of which the tissue called *lardaceous* is an example. When perfectly developed, however, there does exist a distinction between the external characters of those products; and setting this aside, the difference in their history, their respective effects on the general economy, and subjection to therapeutic means, afford weighty grounds for considering them as different organic textures. These counterbalance in our judgment any arguments for their identity derived from their original deposit or molecular analysis; the latter considerations scarcely afford to the science any basis for the division of morbid tissues, which can be placed in competition with such palpable marks of pathological distinction as are supplied by the former. It is certainly often a matter of observation that the foreign deposits are found in the midst of the hypertrophied cellular tissue, nor is it possible to define the gradation by which the change takes place; but we would only remark that the same may be predicted of the conversion of cartilage into bone. Finally, we rather recognise that the hypertrophy of the cellular membrane of the stomach is frequently a nidus for the deposition of cancerous tissues, than agree with those who regard them as identical, and we publish this here only with the confidence derived from its being the opinion of some eminent British pathologists.

2. *Atrophy* of the gastric parietes is a change which is not unfrequently brought under observation by necroscopic examination. It may be local or general, and involve the tunics separately, or embrace them altogether. At one time the villi of the stomach have disappeared under its influence, partially or entirely; at another, the substance of the mucous membrane is so diminished as to be scarcely capable of being discerned separately from the subjacent tunics. These in their turn suffer the same diminution of nutrition; and lastly, it is found in different degrees to invade the whole parietes, which are occasionally reduced to such a thinness as to be transparent, and to seem to be constituted almost wholly by the peritoneal tunic. When the atrophy is local, it is ordinarily seated in the fundus of the stomach, and this situation manifests more obviously its effects, being naturally the thinnest portion of the organ.

Every form of these organic lesions is referable to some variety of chronic irritation in the stomach. The hypertrophy of the mucous membrane appears to be the only one of them which is contemplated by pathologists in the light of a primitive disease; this is a direct result of chronic gastritis. We have stated before that the hypertrophy of the subjacent cellular membrane is a secondary result of the latter, and that of the muscular tunic is found generally to attend upon cancerous disease. The atrophy of the stomach acknowledges an organ still more indirect, as proved by the researches of M. Louis, with respect to its occurrence in the mucous membrane; in the

great majority of instances it occurs as a secondary lesion in the course of chronic diseases of other organs, such as phthisis and disease of the liver and of the brain. These organic changes will have to be referred to again in considering the dilatation of the stomach.

IV. **Softening of the Stomach.**—This lesion constitutes the post-mortem appearances of a disease, which is in a great degree peculiar to infants, but which occurs also in adults, and is found in them generally to accompany the last stages of some profound affections of other organs. Although it has proved to be not a very rare occurrence, it escaped being fully identified until a recent period; but upon the recognition of its fatal character, and its importance as a pathological phenomenon, it received attentive investigation. It has been described by Jaeger, Cruveilhier, Guersent, Gairdner, and others, and experiments have been instituted by Camerer and Carswell, which have furnished satisfactory evidence with regard to its true nature. It would be superfluous to present its description in this place, as it has already been amply treated of in other articles. Under DENTITION and GASTRITIS is to be found an account of its history and symptoms; and for that of its pathology, which seems to be now fully established by the experimental researches of its author, we refer to SOFTENING OF ORGANS. Nothing remains for us but to indicate it here amongst the organic lesions of the stomach.

V. **Enlargement of the Stomach, and Contraction.**—1. *Enlargement* of the stomach is an organic change, which involves in its causes and many of its phenomena considerations of great interest. On account of it being almost always a secondary lesion, and one which is not of common occurrence, it has seldom been formally noticed in medical works; extraordinary cases of it have, however, been recorded by Mauchart, Riverius, Lieutaud, Bonet, Valsalva, Morgagni, and others among the moderns; but it deserves more special attention than it has received in any systematic work, if it were only because it forms one of the several causes of abdominal tumours, which are known to be a frequent source of diagnostic embarrassment in the practice of medicine. Amongst the descriptions of it which have been given by recent authors, none have occurred to us which contain so much information as that by M. Duplay, and we desire to acknowledge the obligations which we lie under here to his well-digested memoir.*

When the functional and mechanical relations belonging to the stomach are considered apart, its morbid dilatation has a strict analogy with that of the other hollow viscera which are endued with muscular parietes, as the heart and the bladder. The organic lesions with which it is connected are at one time obvious, and at another are not demonstrable to the senses; but like the corresponding affection of the latter organs, they are referable to two distinct classes; namely, to lesions producing mechanical obstruction to the contents of the stomach; or to others, which deprive the organ of its power of propelling the alimentary mass. In both orders of causes retention of the latter is the invariable accompaniment of the dilatation, in like manner as the urine is retained and becomes a secondary cause of distension, as well from obstruction in the urethra as from any condition which diminishes the expulsive power of the bladder. As far as has been already observed, the following pathological conditions of the stomach may be recounted as standing in the *relation of cause* to this affection.

1. Contraction of the pyloric orifice. This is by far the most frequent source of dilatation of the stomach, and is ordinarily produced, as we have seen, by cancerous disease. Its mode of action is obvious: the alimentary matters not finding a free outlet by the pylorus, accumulate in the stomach, and distend it to a greater or less degree, which is determined chiefly by the extent of the obstruction, and in part by the quantity of the accumulation which may be rejected by vomiting. When depending upon this cause, the parietes of the viscus may be found in a state of simple dilatation, or along with this they may have suffered thinning and softening to such a degree as to give occasion to rupture; or, on the contrary, hypertrophy of all the tunics, especially the muscular, may coincide with its increased capacity; which lesions, it may be remarked, preserve an analogy between this alteration of the stomach and diseases of the heart connected with valvular obstruction.

It is, however, to be observed that dilatation does not occur in every instance of pyloric contraction, nor even invariably where total obliteration of the orifice is found. Moreover, it happens in cases in which this orifice has continued perfectly patent, or still wider than in the natural state; all which circumstances conspire to prove that other conditions co-operate with the mechanical obstruction to produce the dilatation, even when they appear most obviously in connection. M. Andral has made it apparent from researches on the action of the pyloric end of the stomach, in propelling the chyme from this viscus into the duodenum, that the integrity of its muscular action is necessary for the performance of this movement. But it will be observed that it always happens in cancerous disease of the pylorus, that the muscular tunic, to a greater or less distance from the orifice, is surrounded by the scirrhous induration, which must impede its contraction, and thus deprive the stomach of its action. This sufficiently explains the cases of dilatation with patency of the pyloric valve, for in all the instances of organic disease in which these conditions coincided, the muscular fibres in its neighbourhood have been observed to suffer either by surrounding induration or by their direct lesion. Another circumstance which frequently co-operates in cancerous disease to impede the muscular action, is the occurrence of adhesions between the stomach and the neighbouring organs, which, in the same manner as the former conditions, contributes to effect the dilatation of the organ by causing the retention of the alimentary mass.

2. Organic alterations in the muscular tunic. With reference to their effect in originating dila-

* De l'ampliation morbide de l'estomac considérée surtout sous le rapport de ses causes et de son diagnostic; par A. Duplay, chef de Clinique interne à l'hôpital de la Pitié. Archives Générales de Médecine, Octobre 1833, et Décembre, même année.

tation of the stomach, these may be partial or general. Observation has established that the destruction of the muscular fibres which are situated near the pylorus is an occasional cause of this morbid condition, and not less certainly that it originates under an atrophied state of the whole of this tunic. On account of the special office which the pyloric end performs, of propelling the gastric contents into the duodenum, the partial injury of the muscular tunic, when seated here, is as effectual in causing retention and the consequent dilatation, as the general atrophy of this tunic, but it is easily conceived that the action of both is similar.

3. Paralysis of the stomach. — The dilatation has been occasionally observed to occur where none of the foregoing causes existed, the stomach being entirely free from any organic disease. This organ in fact may be affected with a paralytic loss of its contractility in the same manner as the bladder; and as the urine, under such a condition of this viscus, accumulates without the power of being voided, so the stomach, in like circumstances, yields, as a flaccid bag, and becomes dilated gradually by the accumulation of the food. This source is worthy of particular attention, as it affords a hope with reference to the employment of therapeutic means, which the affection connected with organic lesions leaves scarcely any room for entertaining.

4. Finally, it may be produced by tumours of various kind, polypi, fibrous growths, or hydatids, situated either internally and involving obstruction of the orifices, or by their weight giving rise to a relaxation of the viscus, which may occur when they have an external attachment, or are even situated in the omentum.

History and diagnosis.—With this enumeration of its causes prefixed, the phenomena of enlargement of the stomach present themselves with freedom to the mind, and we are prepared to meet the diversity which they offer, the result of the various morbid states connected with this lesion: in proceeding to detail its symptoms, we shall first notice the manner in which it progresses.

When the contents of the stomach become accumulated, either, as we have seen, from the obstruction of its orifice or loss of its contractile power, distension takes place. In the commencement this may not be immoderate, and only temporary, as it can be relieved by vomiting; which action, however, if the viscus be already somewhat weakened, is only partial, permitting much of the ingesta to remain still lying in its cavity. This, by its continual weight, diminishes the power of resistance, and by a reacting influence the alimentary matters are allowed to augment, so that at length the most depending part of the stomach begins considerably to yield under the downward pressure. As the dilatation advances, the oblique position of the viscus disappears, and the two orifices take the same level, and approach each other, so closely in some extreme cases as to be found in actual contact. The vomiting becomes more infrequent as the capacity is increased, and in the same proportion it becomes more difficult to unload the stomach completely, so that all the circumstances contribute to the accumulation. The dilatation augments in this manner to an enormous measure; in some cases it invades the entire abdominal cavity and pelvis, stretching downwards to the pubis, and covering the intestines which lie compressed behind it; in others, its pressure extends upwards and produces great distress by interference with the thoracic organs, and sometimes even dangerous effects by obstructing their functions.

With respect to the appearances which are found post-mortem, as far as they depend simply upon the enlargement of the stomach, they correspond of course with this description of its progress; but it is easily conceived that almost the entire pathological interest of those is absorbed in the investigation of the primary lesion with which they are connected. Concerning the latter we add nothing here; it may be mentioned, however, that besides the displacement of the various viscera which is occasionally found to have been effected by the dilated stomach, not unfrequently every trace of the epiploon disappears; the gradually expanding organ having glided between its separate folds, those overlay it, and become united to its parietes.

The symptoms belonging to the diseases of the stomach, which originates the dilatation, form an important part of its general features; but we shall consider them here only so far as they are characteristic of the lesion itself. Amongst the causes above enumerated, those which involve organic disease, such as cancer of the pylorus, afford signs which have been more or less adverted to; but it is necessary to notice the conditions which have been observed in connection with the atonic relaxation or paralysis of the stomach. This morbid state has been found most frequently to occur in those who have contracted extreme habits of gluttony, and more especially in those extraordinary instances of perverted appetite in which the individuals have been accustomed to swallow foreign substances. In a man at Brest whose stomach was found to contain a quantity of fragments of glass, pieces of wood, iron, and tin, with an entire knife and handle, this organ was found enormously dilated. In the case of a lunatic which latterly occurred in Dublin, the enlargement was connected with his swallowing buttons, half-pence, pins, &c. which were found after death in considerable number, and even during life betrayed themselves by a jingling sound on the succussion of the abdomen.* M. Percy has collected the histories of several cases of individuals addicted to gluttonous excess in eating and drinking, in whom enormous dilatation occurred; and it has happened in others in which the gluttony was not carried to the immoderate excess which distinguished the latter, as in an interesting observation related by M. Pezerat, where an evident paralytic relaxation of the stomach ensued in an individual who was unable to refrain from the indulgence of a habit contracted from his infancy, namely, taking copious drinks of weak wine and water. (Journal compl. des Dict. des Sciences Méd. t. xxxv. p. 162.) It has been known also to occur in females liable to recurrent attacks of hysteria, in whom the meteorismus of the stomach prevails, which is a common accompaniment of the nervous dyspepsia attending upon this disease. Other in-

* The particulars of this case, which are, as we learn, interesting in many respects, we hope to see shortly published by Mr. Adams, in whose practice it occurred.

stances are not wanting where no connection could be traced between it and any of those exciting causes; in such the stomach seems to undergo a true paralytic relaxation, which was regarded by Lieutaud, who described it, as similar to that which is observed in the bladder in advanced age: the same condition is noticed by Chaussier, and compared by him to the relaxation of the scrotum, which occurs in certain individuals.

Pain, oppression in the epigastric region, and general tension of the abdomen, repeated, uncontrollable eructations of sour air, and profound digestive derangement, are symptoms which are to a greater or less degree invariably present in this morbid condition. They cannot, however, be relied on as special characteristics; nor is any single sign entitled to be esteemed as such, as none taken alone is sufficient to establish the diagnosis. Yet for this object much assistance is furnished by the examination of a particular symptom, the vomiting, and more especially by the exploration of the abdomen.

The vomiting consists at one time of the mucus of the stomach in great quantity, and at others of the alimentary matters which had been swallowed, more usually of a mixture of both, or, if cancerous disease exists, of its peculiar secretions. Its action is remarkable, being rather a regurgitation of the gastric contents than the forcible muscular expulsion which characterizes ordinary vomiting. In the beginning of the affection it occurs more frequently than when the dilatation has already made some progress, and at the more advanced period it is apt to observe distant periodic intervals of two, three, or four days in its return, and then brings a much-desired relief, by unloading the organ partially or entirely of its enormous accumulation. To procure this artificially, the patient sometimes has recourse to tickling the fauces, or the use of emetics; in other cases he finds the relief, still more effectual, which the operation of drastic purgatives produces. Unhappily, instances occur in which the vomiting ceases totally, the stomach seems insensible to any stimulant, the consequence of which is, that the feeling of oppression is not to be relieved by any means, and the accumulation continually increases.

The exploration of the abdomen, the most palpable sign, in every respect furnishes the most valuable data towards recognising this morbid state. On this subject we quote from the memoir of M. Duplay, in which the information derivable from this source is lucidly set forth. The patient should be subjected to a double examination; the first to be conducted some time previous to the coming on of the vomiting, the second after the vomiting.

"*Before vomiting*, the examination of an individual with enlargement of the stomach, whatever be the nature and cause of it, presents to the touch *a tumour* more or less indistinctly circumscribed, which extends from the left hypochondrium to the right iliac fossa. This tumour extends also to the hypogastrium, and ascends towards the right side; in some instances, its outline along this track is easily distinguished. When the patient is placed in a vertical position, the epigastrium projects less than the lower part of the abdomen; on the contrary, when he lies in a horizontal position, this region participates in the general tumefaction of the belly, which in every part gives the sensation of an obscure fluctuation and absence of elasticity (*empâtement*).

"On practising percussion, the abdomen gives a clear sound in the epigastric region, which becomes more dull as we descend towards the hypogastrium; a difference which naturally depends upon the respective gravitation of the fluids and the air contained in the viscus. This consideration also evidently suggests that the difference is much influenced by position; the dulness in the inferior part of the abdomen augments in the vertical position and becomes diffused, and appears to ascend towards the epigastrium in proportion as the patient changes to the horizontal.

"On tapping for fluctuation (*ballottement*), by the hands being placed on either side of the abdomen, a particular sound is perceived, similar to that which is produced by striking on a bladder half filled with air and liquid.

"Succussion has not yet been employed in its diagnosis, or at least its application has not been described in any of the cases which the author has consulted. Smart shocks upon the trunk, with the ear applied to the epigastrium, would, however, produce the sound of fluctuation more distinctly than the *ballottement*, especially in individuals who have still preserved their fulness of flesh. This is evident from the fact that some individuals have the power of producing a gurgling sound by alternately contracting and relaxing the diaphragm and the abdominal parietes.

"The ingestion of liquids or of aliments may also contribute towards establishing the diagnosis of this morbid condition. In some cases, the patient will be able himself to perceive the substances which he receives into his stomach descending to the lowest part of the abdomen.

"*After vomiting*, all the signs above stated disappear in part, or become less evident. The projection which the distended stomach forms is less easily to be traced through the abdominal walls, even when these are emaciated. The dulness on percussion disappears more or less completely; the lateral pressure and the succussion no longer produce the fluctuation, nor the gurgling, or only in an obscure degree. Again, the signs are reproduced upon the re-introduction of food or liquid into the stomach." (Archives Générales de Médecine, Décembre, 1833, p. 549.)

It is scarcely necessary to add that those means of exploration furnish their data, both positive and negative, in proportion to the extent to which the dilatation of the stomach has proceeded. If it be supposed that this lesion is of such a palpable nature that it would not be difficult to recognise it, this is not accordant with the histories of it which the annals of medicine contain; in the great majority of these, it has never been discovered until after death. But, besides this fact, cases are recorded in which it had been mistaken for other abdominal tumours, such as ascites, encysted dropsy, or pregnancy. A case, extraordinary for the enormous quantity of fluid which was contained in the stomach, amounting to ninety pounds, is related in the works of Riverius, in which the disease of the female was first supposed to be pregnancy; when the period passed which dis-

closed this error it was taken for ascites, and after death a puncture was made in the abdomen to give exit to the fluid which was thought to exist in this cavity, the distension being so great as to exceed the size of the coffin: and finally the same case has been recited in several authors as an example of the disease which they named "dropsy of the stomach." A fact of similar import is related by Bonet, namely, that a woman, the volume of whose abdomen had caused her to be regarded as pregnant, died, and being opened, it was discovered that the swelling was produced by the stomach enormously enlarged. In these cases the puncture of the abdomen was not made until after death; but in an instance related by Chaussier, (Essai sur les fonctions du grand épiploon; Mém. de l'Acad, Dijon 1784,) and in another by Vacca, (Arch. Gén., Déc. 1823, p. 528,) this error was committed during life, and death was the speedy consequence. All those cases, but particularly those last mentioned, are worthy of consideration with regard to the diagnosis of this disease; it is not likely that at the present day any practitioner who is in possession of the resources of diagnosis would be so far deceived as to proceed to such an operation; but still much ambiguity may be found in certain cases, and it may be said that in none should we be so confident as to dispense with the diligent application of all the means which can be devised.

For the purpose of distinguishing it from ascites, the following will serve as valuable marks of difference. The form of the abdomen varies in the two affections; in ascites no approach to a definite contour is visible, as occurs where the tumefaction of the belly is referable to enlargement of the stomach. The progressive growth of the tumour in both diseases proceeds in contrary directions; in the stomach the fundus supporting the liquid and solid contents, gravitates from the epigastrium downwards; while in the dropsy of the peritoneum the gradually increasing fluid ascends from the hypogastric region into the superior parts of the abdomen, and corresponding to this opposite progress the dulness of sound on percussion also moves. Together with these the comparative states of the tumour before and subsequent to the emptying of the stomach afford a characteristic which is quite peculiar to enlargement of this organ, and distinguishes it with much certainty from ascites, pregnancy, or tumours in any other of the viscera of the abdomen.

Many of the same differential signs are applicable to prevent it being confounded with pregnancy. The latter condition, however, possesses in auscultation and its other means of exploration signs of such positive value, that an attentive investigation can at the present day scarcely fail to decide correctly between them.

Treatment. — It will appear manifest from the consideration of the ætiology of morbid enlargement of the stomach that the resources of medicine are of little avail for its counteraction. The connection in which it stands in the majority of instances with the most profound organic lesions leaves room for it only to be regarded as a distressing complication of a disease in itself hopeless. We have already seen the fatal character of cancerous disease of the stomach, and how impotent the medical art remains against ulceration, atrophy, or hypertrophy of this organ. In the variety of it which depends upon atonic relaxation, more room is left for the trial of curative means; but they can rarely afford any prospect of success in an affection which is the accompaniment either of old age or of some serious lesion of the nervous system. Where the dilatation exists in individuals addicted to gluttony, at first view it would seem more amenable to treatment, as it has rarely in such to contend with primary structural lesions, or with loss of the organic nervous power. But are the perversions of our spiritual nature less untractable than the diseases of the body?

Some relief may be obtained from the evacuation of the intestinal tube by means of gentle laxatives. Strong purgatives are not recommendable, as the irritation and weakness consequent upon their action tend to aggravate the evil. In the paralytic dilatation an attempt should be made to excite the action of the stomach by the use of light tonic bitters, such as the sulphate of quinine, gentian, calomba, or others of this class; a fair indication seems also to be afforded for the exhibition of strychnine. In a case in which M. Rayer employed it, the tetanic twitches seemed to be produced in the region of the stomach which have been sometimes observed to precede its successful operation in other parts affected with paralytic disease; but these were not attended by any sensible amelioration. The application of moxa to the epigastric region has been tried with the same object; it might be applied with as much suitableness to the dorsal region of the spinal column. It seems probable that in some cases the oppressive distension might be mitigated by the use of a bandage surrounding the stomach in such a manner as to give support to the depending viscera. Finally, the regulation of the diet demands close attention; it should consist of the materials which agree most with the stomach, and this at one time is answered by animal food, while at another this is improper. It is obvious that in the case of voracious eaters the overcoming of the vicious habit is the only hope of success; but the accomplishment of this is extremely difficult. It should be attempted by the limitation of their meals to a restricted quantity, and making them consist of that which is of the most nutritive quality, in the smallest compass. The internal use of ice may be employed for the purpose of allaying the hypersthenic state of the stomach, at once the effect and the reacting cause of the craving appetite of such individuals. On their part this treatment will meet probably with resistance, but it should be enforced, if possible, by persuasion, if not, by this combined with firm restrictive measures; and it will be happy for the victims of such a tendency who shall be placed in circumstances of life which admit of the employment of coercion.

2. *Contraction of the stomach.*—This lesion has been already adverted to as a consequence of cancerous disease of this organ, which is by far the most usual pathological state with which it is found connected. It is frequently met, however, quite independent of this; in almost every collection of anatomical observations promiscuous cases of it are related, and to many of those much inte-

rest attaches; yet there is wanting (as far as we are aware) a digest of the materials which illustrate the subject. When it receives an enlarged investigation of this nature, including facts which contain the light of modern research, little doubt remains but that this lesion will be found to possess much practical importance; at present we are obliged to be content merely to mention it with reference to the circumstances in connection with which it has been observed.

The diminution of volume is sometimes to be ascribed to direct pressure upon the organ, by collections of fluid in the abdomen or by enlargement of the different viscera of this cavity adjoining the stomach, as the spleen, the liver, and the pancreas. The same cause operates also acting from without; it has been proved to originate under the influence of tight lacing of the stays in females, and also in individuals whose daily employments necessitated them to lean the abdomen upon the edge of a table, as in the case of hatters and writing clerks.

It has been also observed to arise from the violent action of purgative medicines and emetics, which in such cases are to be placed in the rank of poisons, as it is one of the most common appearances which are found in those who have died from poisoning, especially from having taken the metallic poisons or the strong acids. Hysteria seems to be another cause of this lesion, as it has been also occasionally found in individuals who had been subject to this disease. Portal affirms, that in several persons who died from the abuse of magnetism, which had caused a disease manifesting languor, marasmus, and vomiting, the stomach and intestines were exceedingly contracted. (Cours d'Anatomie Médicale, t. v. p. 179.) According to the same author, venereal excesses are also to be reckoned amongst the causes of it, which have been proved by post-mortem inspection; and in individuals who have died after prolonged abstinence or chronic diseases during which little food could be taken, the stomach is often seen to have its capacity so much diminished as to present its cavity nearly obliterated.

Much diversity exists with respect to the forms which the contracted stomach under different circumstances may assume; in some cases longitudinally disposed, it appears like the remainder of the intestinal tube, in others it takes a globular shape, while in others it is found divided into two or more cavities; a condition which depends upon the irregular and spasmodic contraction of the muscular fibres, and seems to have originated a mistaken idea amongst some of the old authors, who describe the occurrence of two or three stomachs as a variety which the human subject occasionally presents.

J. Houghton.

[STOMATITIS, *Inflammation of the Mouth.*

The mucous membrane of the mouth is liable to various forms of inflammation, which may be simple or erythematous, accompanied by a pseudomembranous or diphtheritic exudation, or by an eruption; or the follicles of the mouth may become ulcerated, or the stomatitis may end in gangrene. All these pathological conditions deserve a separate inquiry.

1. Simple Stomatitis.

Diagnosis.—The mucous membrane is unusually red, hot, and dry, and extremely sensible to the contact of foreign bodies, even of the tongue. The redness is commonly in patches, and the affection rarely gives rise to general symptoms. It usually passes off in a few days by resolution, but occasionally terminates in ulceration or gangrene. The latter is not, however, to be anticipated; but induration of the submucous tissue is at times left by it. Ptyalism is not an unfrequent concomitant.

Causes.—The most frequent cause is the ingestion of hot or acrid substances; injuries done to the mouth by bruises, or the operations of the dentist, or by the accumulation of tartar around the teeth. During the age of the first dentition, stomatitis may arise from this source, when it may be accompanied by signs of general pyrexia. Occasionally, too, erythematous stomatitis would seem to be induced by disorder of the tube lower down.

Treatment.—This form of stomatitis generally yields readily. If induced by acrid or hot substances, it passes off spontaneously in a short time. Milk diet and mucilaginous gargles, as of flaxseed tea, or infusion of slippery elm, or a lotion of the white of egg mixed with water, are all that can be demanded. If the stomatitis be dependent upon gastric derangement, it disappears as soon as the derangement ceases. Small doses of magnesia, combined or not with charcoal, may generally be prescribed in such cases with marked benefit.

2. Diphtheritic Stomatitis.

This is the stomatitis with altered secretion of some, and ought to include both the thrush or *muguet* of the French writers, and the pseudomembranous stomatitis, *stomatite couenneuse* ou *diphthérite buccale*. Both are varieties of the same kind of inflammation of the mucous membrane, but it may be convenient to examine them separately.

a. *Pultaceous Stomatitis.* (See Aphthæ of Children.)

b. *Pseudomembranous Stomatitis, Diphthérite Buccale.*—This can be regarded as only a severe variety of the last, affecting the same parts; the exudation being detached in large flakes, having the ordinary appearance of false membranes. These are soon renewed, but in favourable cases, the inflammation, that gave rise to them, gradually disappears; in other cases, signs of gangrene supervene; this termination, however, and indeed the variety of the disease itself, is rare, except in large foundling establishments, where the mortality from it is at times frightful: of 193 cases, observed by M. Valleix, (*Clinique des Maladies des Enfants*, Paris, 1838,) 153 terminated fatally. In such cases a disagreeable sense of heat is experienced by the little sufferer, with pain augmented by the contact of foreign bodies; the breath is fetid, and the submaxillary glands enlarge and become painful. Later on, the lips and gums are tumid and bloody; a sanious saliva flows copiously from the open mouth; the breath becomes more and more fetid; and the face flushed and swollen. The fever is more or less intense, with headache, restlessness and want of sleep.

Treatment.—Where an impure air is connected with the origin of the disease, it is, of course, important that the patient should be removed from its influence. In the early period, the mucilaginous collutories, recommended in the last variety, may be used, with gentle laxatives of magnesia or castor oil. Afterwards, a mixture of muriatic acid and honey may be employed to touch the pseudo-membranous patches: this may be done by means of lint rolled around, or of sponge attached to, a small stick. Collutories of chlorine water, chlorinated lime, creasote, and vinegar and alcohol, have likewise been recommended.

The application of muriatic acid, as well as of the other collutories, must be made once or twice, or oftener, in the twenty-four hours, as the case may require.

Alum, nitrate of silver, and sulphate of zinc, have all been used as collutories, but they are not possessed of any advantages over the articles already mentioned.

3. Follicular Stomatitis, (See Aphthæ of Adults.)

STOMATITIS OF NURSES, (See Aphthæ.)

STOMATITIS, GANGRENOUS, (See Mortification, and Throat, Diseases of the.)

Robley Dunglison.]

[STROPHULUS, *Tooth Rash, Gum* or *Gown, Milk Spots*, has by some been described as a variety of Lichen,—*Lichen Strophulus*. It is very common in infants, and is characterized by an eruption of greater or less extent, or papulæ either more white or more red than the rest of the skin; which are seated generally on the face, and are accompanied by more or less itching (A. Cazenave, *Dict. de Méd.* xxviii. 659, Paris, 1844). It presents great diversity in its appearance, and all the forms are seen at times on the same child. When the papulæ are red, inflamed and prominent, scattered here and there, and intermixed with erythematous patches, it is the *strophulus intertinctus* of dermatologists, *Red gum* or *Red gown*. In some cases they are smaller or of different sizes, crowding in clusters, and in more extensive crops—*strophulus confertus* or *rank Red gum*; and in others, the eruption appears in little circular clusters, somewhat solitary, and generally on each arm or cheek; more commonly, however, flying from part to part—*strophulus volatilis*. Sometimes the papulæ are minute, hard, and of a whitish colour, surrounded occasionally by a reddish halo—*strophulus albidus* or *white gum*,—or the pimples are large, glabrous, shining, of a lighter hue than the skin, and without a halo or blush—*strophulus candidus*.

In the majority of cases, strophulus seems to be connected with the process of the first dentition. It generally requires and receives but little attention. It is commonly sufficient to administer an occasional dose of rhubarb and magnesia. The cause is generally transient; and as it yields, the disease yields likewise.

Robley Dunglison.]

SUCCESSION OF INHERITANCE.—LEGITIMACY.—It would be more than superfluous to dwell, even for a moment, on the immense importance of the interests which are involved in the determination of the question of *legitimacy*. It is sufficient only to remember that the honour and purity of virtue, and the succession to rank, titles, and property, not unfrequently depend solely for their invalidation or establishment on the settlement of this question; while the fact to be established is unfortunately one which does not always admit of being tested by any fixed criterion either in law or physiology, but on every new occasion of doubt or difficulty depends for its elucidation on the contradictory evidence of witnesses, and the opinion that may, in the particular instance discussed, be formed by judges or committees, of the connection between facts stated and admitted, and their relations with other circumstances, in general not admitting of any certain or satisfactory method of proof.

Our ancestors of the olden time were satisfied with a very simple rule on the subject of legitimacy:—*the husband of the woman was the father of her children*, unless he happened to be impotent or "beyond the four seas" during a period exceeding that of gestation; so that, in fact, the wife might with impunity, so far as the law was concerned, have twenty children by as many paramours, and the law would father them all on the husband. Absolute proof of paternity being nearly impossible, recourse was had to presumptions, and of these the most natural, reasonable, and satisfactory is that founded on marriage; and hence the rule of the civil law, *pater est quem nuptiæ demonstrant*, was very early adopted, and could not be impeached, except in the two cases already mentioned—impotence of the husband, or his absence from the realm. No rule of law was ever more strictly adhered to than this for a period of nearly five centuries, the judges with singular pertinacity resisting every effort that was made to infringe it.

The old English law, as laid down by Bracton, and copied from him in *Fleetwood*, differed considerably from this, and recognised three valid objections to legitimacy,—impotence, non-access, and all conclusive presumptions deduced from physical and moral causes; and so far did they carry the latter, that a refusal by the husband to recognise the child was held sufficient, so that it was in the power of any unnatural father to disinherit his offspring, and avoid the trouble and expense of rearing it. In all Bracton's cases this arbitrary recognition appears to have been a *sine-qua-non*, but the rejection of a once acknowledged child was at no time evidence.

These statements are confirmed by Britton; but no sooner had the common law struggled into respectability and thrown off the bondage of canonists and civilians, than a system entirely different grew up; and from the time of Edward III. until that of Lord Hale, one simple and inviolable rule prevailed, viz. that every child born in wedlock was legitimate, unless the husband was impotent or beyond the four seas (*extra quatuor maria*) at the epoch of conception.*

* For cases on the dictum of Hale, see Pendrill v. Pendrill, Strange, 925; Rex v. Reading, Case, Temp. Lord Hardwicke, 82; Rex v. Luffe, 8 East, 208. See, also, Rex v. Rook, Jay. Rep. 61, and Rex v. Inhab. of Bedell, Andr. 8.

That great judge resolved to purify the law from its manifest absurdity, and was the first to admit evidence of the non-access on the part of the husband without the foolish condition of *ultramarine* absence. This occurred in the case of Dickens v. Collins, of which unfortunately no report exists; but this was the whole amount of innovation. It was, however, regarded as of the greatest consequence, and immediately followed by the judges; and in a very important case in the beginning of the eighteenth century it was laid down by Lord Chief Justice Raymond, that the old doctrine was not to be held, but that the jury were at liberty to consider the point of access. This was the case Pendrill v. Pendrill:—the husband, after cohabiting with his wife for some months, went to Staffordshire, the wife remaining in London. At the end of three years the wife had a son, who rested his claim upon the presumption of law in favour of legitimacy, he being born in wedlock and his father *within the four seas*. Strong evidence was admitted that the husband had never left his house in Staffordshire; and so upon the ground of non-access the jury found the son a bastard. (2 Strange, 924; see, also, Paris and Fonblanque, vol. i. p. 216.)

Neither Lord Hale nor his successors ever thought of admitting evidence that did not demonstrate the absolute *impossibility* of access, as where the husband was in a different country, or entirely disabled by disease during the period of conception. Thus in Lomax v. Holmden and another, 2 Strange, 490, which was a trial in ejectment, where the question was whether the lessor of the plaintiff was son and heir of Caleb Lomax, deceased, the defendants gave in evidence the inability of the ancestor from a bad habit of body; but their proofs going only to *improbability* and not *impossibility*, there was a verdict against them. The disavowal of the offspring by the husband was of no avail, nor was the wife allowed to prove his non-access, although she might the access of another man.

As late as 1807, Lord Ellenborough said, "If we may resort to all impediments arising from natural causes, we may adopt other causes equally conclusive to show the *absolute physical impossibility* of the husband being the father, I will not say the *improbability* of his being such; for upon the ground of improbability, *however strong*, I will not venture to proceed."

How strictly such a rule was acted upon by one of our most acute judges, the following case, decided in 1792 by Sir William Wynne, will show. It was a cause in the Prerogative Court of Canterbury, for the administration of the effects of John Newport, Esq. The intestate was the only son of Ann the wife of Ralph Smyth, and was born when his mother had left her husband for some years to live with Lord Bradford as his mistress. He was educated by that nobleman as his son, inherited from him a splendid fortune, and assumed his family name by act of parliament.

The separation between Mr. and Mrs. Smyth was of an amicable nature; he appeared rather to promote her intercourse with Lord Bradford, and allowed her a small annuity. For the payment of this they had occasionally brief interviews, but there was no proof of any such having taken place for some time previous to the birth of her child.

Mr. Newport, on his return from abroad, became insane, (the disease was hereditary in Lord Bradford's family,) and he was placed under the care of some members of it. Suits in chancery were instituted respecting his property, and Mr. Smyth as his mother's husband was made party to them; but although the latter gentleman would have derived great pecuniary advantages from claiming the lunatic as his son, he studiously avoided all declarations to that effect; and both acted himself, and allowed the court to act, as if no doubt could be entertained of Mr. Newport's illegitimacy.

The lunatic survived his mother and her husband, and died possessed of property which had accumulated to an immense amount, which property was claimed by the grand-nephew of the deceased, Mr. Smyth; whereupon Sir William Wynne decided that the legitimacy of Mr. Newport was established, and consequently in favour of the claimant. His reasons were, that the circumstance of the husband and wife both residing in London for some time previous to the birth of the child was proved in evidence. It was also proved that they occasionally met; that she visited him at his lodgings in Holborn to receive her annuity, and on those occcasions remained alone with him in his room, which was a bed-room, for half an hour at a time. It seemed probable that he occasionally dined with her at a house of Lord Bradford's, at Hammersmith. Thus possibility of access was established, and the learned judge delivered his opinion as to the legal question in these words:—"The law of England on this subject, as now settled, I take to be this: that if such proof can be given, of whatever kind, as shall satisfy legally the mind of the court that the husband had no access to the wife at the time when the child must have been begotten, the child is a bastard, though born of a married woman in the lifetime of her husband; but if the husband and wife were so circumstanced that access must be presumed between them (as if they lived in the same town or place, and cannot be proved by persons who have watched them never to have come together); or if by direct evidence it can be proved that they had access to each other, in such a case I take it the son is legitimate, *notwithstanding any circumstantial evidence that may be given to the contrary*."

Such appears to have been the law on this subject until the year 1813, when it was first disturbed and altered by a judgment of the House of Lords in the Banbury peerage case, in which, although constant access was admitted and impotence not proved, the offspring was declared illegitimate *from circumstantial evidence*. On this occasion Lord Ellenborough proposed that "it was desirable to have the opinion of the judges, whether any circumstances could rebut the presumption of access," and "whether there existed in this case any such circumstances." Accordingly, several important queries were submitted to them; and amongst the most material of their answers were the following:—"That the presumption of legitimacy arising from the birth of a child during wedlock, the husband and wife not being proved to be impotent, and having opportunities

of access to each other during the period in which a child could be begotten and born in the course of nature, may be rebutted by circumstances indicating a contrary presumption.

"That in every case where a child is born in lawful wedlock, the husband not being separated from the wife by a sentence of divorce, sexual intercourse is presumed to have taken place between the husband and wife, until that presumption is encountered by such evidence as proves, to the satisfaction of those who are to decide the question, that such sexual intercourse did not take place at any time, when by such intercourse the husband could, *according to the laws of nature*, be the father of such child.

"That the presumption of the legitimacy of a child born in lawful wedlock, the husband not being separated from his wife by a sentence of divorce, can only be legally resisted by evidence of such facts or circumstances as are sufficient to prove to the satisfaction of those who are to decide the question, that no sexual intercourse did take place between the husband and wife at any time, when by such intercourse the husband could by the laws of nature be the father of such child."*

Lords Ellenborough, Eldon, and Redesdale concurred in their opinions on this case; and their arguments may be thus briefly stated. "This is a question of presumption: the presumption of legitimacy arising from the fact of marriage may be rebutted by circumstances inducing a contrary presumption. Impotence is such a circumstance; so, also, is any other cause or combination of circumstances, proving that the husband could not be the father of the child. It is agreed that neither impotence nor want of access is proved in the present instance; there is, therefore, no *physical* impossibility of Lord Banbury's being the father. But in the absence of such evidence the question may be decided on the ground of a *moral* impossibility, which the conduct of the parties in this case establishes."

Lord Erskine made great exertions on the opposite side and in favour of the legitimacy, but he was unsuccessful; and on the 18th of June, 1813, the house resolved that the petitioner had no claim to the title, dignity, and honour of Earl of Banbury. (See Lords' Journals, vol. xlix. 178.)

It appears, then, that the law formerly stood thus:—

Presumption of legitimacy may be rebutted by *physical* evidence *proving* the contrary; and that, since the Banbury peerage case, it stands thus:—

Presumption of legitimacy may be rebutted by *physical* evidence *proving*, or by *moral* evidence *rendering probable*, the contrary.

Accordingly, Mr. Phillips lays it down as a doctrine to be extracted from this case, "that the jury may not only take into consideration proofs tending to show the *physical impossibility* of the child in wedlock being legitimate; but they may decide the question of paternity by attending to the relative situation of the parties, their habits of life, the evidence of conduct, and of declarations connected with conduct, and to every induction which reason suggests for determining upon the probabilities of the case." (Treatise on the Law of Evidence, vol. ii. p. 288. Edit. 1829.)

Blackstone lays down the law on some of the most material points connected with this subject, thus: (Commentaries, vol. i. p. 454 et seq. Edit. 1832.)—"A bastard, by our English laws, is one that is not only begotten but born out of lawful matrimony. The civil and canon laws do not allow a child to remain a bastard, if the parents afterwards intermarry; and herein they differ most materially from our law; which, though not so strict as to require that the child shall be *begotten*, yet makes it an indispensable condition, to make it legitimate, that it shall be *born* after lawful wedlock.

"As bastards may be born before the coverture or marriage-state is begun, or after it is determined, so also children born during wedlock may, in some circumstances, be bastards. As, if the husband be out of the kingdom of England, or, as the law somewhat loosely phrases it, *extra quatuor maria*, for above nine months, so that no access to his wife can be presumed, her issue during that period shall be bastards. But generally, during the coverture, access of the husband shall be presumed, unless the contrary can be shown, which is such a negative as can only be proved by showing him to be elsewhere; for the general rule is *præsumitur pro legitimatione*. In a divorce *a mensâ et thoro*, if the wife breeds children they are bastards; for the law will presume the husband and wife conformable to the sentence of separation, unless access can be proved; but in a voluntary separation by agreement, the law will suppose access unless the negative be shown. So, also, if there is an apparent impossibility of procreation on the part of the husband, as if he be only eight years old, or the like,† then the issue of the wife shall be bastards. Likewise, in case of divorce in the spiritual court *a vinculo matrimonii*, all the issue born during the coverture are bastards, because such divorce is always upon some cause that rendered the marriage unlawful and null from the beginning.

"From what has been said it appears that all children born before matrimony are bastards by our law; and so it is of all children born so long after the death of the husband, that by the *usual*

* In the celebrated case of Morris v. Davis, Mr. Justice Gaselee, who presided at the third trial of that cause in 1828, in summing up his charge to the jury, made the following observations on the subject of *access* and *intercourse:*—"The Banbury peerage is now the law. There is proof that the husband was in the wife's neighbourhood, and this is *primâ facie* evidence of intercourse: but it is competent in the defendants to rebut the presumption thus raised, by anything that amounts to satisfactory evidence that no intercourse took place. The question then will be, first, whether you are satisfied there was that access between the husband and wife, that sexual intercourse *might* take place: secondly, whether the evidence satisfies you that no such intercourse did take place? If it might take place, the law presumes it did, unless the contrary is proved. Many witnesses proved opportunities. If you are satisfied there were opportunities, the law says the child is the child of the husband."

† It would be very difficult to assign the opposite limit of advanced age which would preclude the possibility of procreation. "There is," says Lord Erskine, "no statute of limitations on the powers and faculties of man. Instances of robust longevity might be cited still more extraordinary than that of Lord Banbury. Sir Stephen Fox married at the age of seventy-seven, and had four children. The first child was born when the father was seventy-eight: the second and third were twins in the following year; and the fourth was born when the father was eighty-one. The Earl of Ilchester and Lord Holland can vouch for the accuracy of this statement, and I believe their genealogy has stood hitherto unquestioned."—*Speech on the Banbury Case.*

course of gestation they could not be begotten by him. But this being a matter of some uncertainty, the law is not exact as to a few days." (Comm. vol. i. p. 456.)

In the foregoing statements of the law connected with this subject, there is frequent reference to "the usual period of gestation," "the course of nature," "the laws of nature," &c. a conformity to which, in the birth of any individual whose legitimacy may happen to be questioned, constitutes one of the requisites essentially necessary to satisfy the law; "but this being," to use the words of Blackstone, "a matter of some uncertainty, the law is not exact as to a few days." Unfortunately the law is not exact as to any time, however unusual, and affixes no limit; and whenever a question of legitimacy is brought before the judges involving the determination of the usual period of gestation in women, and the variations to which it may be liable, the matter is made on every new occasion of the kind a subject of discussion, to be decided by the evidence of witnesses examined at the time: and the facts proposed to be investigated in reference to such questions generally are:—1. the natural period of gestation in women; 2. premature births; 3. the possibility of protracted gestation; each of which we shall now proceed to consider.

1. *Natural period of gestation in women.*—With regard to this point it must be confessed that our knowledge is by no means so precise as might be at first sight expected in a matter apparently capable of being made the subject of daily observation; but the fact is, that we are very rarely able to ascertain with anything like certainty the exact time of conception, and consequently having in general only one end of the chain, we can have no certain mode of counting the number of links of which it consists. Still, however, it appears to us that we are in possession of facts sufficient to warrant our belief that the natural period of gestation is ten lunar months, or forty weeks, amounting to 280 days, which is also the period acknowledged in law. (See Coke upon Littleton, 123, b.) A good deal of the confusion on this point seems to have arisen from considering forty weeks and *nine calendar months* as one and the same quantity of time, whereas, in fact, they differ by from five to eight days. Nine calendar months make 275 days, or, if February be included, only 272 or 273 days, that is, thirty-nine weeks only instead of forty. Yet we constantly find in books on law and on medical jurisprudence, the expression, "nine months or forty weeks."* Another source of confusion has evidently had its origin in the indiscriminate use of lunar and solar months as the basis of computation in certain writings of authority. This appears to have occurred in the Roman laws on this very subject. Hippocrates, in his book "De Septimestri et Octomestri partu," calculates by lunar months, while in several others of his works solar months are uniformly those referred to, and the Roman laws were founded on his authority. In like manner we find in the book of Esdras, (2 Esdras, iv. 40), "nine months" spoken of as the fixed time of gestation; and in the Wisdom of Solomon, (Chap. vii. 2.), "ten months" is the period assigned for the perfection of the child in the womb; a discrepancy which could only have arisen from the writers using different divisions of time.

An opportunity was lately afforded us of observing the natural term of gestation under circumstances in which the day of conception was known with certainty. A lady who had been for some time under our care in consequence of irritable uterus, went to the sea-side at Wexford in the month of June, 1831, leaving her husband in Dublin, a temporary separation being considered essential to the recovery of her health. They did not meet until the 10th of November, on which day he went down to see her; and being engaged in a public office, he returned to town next day. The result of this visit was conception: before the end of the month she began to experience some of the symptoms of pregnancy; and when she came to town on the 22d of February she was large with child, and had quickened on the 29th of the month preceding. Her last menstruation had occurred on the 18th of October. She went on well through her pregnancy; and the writer was called on to attend her in labour on the 17th of August, when she gave birth to a healthy child after a labour of a few hours' duration. Here the gestation exceeded nine calendar months by just one week, making exactly 280 days from the time of conception. It may be observed that this was the earliest instance of quickening which has presented itself to the writer, occurring as it did before the completion of the twelfth week.

2. *Premature births.*—The premature birth of children not unfrequently gives rise to discussions of a very delicate and important nature, involving on the one hand the legitimacy of the child, and on the other the honour and fair fame of the mother, and consequently the happiness of families, when suspicions are entertained that the development of the fœtus does not correspond to the period which ought to have been that of gestation, dating from the time of marriage, or the return of the husband, and so forth. It is, therefore, essentially necessary that all who are likely to be consulted on such matters should possess themselves with as accurate a knowledge as possible of the progressive development of the embryo, and the marks or characters which belong to each successive period of intra-uterine existence, even in the earlier months. The full details of this subject do not properly belong to the discussion of the question of legitimacy, the investigation of which can only become of interest or importance when the foetus has acquired such a degree of maturity as is likely to render it viable or capable of sustaining its functions independently of the mother. There will then be two distinct points of view under which we must consider this part of the subject. We must inquire, first, what is the earliest period of gestation at which the condition of viability† may be expected to exist; and,

* Vide Coke upon Litt., loc. cit., and Paris and Fonblanque, vol. i. p. 241. Smith's Principles of Forensic Medicine, p. 491. Dewees' Compendium of Midwifery, p. 164. Mr. Burns more accurately says, "nine calendar months and a week." Principles of Midwifery, p. 168.

† Viability is thus defined by Capuron:—"La viabilité pour un enfant qui vient au monde n'est autre chose que la possibilité de vivre complètement et aussi long tems que le commun des hommes; c'est à dire de devenir un adulte, un homme fait, un véritable membre société."—Médecine Légale, p. 152.

secondly, can we admit that a child may in six or seven months acquire that degree of maturity which we observe to belong to those which have continued in the womb the whole natural period of gestation?

With regard to the first of these questions, we think experience warrants us in adopting as correct the opinion of Wm. Hunter, given in answer to an interrogatory put to him on this subject:—"A child may be born alive at any time after three months; *but we see none born with powers of living to manhood*, or of being reared before seven calendar months, or near that time.* At six months it cannot be."† We do not take into consideration, or attach any value to such rare and wonderful histories as those of Fortunio Liceti, the Italian physician, who was said to have been born at four months and a half, and to have attained the age of manhood; nor to that of Cardinal Richelieu, in whose case the parliament of Paris decreed that the infant at five months possessed that capability of living to the ordinary period of human existence which the law of France required for establishing its title to inheritance.

In the consideration of the second point, we have to contend with a very formidable difficulty, intrinsic to and inseparable from the subject,—namely, the great variety constantly observed in the size, weight, strength, and appearance of children at the full time. Some of these, for instance, do not exceed seven pounds in weight, while occasionally we meet with instances where they are of double that weight. This should at least make us extremely delicate in forming, and cautious in pronouncing our opinion, particularly when the period of gestation may have advanced to within a month of its expected termination, in which case it might be impossible for us, with all our care and all our knowledge, to draw the distinction between a child of eight months and one of nine.

But in such case as occurs from time to time, where a woman six or seven months after marriage, or the return of her husband, produces a healthy well-formed child of the *full size* and *development*, we need hardly hesitate about its illegitimacy; at least we never saw an instance where a child, avowedly of six or seven months' growth, presented an appearance even remotely resembling that of a full-grown and matured fœtus. Even though the size alone may not enable us to distinguish the one from the other satisfactorily, there are several characters of imperfect development which mark the really premature fœtus whatever may be its size; while, on the other hand, there are others which accompany the fully matured child, although deficient in bulk.

Of the latter kind are the colour and firmness of the skin; the perfect condition of the hair and nails; the full development of the lower extremities; the solidity of the bones of the cranium, and their close approximation along the sutures. If along with these we find that the child is vigorous and active, crying strongly soon after birth, and taking the nipple readily or even eagerly, and sucking it effectually; that its length measures from 19 to 21 inches,‡ and that the *middle point* of that length *falls at the umbilicus*; we have an assemblage of characters which ought to leave but little doubt of maturity having been attained. The situation of this middle point was first proposed as a test of the age of the fœtus by Chaussier, and his observations have been since confirmed by several others.§ From the trial we have made of this test, we are disposed to attach considerable value to it. [Yet it is far from being decisive; as has been shown elsewhere.] (See the article INFANTICIDE, [in vol. ii. p. 679.])

It should be recollected, also, that there are certain women to whom it is peculiar always to have the time of delivery anticipated by two or three weeks, so that they never go beyond the end of the thirty-seventh or thirty-eighth week for several pregnancies in succession.‖ La Motte (Liv. i. chap. 28,) mentions two women who always brought forth at the end of seven months; and the same thing happened to the daughters of one of them. Van Swieten (Comment. vol. xiv. p. 6, 7,) takes notice of a similar circumstance; as does also Fodéré. (Méd. Lég. vol. ii. p. 28.) A member of the writer's family never passed the end of eight months in three successive pregnancies; but such cases cannot be looked on as instances of gestation *completed*, but of premature labour from some infirmity of the system, or indisposition in the uterus to enlarge beyond a certain size; nor is it contended or asserted by these writers that the children had acquired their full growth: in the instances occurring under our own observation they certainly had not.

[In 1835, an investigation took place before one of the Presbyteries of Scotland, in regard to certain reports which had been circulated to the prejudice of a minister of the district. The marriage of this gentleman took place on the 3d of March, and his wife gave birth to a female child on the 24th of August, that is 174 days after the marriage, and the child continued to live until the 20th of March 1836. When born it was very weak, and did not weigh more than three pounds. The birth of a living child, together with its surviving for so long a period, led to the report, that there must have been intercourse between the parties before marriage. The case went through several appeals, and was not fully settled until May 1839, when the libel was found not proven, and the defendant was absolved from censure. Many medical witnesses in Scotland, and others from France, Italy, and Germany gave evidence,

* The earliest instance we have met with were the following:—A fœtus which at the utmost could only have completed the fifth month, and which lived for a few minutes; and another of five months and a half, which lived for four hours.

† "Ante septimum mensem fœtus non potest supervesse."—*Haller*, Elem. Phys. vol. viii. p. 423. The French civil code, however, regards as legitimate and viable all children born after 180 days, or six months.—*Capuron*, Cours d'Accouchement, p. 69.

‡ Rœderer concludes from his examinations, that the average length of a male at the full time is twenty inches and a third: while that of a female is nineteen inches and seventeen-eighteenths.

§ *Capuron*, p. 172. *Hutchinson*, pp. 6–14. *Fodéré*, vol. ii. p. 149. *Burns*, pp. 114, 118. *Metzger*, by Ballard, 168. *Beck*, p. 112 et seq.

‖ While writing these observations we met with an instance of this. The writer was engaged to attend a lady in her fifth confinement, who told him a month beforehand that from particular circumstances she knew her time would be up about the 23d of the month, but that she expected her labour to occur about the 9th, as she had on the two former occasions anticipated by two weeks; she became in labour on the night of the 10th, and was delivered on the 11th.

the majority of them being in favour of this having been a legitimate and premature birth. (*Lond. Med. Gaz.* xvii. 92. *Med. Chir. Rev.* xxxi. 424. A. S. Taylor, *Manual of Medical Jurisprudence*, p 610, Lond. 1844; and Guy, *Principles of Forensic Medicine*, p. 173, Lond. 1843.)]

3. *Protracted gestation.*—The possibility or otherwise of an extension of the ordinary period of gestation has been for a very long time, and still continues, a question of very warm debate; some maintaining that the time is fixed and admits of no variation; while others, who agree as to there being a certain period most frequently observed, believe that it is not exempt from variety, and may be prolonged. In this view of the subject we entirely coincide; but at the same time we are ready to confess that many of the arguments brought forward in support of it have been vague and nugatory in the extreme, and several of the cases adduced totally unworthy of belief.

We cannot imagine why gestation should be the only process connected with reproduction for which a total exemption from any variation in its period should be claimed. The periods of menstruation are in general very regular; but who is there who does not know, that as there are on the one hand women in whom the return of that discharge is anticipated by several days, so there are also many in whom the return is postponed an equal length of time without the slightest appreciable derangement of their health! (For a case in which the regular menstrual period was five weeks, see Burn's Principles of Midwifery, Edit. 7, p. 168.) Again, menstruation and the power of reproduction in the female very generally, indeed almost universally, cease in these countries about the forty-fifth year; yet occasionally instances are met with in which both are prolonged ten or fifteen years beyond that time of life; and a similar variety is observable in the period of the first establishment of that function in the system.* If we turn our attention to brutes, the conditions of whose gestation so closely coincide with those of the human female, and are less exposed to have it disturbed, we cannot for a moment doubt the fact that there is a great inequality in the term of gestation in different individuals of the same species. The experiments and observations of Tessier, which were continued through a period of forty years, contain facts and information more than sufficient, as appears to us, to satisfy any one on this point with regard to the lower animals. (Magazin Encyclopédique, quatrième année, t. vi. p. 7; or Beck's Medical Jurisprudence, p. 194. Edit. 1829. See, also, *Capuron*, Cours d'Accouchement, p. 71. Edit. 1833.)

[Similar results were obtained by Lord Spencer from observations made on 764 cows. (*Journal of the English Agricultural Society*, part ii. 1839. See also on this subject the writer's *Human Physiology*, 5th edit. ii. 426, Philad. 1844.)]

There is a very curious fact mentioned by the late Sir Everard Home, which, if strictly correct, would go a great length in strengthening the argument from analogy. He says that "where the female of one species of animals breeds from the male of another, the utero-gestation of whose species is different in its period, there appears to be no approximation in the time in which the hybrid is brought forth; but the longest term of the two is the time of such utero-gestation. Thus the mare covered by the ass goes eleven months, her usual period; and the ass covered by the horse goes *eleven months*, although *ten is her usual period*."—Philos. Trans. 1822.

The circumstances of incubation are by no means without some weight, when we observe that of a clutch of eggs laid by the same hen and covered alike during the hatching time, some will produce the chick twenty-four, thirty-six, or even forty-eight hours later than the rest,—an excess in the period amounting to one-tenth of the whole, and as great as that which facts appear to show may be *reasonably* contended for as affecting the period of human gestation.

But if we relinquish the less certain support of analogy, and resort to facts alone, as observed by ourselves, or others worthy of belief, we are quite satisfied that we are in possession of more than enough to prove the point; and let it not be forgotten that the combined testimony of all who have maintained the unvarying fixedness of the natural term, merely because they had known no instance to the contrary, (and they could have no other grounds for their belief,) is, after all, only negative evidence, and must fall before a single well-established instance in which that term was exceeded.

The weight of authority is altogether on the side of those who believe in the occasional protraction of gestation, in favour of which we find the following have recorded their opinions:—Antoine Petit (Recueil des pièces relatives à la Question des Naissances tardives, 1766), Lebas (in a Memoir in answer to Louis), Haller (Elementa Physiologiæ, vol. viii., pp. 421–425), Roussel (Systême de la Femme, p. 174 et seq.), Zacchias (Questiones Medico-Legales, lib. i. tit. 2, quæst. 1), Buffon-Levret (Art des Accouchemens), W. Hunter (Hargrave's Notes on Coke upon Littleton), Fodéré (Médecine Légale, vol. ii. chap. 8, sect. 4), Gardien (Traité des Accouchemens, tom. i. p. 162), Velpeau (Traité de l'Art des Accouchemens, tom. i. p. 388), Capuron (Médecine relative à la Grossesse, pp. 217–224; and, also, Cours d'Accouchement, p. 62, edit. 1833), Desormeaux (Dictionnaire de Médecine, t. x. pp. 374 and 462), Richerand (Physiology, p. 499, edit. 1824), Dewees (Compendium of Midwifery, p. 166), Hamilton (Letter to Dr. Granville, Lond. Med. Gazette, Dec. 12, 1829, p. 344), Burns (Principles of Midwifery, p. 168, edit. 7), Denman,† with a host of others, of less though by no means inconsiderable authority. Many of these have, in confirmation of their opinions, related the cases on

* It is a law of nature very constantly observed, that dentition should commence a few hours after birth, and that some of the teeth of children should show themselves within the first year at farthest, and instances where the cutting of the first teeth is deferred to the end of a year are unusual; yet in the case of one of the writer's children, the first tooth did not appear until the child had reached the twenty-first month of her age, she being at the time and previously in perfect health.

† We think ourselves justified in adding the name of Denman on the strength of the following passage in his Introduction to Midwifery, p. 254, Edit. 5. "At the expiration of forty weeks the process of labour commenceth, unless it be hastened or *retarded* by some particular circumstance."

which their conviction was grounded, and which, of course, had fully satisfied their minds; and we cannot believe it possible that all of these writers could have been mistaken in a mere matter of fact or observation, and that none of the cases which they have put on record were really instances of gestation prolonged beyond forty weeks. At the same time, we must add that the cases which appear to us to carry with them the fullest demonstration of their truth, are those in which the ordinary term was not exceeded by more than three or four weeks. Some of those which appear the most satisfactory, we shall now notice as briefly as possible.

Dr. Blundell, in his evidence before the House of Lords on the Gardner peerage case, declared that he knew positively one case in which conception must have taken place on the 9th of November, and delivery did not occur till the 23d of August following, making an interval of 287 days, or one week beyond the usual time. On the same occasion, Dr. Merriman deposed that he had known cases to be extended to 285 days; in two or three instances, to 296; in one, to 303; and in one to 309 days. (See, also, Med. Chir. Trans. vol. xiii.)

Wm. Hunter, in answer to a query on this subject (vide Hargrave's Notes on Coke upon Littleton), said, "The usual period is nine calendar months; but there is very commonly *a difference of one, two, or three weeks.* I have *known* a woman bear a living child in a perfectly natural way, *fourteen days* later than nine calendar months, and *believe* two women to have been delivered of a child alive, in a natural way, above ten calendar months from the hour of conception."

The late celebrated Professor Desormeaux says, "Observations well attested prove that the term may be prolonged beyond the usual period;" and he adduces the following case, occurring within his own observation, in a patient whom he attended:—"A lady, the mother of three children, became deranged after a severe fever. Her physician thought that pregnancy might have a beneficial effect on her mental disease, and permitted her husband to visit her, but with this restriction, that there should be an interval of *three months between each visit*, in order that, if conception took place, the risk of abortion from further intercourse might be avoided. The physician and attendants made an exact note of the time when the husband's visit took place. As soon as symptoms of pregnancy began to appear, the visits were discontinued. The lady was closely watched all the time by her female attendants. She was delivered at the end of nine calendar months and a fortnight, and Desormeaux attended her." Concerning this case, Raige-Delorme, who is rather sceptical about retarded gestation, declares that it is a fact possessing "the elements of a perfect demonstration," in favour of a protraction so far." (Dict. de Médecine, vol. x. p. 462.)

Dr. Dewees, the professor of midwifery at Philadelphia, relates "that the husband of a lady, who was obliged to absent himself for many months in consequence of the embarrassment of his affairs, returned, however, one night, clandestinely; and his visit was only known to his wife, her mother, and Dr. D. The consequence of this visit was the impregnation of his wife; and she was delivered of a healthy child in nine months and thirteen days after this nocturnal visit."*

Dr. Hamilton, the present distinguished professor of midwifery in Edinburgh, says, "But the result of my experience has been different; in one case, many years ago, the lady exceeded the tenth revolution (of the menstrual period) by twelve days; another lady exceeded it by sixteen days, and another by twenty-four days. This latter patient menstruated on the 1st of August, and was not delivered till the 28th of June. Another lady, the mother of a large family, exceeded her period by above a fortnight on the 4th of March, when her husband went to England, where he resided for some months; but she was not delivered till the 6th of December." (See Extracts from his Lectures, in a letter from him in Lond. Med. Gazette, Dec. 13, 1829.)

Mr. Burns says, "On the other hand it is equally certain that some causes which we cannot explain or discover, *have the power of retarding the process*, the woman carrying the child longer than nine months; and the child when born being not larger than the average size. How long it is possible for labour to be delayed beyond the usual time cannot be easily ascertained." "The longest term I have met with is ten calendar months and ten days, dated from the last menstruation. In the case of one lady who went this length, her regular menstrual period was five weeks, and in her other pregnancies she was confined exactly two days before the expiration of ten calendar months after menstruation." (Principles of Midwifery, p. 168. Edit. 7.)

In the case of Anderton against Whitaker, tried at Lancaster a few years since, intercourse between the parties was sworn to have occurred on the 8th of January, and never at any other time, and labour did not take place until the 18th of October, being the 284th day from the time of conception.

A case which occurred in the writer's practice, closely coinciding with those described by Mr. Burns, appears to be also an instance of gestation prolonged to a like degree. The circumstances were these:—A lady who had suffered from puerperal mania after her previous confinement in 1830, from which however she perfectly recovered, conceived again in the month of July, 1831, and miscarried in October, being then in the third month of pregnancy. She menstruated regularly in November and December, and for the last time in the first week of January, 1832. The writer did not see her again till the 24th of March, at which time she considered herself as in the third month of pregnancy; and as she was suffering pains, was fearful lest abortion was about to happen at the same period as before. It did not, however, occur, and she went on safely. At this date the symptoms of pregnancy were well marked; the areolæ were very distinct on the breasts, and the increased size of the abdomen was obvious to the eye, and corresponded to the supposed period of pregnancy. Quickening occurred on the 10th of

* An interesting fact connected with this case was, that at the time of conception the lady was within a week of her menstrual period, which was not interrupted; but the interruption of the next period gave rise to suspicion in her mind, which was realized by the birth of the child.

May, and all parties looked forward to the occurrence of labour about the middle of October, which, however, did not happen until the 14th of November.

Now in this case, if we suppose conception to have taken place very soon after the last menstrual discharge, as it most frequently does, we have an interval of exactly forty-four weeks, or 308 days, a period of time exceeding the usual one by four weeks, or twenty-eight days, one whole lunar month. And on the other hand, if we suppose conception to have taken place on the very last day of the interval between the two menstrual periods, we should still have an instance of gestation occupying forty-one weeks and two or three days. And lastly, if we assume the middle period of the interval as the time of conception, we should have an interval of forty-two weeks and a half; and certainly, when we saw her in March, she had all the appearance of a woman in the third month of pregnancy. It is also to be recollected that quickening occurred on the 10th of May, just sixteen weeks after the probable period of conception, or eighteen weeks from the time of the last menstrual period, and nearly twenty-seven weeks before labour. We may add that this was the third instance of the same kind which has come under our own observation.

We cannot close this part of the subject without directing the reader's attention to the cases related by Dulignac (in the Causes Célèbres,) Fodéré, (Médecine Légale, vol. ii. ch. 8, p. 195,) and Dr. Granville, (in his evidence before the House of Lords); which, occurring as they did in their own wives, and under circumstances where there could be no possible motive to deceive, and where every successive period of the gestation was carefully observed by persons so eminently qualified to form a correct opinion, are entitled to great attention.

It appears to us that several of the foregoing cases ought to carry conviction to any unprejudiced mind; and it is to be recollected, that if any one of them be true, it establishes the fact in defiance of all objections made by those who deny it because they have not met with any case of it themselves, or because they conceive it to be inconsistent with the usual or established order of nature.* "We ought to admit it," says Fodéré, "not merely because it is possible, but because we have abundant proof that it has happened."

[Cases of single intercourse, if well attested, would be sufficient to settle the question; but it is difficult to obtain them in any considerable number. The following cases are recorded: (Guy's *Principles of Forensic Medicine*, p. 167, Lond. 1843.)

	Duration.
A case by Dr, Nixon,	273 or 276 days.
Dr. Montgomery, before referred to	280 "
Dr. Forster of New York,	283 " 285 "
Seduction case (Lancaster assizes,)	284 "
Dewees,	286 " 288 "
Desormeaux,	290 "
Dr. Reid,	292 " 293 "

The results of these cases are as follows:

Average of the 7 cases,	284 or 285 days.
Minimum,	273 " 276 "
Maximum,	292 " 293 "
Range,	16, 17, 19 " 20 "
Excess above 280 days,	12 " 13 "
Excess above 9 calendar months,	16 or 17 to 19 " 20 "

On a trial for seduction in this country, the female swore to a single connection on the 16th of October, 1840. The child was born on the 10th of August, 1841, being forty-one weeks and four days, or 291 days. (Dr. T. R. Beck, *Amer. Journal of the Med. Sciences*, April 1842, p. 291.)]

In the next place we find that the laws of different countries have been framed from a persuasion on the part of the legislators that a protraction of the ordinary term of gestation might occur. Thus the law of France, the Code Napoleon, provides that the legitimacy of a child born 300 days after the death or departure of the husband shall not be questioned; and the child born after more than 300 days is not declared a bastard, but its legitimacy may be contested. The Prussian civil code declares that an infant born 302 days after the death of the husband shall be considered legitimate. The Scotch law is very precise:—"To fix bastardy on a child, the husband's absence must continue till within six months of the birth; and a child born after the tenth month is accounted a bastard." Our English law fixes no precise limit,† but the decisions that have been made from time to time are in favour of the possibility of protracted gestation.

The first satisfactory precedent of which we are aware is that *M.* 17 *Jac. B. R. Alsop and Stacey.* Andrews dies of the plague; his wife, who was a lewd woman, is delivered of a child *forty weeks* and *ten days* after the death of the husband; yet the child was adjudged legitimate, and heir to Andrews; for *partus potest protrahi* ten days *ex accidente.*

In the case of Forster and Cooke, (Brown's Chancery Cases, v. iii. 349,) a legatee filed a bill to have his legacy, and in order to define the person on whom he had claims, it was necessary to establish a will. But as it is requisite in chancery, for establishing a will, to have the heir-at-law before the court, it was a question to whom that title properly belonged, and so the period of gestation came to be considered. An issue was directed to try whether a child born forty-three weeks after the husband's death was legitimate; and it appears that the jury found this posthumous child to be the heir-at-law.

With the exception of the last-mentioned case, the question of protracted gestation seems to have escaped legal inquiry for more than two hundred years before the contest for the Gardner peerage, which recently excited so much interest in England, and gave rise to a very lengthened investigation.

The following were the facts of this remarkable case. In the year 1796, Captain Gardner (who afterwards became Lord Gardner) married Miss Adderley. They lived together as man and wife until the 30th of January, 1802, on which day Mrs. Gardner took leave of her husband on board-ship, and shortly afterwards he sailed to the West Indies; from whence he returned to England on the 11th of July following. For some time before, and also during the whole time of Captain Gardner's absence, Mrs. Gardner carried

* Ignorat naturæ potentiam qui illi non putat licere, aliquando, nisi quod sæpius facit.—*Seneca*, Nat. Quæst. lib. vii. cap. xxvii.

† "And so it is of all children born so long after the death of the husband that by the *usual course of gestation* they could not be begotten by him; but this being *a matter of some uncertainty*, the law is not exact as to a few days."—*Blackstone.*

on an adulterous intercourse. Upon Captain Gardner's return to England he found his wife with child; and she, hoping to be delivered within the proper time, made no secret of her pregnancy. When, however, she ascertained that the child could not be brought forth in time to be supposed to be Captain Gardner's, she declared that she had a dropsy, and informed his family that such was the case; and not only Captain Gardner, but the whole of his family, considered her as labouring under that complaint. On the 8th of December Mrs. Gardner was delivered in secret, in the presence of three persons only. The child was immediately removed to a lodging, and was afterwards christened by the name of the paramour, who brought it up, and in all respects treated it as his son. The birth of this child was carefully and successfully *concealed* from Captain Gardner, who did not even discover his wife's adultery till the year 1803. He subsequently obtained a divorce, and married again. He succeeded to the title in 1808, and died in 1815, leaving a son by his second marriage, who in the year 1824 presented his petition to the king praying to be entered on the parliament-roll as a minor peer. This was opposed by the young man, Henry Fenton Jadis, alias Gardner, who claimed to be eldest son of Lord Gardner, being born 311 days, or ten calendar months and nine days after Captain Gardner's departure from the country.

The petitions were referred to the committee of privileges, who called before them seventeen of the most eminent practitioners in midwifery in London and elsewhere, and examined them as to the possibility of such a protraction of the term of gestation as was here contended for. *Five* of these gentlemen maintained that the limits of gestation were fixed, and consequently denied the possibility of such a protraction. The other *twelve* supported the affirmative side of the question, and some of them adduced cases very strongly in favour of their views, particularly Drs. Granville, Conquest, and Blundell. Without wishing to enter into any criticism of the medical evidence, we cannot help remarking that two or three of the gentlemen who asserted forty weeks to be the ultimatum, admitted that it might be *exceeded* by a *few* days; and we would ask, if the principle of extension be admitted, how or by whom can the limits be assigned?

The House of Lords decided in favour of the petitioner and against the counter-claimant, Henry Fenton Jadis, *but not because of the time of his birth;* for Lord Eldon, who was their Chancellor, in giving his judgment, says, "It is not by any means my intention to do more than express my conviction that the petitioner has made out his claim,—that there are a great many more questions which arise in a case of this nature, almost the whole of which were considered in the Banbury peerage, but without entering into a detail of these questions, and *without entering into a discussion as to the ultimum tempus pariendi*, I am perfectly satisfied upon the whole evidence that the case has been made out." (Le Marchant's Report of the Proceedings, &c. p. 335.)

It was the *adultery* of the mother, and the *concealment of the birth from the husband*, which justified the house in refusing the petition of the counter-claimant. If the only point in the case had been that he was not the son of Lord Gardner because it was *impossible* his mother could have gone forty-four weeks with him, the House of Lords could not have declared him illegitimate; and when Lord Eldon said he should give his opinion "*without entering into the question of the ultimum tempus*," it is perfectly clear he did so for the purpose of guarding against the decision being ever taken as a precedent that a gestation protracted four weeks beyond the usual time should be a ground for bastardizing a child.

W. F. Montgomery.

SUCCUSSION. (See Chest, Exploration of the.)

SUDORIFICS. (See Diaphoretics.)

SUPPURATION. This term is employed to denote the process whereby a certain fluid, called *pus*, is formed or deposited on the surface or in the substance of any tissue. It seems to be strictly analogous to the words εμπυησις, εκπυησις, or απο-πυησις, which Hippocrates appears to have applied indiscriminately to the deposition of pus, without any reference to the precise nature of the process by which it is produced. The propriety of regarding this process only as a sequel of inflammation will be considered in the course of this article; but it is obvious, that where there may exist a doubt upon this head, it is much more consonant with the most approved method of scientific definitions to omit all mention of a questionable connection. We prefer to denote by *suppuration* that which it so clearly expressed by a term used by some French writers, *pyogénie*, which we believe originated with Brugmans. (Brugmans de Puogenia, sive Mediis quibus Natura utitur in creando Pure.—Groningæ, 1785. Dict. des Sc. Médicales, Art. *Pyogénie*.)

Having first treated of the properties of the fluid which characterizes the suppurative process, we shall, in the second place, proceed to the consideration of the precise nature of that process, and, lastly, to the various phenomena which accompany it.

Pus is obtained in its greatest purity from the surfaces of external ulcers which are in a perfectly healthy state, and show a disposition to heal, or from acute and healthy abscesses. As the qualities of this fluid are apt to vary considerably under the influence of even trivial causes, it is desirable to be particular in procuring that which is destined for examination, from a healthy source. Pus thus obtained, and absurdly denominated "*laudable*," is a homogeneous fluid, of the consistence of cream, of a white colour tinged with yellow, slightly tenacious, of a mild taste, and sometimes a mawkish smell, but at times also inodorous.

It is important, in a practical point of view, to ascertain what are the fixed and constant characters of pus. Most observers have stated that it consists of globules, which they consider its essential part; these globules float in a fluid possessing some resemblance to the serum of the blood, but from which it especially differs in being coagulable by muriate of ammonia. Hunter, (on the Blood, Inflammation, &c.) Home, (on Ulcers,) and Pearson, (Phil. Transact. an. 1810,) have considered

these globules as very similar to those of the blood; and Gendrin, who regards pus as blood in a transformed condition, and whose microscopic observations fully confirm those of MM. Prevost and Dumas, thinks that the only difference between them is, that the globules of pus are somewhat larger and of an opaque yellow colour. (Histoire Anat. des Infl. tom. ii.) Mr. Lister and Dr. Hodgkin, however, have expressed a different opinion; and they state, as the result of their observations, that the globules of pus are extremely irregular in size and figure, and "bear no resemblance to those of the blood." (Appendix to Hodgkin's Translation of Edwards on the Influence of physical Agents on Life, p. 441.) The following concise statement is from Kaltenbrunner, an exact and cautious observer. "In hominis pure meraco, quod ab aëris injuriâ bene erat munitum, granula æqualia, spherica, pellucida, nucleo penitus carentia, conspiciuntur nec aliud quidpiam. Aëri vero exposita, granula mox inter se conglutinantia et decomposita, floccos inæquales exhibent, qui sero quodam cincti sunt." (Experimenta circa Statum sanguinis et vasorum in Inflammatione, § 86.) In fine, Raspail, the latest systematic writer on organic chemistry, considers the existence of globules in pus entirely dependent on the presence of albumen in it, and observes that they so easily alter their shape that it is but lost time to devote any attention to microscopic observations upon it, with the hope of ascertaining any determinate form in them. (Nouveau Système de Chimie Organique, p. 508.)

The great importance which was formerly attached to the discovery of some criterion for distinguishing between pus and mucus, led physicians to subject the former fluid very extensively to the action of chemical re-agents; nor does it appear that any very useful results have been obtained from their numerous trials. The well-known essay of Darwin, entitled "Experiments establishing a criterion between mucilaginous and purulent matter," was composed in consequence of this question having been appointed the subject for the medal offered by the Æsculapian Society of Edinburgh, in 1778. From this essay we learn that he treated pus with pure water, with sulphuric and nitrous acids, and with caustic alkali and corrosive sublimate; he found that it was diffused through water, forming a white, milky, opaque fluid; in dilute sulphuric acid it formed a uniform turbid white mixture, from which, when allowed to stand, a white sediment was deposited; nitrous acid dissolved a considerable quantity with great effervescence, "the mixture became green and retained its froth," but the addition of water rendered it very turbid and milky; with caustic alkali it mixed intimately, "the pus seemed dissolved, but when water was added a separation took place:" however, in six subsequent experiments, in which pus from an abscess of the mamma was used, the alkali would not dissolve it, for it remained viscid at the bottom of a glass of lixivium, and nearly separable for the space of twenty-four hours; on adding water to this, a semi-pellucid matter fell to the bottom, which was more tough and viscid, and readily drawing into strings than the pus before the addition, and could not be separated into parts nor in the least diffused through the water.

It apppears that, prior to the period at which Darwin instituted the experiments which we have just alluded to, Mr. Hunter had been examining into the true nature of pus. His most important conclusions respecting it are thus summed up in one paragraph of his chapter on this fluid. "True pus," he says, "has certain properties which, when taken singly, may belong to other secretions, but when all joined form the peculiar character of pus, viz. globules swimming in a fluid, which is coagulable by a solution of muriate of ammonia, which no other animal secretion that I know of is," and, at the same time, a consequence of inflammation; these circumstances taken together may be said to "constitute pus." (On Inflammation, &c. p. 421.) His experiments with chemical agents were of a more general kind, and were tried upon organic and inorganic substances; the former being muscle, tendon, cartilage, liver, and brain; the latter pus and the white of egg. He dissolved each in sulphuric acid, and then precipitated the solution with vegetable alkali; the precipitates, when examined with the microscope, all appeared to be of the same nature, viz. "fleaky substances." Similar results were obtained with the volatile alkali, and when he dissolved the same substances in the vegetable caustic alkali and precipitated the solution with the muriatic acid.

The experiments of Dr. Pearson, published in 1810 in the Philosophical Transactions for that year, were attended with similar results to those we have detailed. This physician appears to have examined pus on a more extended scale than his predecessors. He applied his tests to that fluid under all its principal modifications. He differs from Hunter in ascribing the effects of muriate of ammonia on pus to inspissation, not to coagulation. He conceives that pus consists essentially of three parts: 1. a fibrinous matter, to which he gives the name animal oxide; 2. a limpid fluid resembling the serum of the blood; and 3. innumerable spherical particles visible only by the microscope; and that the varieties of this fluid, which are so constantly met with, relate to the differences of proportions of the essential substances and of adventitious parts; these latter are curdy masses, which he considers to consist chiefly of lymph, colouring particles of the blood, small sloughs from neighbouring parts, some fluid in a putrefied state, specific infectious particles, such as characterize the purulent matter of small-pox, syphilis, &c.

Beaumes and Andral, in repeating Darwin's experiments, have not met with results similar to his. Andral's experiments were upon various kinds of purulent matter, softened tubercular matter, creamy pus collected from cavities in the lungs of patients dead of phthisis, pus furnished by a pleuritic effusion, the sputa of persons in the last stage of consumption, the sputa of patients labouring under chronic pulmonary catarrh, mucus from the pharynx and nasal fossæ: "All these different fluids were alike dissolved by the sulphuric acid, which in every instance turned at first red and afterwards black, this latter change being accompanied with a considerable elevation of temperature. When a small quantity of water was poured into these solutions, they assumed a greyish white colour, and, if a little more were added,

a grumous curdy deposit was observed gradually forming in large quantities, and when after some hours it had completely subsided, the rest of the fluid became transparent and colourless." (Anat. Pathol. by Townsend. vol. i. p. 487–8.—*Beaumes*, Traité de la Phthisie Pulmonaire, tom. i.) Andral did not find that nitric acid dissolved pus, as stated by Darwin, but on the contrary it acquired a greater degree of consistence, and remained suspended in the form of yellow grumous masses without depriving the medium of its transparency.

Pus does not appear to be either alkaline or acid: that from scrofulous individuals has been said to be in general alkaline, and, as Gendrin remarks, contains a large proportion of soda and muriate of soda. It is said by several writers, Pearson in particular, that pus resists the putrefactive process for a considerable time, except when it happens to be mixed with adventitious particles which are prone to it. Shwilgué has given us the following chemical analysis of pus: albumen in a state of concretion; extractive matter; a substance bearing a considerable resemblance to adipocire; soda; muriate of soda; phosphate of lime, and other salts. (Vid. *Pinel*, Nosographie Philos. vol. ii. p. 10.) According to this analysis, Andral remarks, the only difference between the serum of blood and pus consists in the presence, in the latter fluid, of extractive matter, and in the particular state of the albumen. The nature of the extractive matter has been successively regarded as a peculiar animal substance, *sui generis*; as a combination of albumen and fibrine; as a peculiar modification of fibrine, incapable of coagulating spontaneously or of being organized; an animal oxide, (*Pearson*); in fine, it has been supposed to present a considerable analogy to the caseum of milk. (*Andral*, vol. i. p. 485.)

Pus was supposed to possess certain acrid qualities by which it exerted a solvent or corroding power on parts in its vicinity; this supposition, though abundantly contradicted by facts of every day's occurrence, was more decisively overthrown by a series of comparative trials instituted by Sir E. Home, in which he exposed a piece of muscle to the action of pus in an abscess, of pus from the same abscess removed from the body, and of animal jelly. By these experiments he ascertained that the pieces of muscle placed in the last two lost weight much more rapidly than that immersed in the pus of the abscess. That pus varies considerably in its qualities, and that it changes under the operation of even the most trivial causes, and in an incredibly short time, are facts well known to those who have had any experience in the treatment of external ulcers. An increase or diminution of the local irritation, a sudden mental emotion, the occurrence of a fresh disease, change of temperature, indigestion, the action of some medicines, have been severally known to produce these alterations; and there are some persons whose constitutions or idiosyncrasies are such that the purulent fluid secreted from them is always of a peculiar character, as a sero-purulent fluid, a grumous fluid with fragments of cheesy matter floating in it. (*Andral*, loc. cit.) Pearson and Hunter account for this alteration by the addition of adventitious substances in variable proportions, and the former author has founded upon it the following varieties of pus:—1. creamy homogeneous pus; 2. curdy pus; 3. serous pus, or sero-purulent fluid; 4. glairy muciform pus, or puriform mucus; 5. concrete or lardaceous pus; which last has been added by Andral.

Of the distinctive characters of pus and mucus we have little to add to that already mentioned in the article Expectoration. The test proposed by Dr. Young does not seem to have obtained very general attention; it is founded upon the opinion that globules constitute an essential part of pus, and their presence is necessary in order to the production of the phenomena which characterize the test. If we put a small quantity of the substance to be examined between two pieces of plate-glass, and holding it near the eye, look through it at a distant candle, we shall observe the appearance, even in the day-time, of a bright circular corona of colours, of which the candle is the centre; a red area, surrounded by a circle of green, and this again by another of red, the colours being so much the brighter as the globules are more numerous and more equable. If the substance be simply mucus, there will be no rings of colours, although sometimes there is a sufficient mixture of heterogeneous particles, even in mucus, to cause the appearance of a reddish area only about the candle. (Young on Consumption, and Cooper's First Lines; also Young's Med. Literature, p. 574.)

Suppuration is commonly considered as a sequel of inflammation, and is by far most frequently met with in practice as such. Whether it be connected with inflammation as an effect to its cause has been doubted; but it is certain that the greatest number of suppurations met with in the body externally or internally would not have existed had not inflammatory action been previously excited. It was Mr. Hunter's opinion that pus could not be formed without inflammation; and this is the opinion of many moderns; among whom we may mention the distinguished Dupuytren, who observes, "les tumeurs purulentes ont toutes la même origine—l'inflammation." (Dict. de Méd. et Chir. art. *Abcès*.)

It may be truly said, with Thomson, that there are perhaps few subjects in pathology concerning which more numerous or contradictory opinions have been entertained than concerning the formation of pus. Boerhave and many of his followers attribute it to the breaking-down of the solids, and to the changes induced in the extravasated blood. Sir J. Pringle and Gaber conceived that the serum, when stagnant, underwent a particular alteration, by which the gluten present in it was changed into a white opaque fluid called pus. Gorter and Quesnai ascribed it to changes induced upon the coagulable lymph; Hoffmann and Grasius to the melting down of the fat; and Dr. Stewart to the putrefaction of chyle. But these hypotheses, adds Dr. Thomson, have deservedly become obsolete, and may be allowed to remain so, for they throw no light whatever on the process by which pus is produced. That pus is a new secretion, or formed in an analogous way, is a doctrine sanctioned by high names; it was first suggested by Simpson of St. Andrews, from observing the effect produced by keeping up irritation of a wound, and the changes in the characters of the effused fluid cor-

responding to the variation in the degree of irritation. De Haen formed a similar opinion some years afterwards. He considered that pus was secreted immediately from the blood; "that although the blood appears to be homogeneous, nevertheless it is obvious that there is something in it which when collected appears to be tenacious, whitish, or yellowish, and which ought to be called the matter of pus." And again, he expresses himself as authorized to conclude that a certain disposition is set up in the blood, ("in sanguine nostro dispositionem dari,") by which the matter, called purulent or phlogistic, is separated from the remaining principles of the blood and expelled from the body in various ways. (Rat. Medendi, cap. xi. tom. i. Edit. Lugd. Bat.)

Mr. Hunter was an advocate for the opinion that pus is a secreted fluid. "The cellular membrane," says he, "or circumscribed cavities have their vessels but little changed from the adhesive state at the commencemont of the suppurative disposition, so that they still retain much of the form they had acquired by the first state, the discharge being at the beginning little more than coagulating lymph mixed with serum. This is scarcely different from the adhesive stage of the inflammation; but as the inflammatory disposition subsides, the new disposition is every instant of time altering these vessels to their suppurative state; the discharge is also varying and changing from a species of extravasation to a new-formed matter peculiar to suppuration. *This matter is a remove further from the nature of the blood, and becomes more and more of the nature of the pus;* it becomes whiter and whiter, losing more and more of the yellow and green which it is apt to give the linen that is stained with it in its first stages, and in consistence more and more viscid or creamy." — "By the formation of this new substance, the coagulating lymph which was extravasated in the adhesive state of the inflammation and adhered to the sides of the cells either in cut surfaces, as in wounds, in abscesses, or circumscribed cavities, is pushed off from these surfaces, and if it is the inner surface of a cavity it is pushed into it, so that the cavity contains both coagulating lymph and pus; or, if it is a cut surface, the coagulating lymph is separated from it by the suppuration taking place, and is thrown off; but as such surfaces are dressed immediately after the operation while the wound is bleeding, this blood unites the dressings to the sore, which is assisted afterwards by the coagulating lymph thrown out in the adhesive stage: the whole, viz. dressings, blood, and coagulating lymph, are generally thrown off together when suppuration commences on these surfaces. This is the process that takes place on the first formation of an abscess, and the first process towards suppuration in a fresh wound."

"Pus is not to be found in the blood similar to that which was produced in the first stage, but is formed from some change, decomposition, or separation of the blood, which it undergoes in its passage out of the vessels, and for effecting which the vessels of the parts have been formed, which produces a subsiding of the inflammation from which it took its disposition; hence it must appear that the formation of pus consists of something more than a straining of juices from the blood. Many substances, indeed, which appear to be considered as extraneous bodies in the blood, being only mixed with, and not making an essential part of that fluid, and perhaps even necessary to it, may pass off with the pus as with every other secretion; yet the pus is not to be considered on that account as simply parts of the blood unchanged, but we must look upon it as a new combination of the blood itself, and must be convinced that, in order to carry on the decompositions and combinations necessary for producing this effect, either a new or peculiar structure of vessels must be formed, or a new disposition, and of course a new mode of action, of the old must take place. This new structure or disposition of vessels I shall call glandular, and the effect, or pus, a secretion." (Hunter on the Blood, &c., 4to. ed. pp. 415–17.)

Gendrin, to whose writings we have had occasion to refer so extensively when treating of the properties of pus, has with great care examined the mode of formation of this fluid, and with no less clearness and precision detailed the results.

One of the earliest effects of inflammation upon a tissue is the effusion or infiltration of a fluid into its substance; after the inflammation has reached a certain height, this fluid alters in its characters, becomes gelatiniform and coagulated, and is deposited between the fibres of the part to the extent of the inflammation; and, if the inflammation be extremely violent, this coagulated matter becomes red, sanguinolent, with all the characters of blood itself; a transverse section of the inflamed organ exhibits this infiltration in all its degrees. The gelatinous infiltration is formed of a reddish matter, half serous, half gelatinous, in which the blood appears in scattered striæ. At a distance from the centre of the inflammation, the proportion of serum is greatest, and the colour of the infiltrated matter is yellowish; and at the extreme limits the infiltrated fluid is serous and colourless. There is a direct relation between these degradations of the infiltrated matter and the degrees of vascular injection and of inflammatory alteration of the substance of the inflamed organ. (*Gendrin*, p. 406 et seq.)

On inspecting a tissue some time in the state of inflammation, and which has passed into suppuration, this coagulated gelatiniform matter is still seen at the limits of the inflammation, and even in the centre amid many other alterations. It becomes of a yellowish-grey colour in other points, more numerous as we approach the true purulent infiltration, which becomes evident from the deposition between the fibres of a yellowish-white fluid, which seems less adherent and less identified with the tissue than that which is found in the earlier stages. When this fluid is examined with the microscope, pus is recognised by its characteristic globules; and in some points, where the infiltrated matter is about to become purulent, we find the true purulent globules mixed with small globules which retain a little of the rosy-greyish colour of the globules of the blood, deprived of the colouring matter by rest after their escape from the vessels; so that it would appear that the infiltrated pus is only a modification of the spontaneously coagulated matter, the infiltration of which preceded its presence. This fluid may be collected, and on examination will be

found to differ in nothing from the pus of abscesses, excepting that, not being as yet completely elaborated, it is still more or less gelatiniform in consistence.

When an artery is obliterated by means of a coagulum, if a ligature be placed round it above the obliteration, and a seton passed through the coagulum in the direction of the tube of the artery, suppuration takes place; the coagulum is then seen to soften, and to be progressively converted into pus, in the same manner as in the inflated tissues. A similar effect is produced by the introduction of any foreign body into the interior of an artery, after stopping the course of the blood in that portion of it, and removing the blood which it contained. The artery becomes closed by the formation of coagulable matter by adhesive inflammation; this effused matter becomes softened, and converted into pus immediately around the foreign body. From these facts Gendrin justly concludes, "*Il n'y a donc entre le fluide purulent des tissus enflammés et le fluide coagulable organisable qu'un degré de plus;*" and the reader will not fail to recognise the correspondence of these facts with the opinion already quoted from Mr. Hunter, in which he states *that the new-formed matter peculiar to suppuration is a remove further from the nature of the blood than the matter formed by adhesive inflammation.*

From the preceding observations, it would appear that pus is formed from the blood in the same manner as the fibrino-albuminous deposits which are consequent on inflammation. Whatever be the mechanism by which some of the healthy secretions are formed, it must be admitted that pus is produced from an inflamed surface in a similar or analogous manner. When so produced, it sometimes is collected into a separate cavity lined by a distinct membrane, which is formed, doubtless, by the condensation of the surrounding cellular tissue from pressure, combined with more or less of the adhesive inflammation. This membrane appears to have the power of secreting pus, as is indicated by the rapidity with which that fluid is reproduced in cavities which have been opened and evacuated. Pus is produced in an analogous manner from the surfaces of inflamed membranes which have not suffered any solution of continuity. Delpech is of opinion that wherever pus is formed, whether with or without solution of continuity, a pseudo-membrane precedes its formation, and is the immediate secreting tissue (*membrane pyogénique*).

[Of late, under the revival of microscopic inquiries, the subject of pyogeny has been closely investigated. The common belief is, that the process takes place both within and without the vessels; and the process is conceived to consist in the conversion of the globules of the blood and lymph, from which the colouring matter has been separated, into an opaque fluid nearly of the colour and consistence of cream. Magendie considers the essential difference between the terminations by resolution and suppuration to consist in the fact that, in the former, the molecules of blood reenter the circulation after having been softened; whilst, in the latter, they undergo further modification, and are expelled from the system. In the opinion of Gerber (*Elements of the General and Minute Anatomy of Man*, &c., by Mr. Gulliver, Lond. 1842), which has been embraced by many observers, those exudation corpuscles that lie beyond the vivifying influence of the suppurating surface, and are exposed to external agencies, cannot be expected to retain their vitality for any length of time: they begin to degenerate in their organization, and to suffer changes in their chemical constitution, whilst those that continue in immediate contact with the living structures advance in their organization. The globules that are cast loose then die. In ill-conditioned sores, the surface of which is not giving origin to new structure, the discharge is not found to contain the true pus globule; but in place of it are found what are called ichor globules, which have been considered to be evidently altered blood corpuscles. These points of microscopic anatomy require, however, renewed observation.

That pus may be formed from blood, apparently without any action on the part of the capillary vessels, is shown by the fact that distinctly purulent matter, according to M. Andral, has been found within coagula in the large vessels and in the heart, where there has been no suppurating surface—the result, it has been supposed by M. Piorry (*Traité de Méd. Pratique*), of hæmitis or inflammation of the blood; and that the vessels are in other cases implicated, is equally demonstrated by the circumstance that, when inflammation has continued for some time in any important organ, globules of pus are said by Mr. Gulliver (Gerber, *op. cit.*) to have been recognised in the blood. This, however, has been combated by M. Mandl (*Anatomie Microscopique*, 2e série, livr. 2), who maintains that the white globules, considered to be pus globules, originate in the fibrin as it coagulates on the object-glass of the microscope. They do not exist, he affirms, whilst the blood is circulating, and form either on the object-glass, or in the vessels after death. M. Mandl maintains that microscopic examination cannot determine whether the blood be pure or mixed with pus, as the purest blood contains globules in every respect like those of pus. The size of the pus globules varies between the $\frac{1}{80}$th, $\frac{1}{100}$th, and $\frac{1}{110}$th of a millimètre; a circumstance which he considers to decide the question of purulent absorption, since globules of this size could not pass through the parietes of the vessels.

When pus is effused from large membranous surfaces, as from the pleura, the membranes are often found thickened instead of extenuated; and this has been adduced as a reason for the belief that pus is not formed at the expense of the tissues. The phenomena of *ulceration*, on the other hand, seem to show that there may be solution of the solids; but the loss of parts is probably owing mainly to absorption. Why this absorption takes place under such circumstances, it is not easy to say. The remark of Dr. Alison (*Tweedie's Library of Practical Medicine*, 2d Amer. edit. ii. 76, Philad. 1842), that "the commencement of ulceration, as an effect of inflammation, implies merely that the attraction by which extra-vascular matters are constantly taken into the small veins, preponderates over that by which portions of the

blood pass out of the capillaries," is a mere expression of what is conceived to be a fact. It throws no light on the subject.

It would appear that the globules of various species of pus may be recognised by certain physical characters, which vary, however, according to the organs or tissues in which it is formed. It is thin and greyish in the bones; opaque and caseiform in the cellular membrane; flocculent in the serous, and greenish and thready in the mucous membranes; reddish in the liver, and yellowish-grey in the muscles. Magendie asserts, that one of the gentlemen present at his lecture, M. Kluge, was able to distinguish the different species of pus from each other, by simple inspection of the globules. He was subjected to a variety of tests, and in every instance was successful. Magendie took pus from the hospital, which had been collected in the lung, the pleura, the peritoneum, and the cellular tissue, and M. Kluge invariably announced its source with perfect accuracy. On one occasion, Magendie endeavoured to entrap him by presenting him with some artificial pus of his own making, as if it had been taken from one of his patients, but M. Kluge was not to be deceived. "This important fact," adds Magendie, "is another to be added to the list of experimental discoveries."]

The process of suppuration is essentially the same in all tissues; some, however, appear more prone to it than others. Referring to that section of the article Inflammation, headed, *Varieties of inflammation according to texture*, for details respecting suppuration in them, we shall merely observe that as to relative proneness to suppurations the several tissues rank as follow:—1. Cellular tissue; 2. skin and mucous membrane; 3. serous membranes; 4. vascular tissue. In bone, cartilage, or fibrous tissue, purulent deposits are of rare occurrence. In muscle they, in all probability, originate from the large quantity of cellular membrane found in that tissue. In the brain and nervous tissue they are occasionally met with. In glands and parenchymatous organs suppuration is proportionally more frequent, as those parts contain a larger quantity of cellular membrane.

Suppuration, as the sequel of inflammation, is generally attended with similar symptoms, and a fever of the same characters. The occurrence of rigors in the progress of the inflammatory fever, followed by a hot fit, is very frequently indicative of the formation of pus. In inflammation succeeding to injuries of the head, Dr. Thomson observes, these rigors are often the first constitutional symptoms which give alarm to the well-informed practitioner, for they are generally, though perhaps not always, an indication that inflammation has already made a dangerous, if not fatal progress. These rigors, also, accompany the formation of pus in the viscera contained within the cavities of the chest and belly, and are often the first symptoms which inform the practitioner that his endeavours to procure resolution have not been successful.

The practitioner must be on his guard to distinguish these rigors from those of intermittent fever, those which precede continued fever, or such as may depend on some local irritation, as that which arises so frequently from irritation in the urinary passages, and which forms one of the most remarkable features of urinary fever.

When the suppuration has become chronic, that train of constitutional symptoms which constitute hectic fever is present; nor does it subside till the suppuration has ceased, or is greatly diminished. (See Fever, Hectic.)

Treatment.—The treatment of the suppuration of internal parts will depend very much on the nature or character of the constitutional symptoms, and must be directed to the alleviation of the violence of fever, or the support of drooping vital powers, for such opposite conditions are met with in company, in cases of internal suppurations. No plan of treatment that we know of can expedite the process of suppuration, bring it more speedily to issue, or completely arrest it when once it has set in. As the natural tendency of pus is to make its way towards the surface, it is an obvious indication to give exit to it by artificial means where and when that can be done with due regard to the patient's safety. For further details respecting the treatment of suppuration, we refer to the practical remarks at the close of the article Inflammation, especially at page 798 of the second volume.

It sometimes happens that purulent formations occur with great suddenness in the body under different circumstances. When a part is undergoing a profuse suppuration, pus may be formed in an organ remote from it: after injuries of the head, or severe or trifling injuries to other parts, whether from accident or operation; in the course of tedious fevers, and after parturition. From the fact that these abscesses appear when parts are in the state of suppuration, they have been supposed to be metastatic in their nature; or in other words, that the pus was absorbed from the suppurating surface and carried into the substance of the organs. They do not appear unattended with constitutional disturbances, although they sometimes come on insidiously, frequently at a period when there is every reason to hope for a favourable issue to the case. The constitutional symptoms that precede these purulent depositions with variable severity are, shiverings, sometimes resembling in the periodicity of their return the cold fits of intermittent fever; delirium; prostration of strength; sometimes insensibility. They have the constant property of being developed with extraordinary rapidity, especially when we compare the time they take for their completion with that commonly necessary for the formation of pus after inflammation. At times, moreover, they come on without heat, pain, or redness of the part affected; and the first indication of their presence is afforded by the prominence made externally. (Dict. de Médecine, art. *Abcès Metastat.*) The abscesses are generally found in internal organs, parenchymatous viscera, sometimes in joints, and sometimes even in the external cellular tissue.

Recent researches in morbid anatomy have traced a connection between these abscesses and inflammation of veins in their vicinity in a large proportion of cases. "There exists," says M. Dance, "in a great majority of cases, where we observe these metastatic abscesses, a venous inflammation which takes its origin round the wound or original injury; and this inflammation

is the true means by which the pus is produced and introduced into the circulation, and mixed with the blood, the composition of which it injures. The blood thus contaminated, finds its way into the parenchymata, and then excites new inflammations, which attack in preference those structures in which blood-vessels are most abundant." On this subject the reader will find much interesting information in M. Dance's Memoirs on Phlebitis, in the Archives Générales de Médecine, tomes xviii. xix.; and in the papers of Rose, Arnott, and Lee, in the Transactions of the Medico-Chirurgical Society of London.

R. B. Todd.

SURVIVORSHIP.—To determine which of a number of persons overwhelmed by the same accident, as shipwreck, fire, falling of buildings, &c. has perished first, or survived the last, is a question of as great difficulty as its solution is often important. Thus, in the case of a father and son, brother and sister, husband and wife, who have died together, without any positive evidence of the event, it is frequently necessary to decide which of them outlived the other, for the survivor having succeeded, although but for an instant, to the property of the other, gives to his or her heirs a claim to the inheritance. If a man be seized in fee of land and tenements, though but for a moment, his wife is entitled to dower; therefore, if both father and son perish by a common accident, and the son survive, however short the period, his wife shall have dower, for the lands descended the instant the father died. This doctrine was extended very far by a jury in Wales, where the father and son were both hanged in one cart, but the son was supposed to have survived the father by appearing to struggle longest; whereby he became seised of an estate in fee by survivorship, he and his father being joint-tenants, in consequence of which seising his widow had a verdict for her dower. So also of joint-tenants, (as partners,) where the interest of the first deceased passes to the survivor, and not to the heir-at-law or next of kin of the deceased; but the heir-at-law or next of kin of the last survivor is entitled. Also between testator and legatee, if the legatee die first, it is a lapsed legacy and falls into the residue; but if the legatee survive, his executor or administrator shall take it. (See Park on Dower. Cro. Eliz. 502. Paris and Fonblanque, 390.)

Always occupied by war, and dying more frequently in battle than in bed, the Romans had need of laws to regulate the order of succession when the father and son, the brother, uncle, and nephew, &c. had perished in the same action. It was accordingly decreed, that when two persons of different ages perished at the same time in an engagement, it should be considered that he who had not yet arrived at puberty had died first; that on the contrary, when the father and son already of adult age, had lost their lives together, the son should be esteemed the survivor. This law, which at first had reference only to the events of war, was subsequently extended to all other cases, and to it was added that which enacted, that if a man and woman died together, the woman should be considered as having died the first. These statutes were founded on the consideration of the relative state of strength and weakness of the respective ages and sexes. On these grounds judgment was given in a case mentioned by Zacchias, (Quæst. Med. Leg. lib. v. quæst. 13,) in which many persons were destroyed by the fall of a building. Among them was a father with his daughter aged thirteen years; and it was ruled that the girl, in consequence of her age and temperament, had perished first, while the father being in the vigour of health had survived her. This principle continued to form the foundation of decisions in the French tribunals up to a late period, of which a remarkable instance is related by Ricard, (Traité des Dispositions Conditionelles, chap. 5, sect. 5,) a celebrated advocate of the seventeenth century. In 1658 two persons perished in the famous battle of Dunes, one, the father, serving in the Spanish army, the other, the son, serving in the French. On the same day at noon the daughter of this gentleman, and consequently the sister of his son, took the veil as a nun, at the very hour in which the battle commenced. The nun being dead in law, it was inquired which of the three should be presumed to have outlived the two others. It was decided that the girl had died first, for her death being voluntary was instantaneous; while the death of the father and son having been violent, might have been protracted for some time after the receipt of their wounds. It remained, then, to determine which—the father or son—had died first, and this gave rise to a lengthened discussion, which terminated in the adoption of the ancient law; and it was ruled that the two having died in the same engagement, without any evidence to fix the precise moment of their death, the son should be presumed to have outlived the father, because he had passed the age of puberty. Many other cases are given by Fodéré (Méd. Légale, t. ii. p. 220, et seq.) as illustrations of the application of the old Roman law. A modification of this has been adopted in the construction of the present French law, (Code Napoléon, art. 720–1–2,) by which it is enacted, that if several persons, naturally heirs of each other, perish by the same event, without the possibility of knowing which died first, the presumption as to survivorship shall be determined by the circumstances of the case, and in default thereof, by strength of age and sex. If those who perished together were under fifteen years, the oldest shall be presumed the survivor. If they were all above sixty years, the youngest shall be presumed the survivor. If some were under fifteen and others above sixty, the former shall be presumed the survivor. If those who had perished together had completed the age of fifteen, and were under sixty, the male shall be presumed the survivor, when ages are equal, or the difference does not exceed one year. If they were of the same sex, that presumption shall be admitted which opens the succession in the order of nature; of course the younger shall be considered to have survived the elder.

According to the civil law of England, which generally regulates the administration of personality, it is held that when parent, whether father or mother, and child perish together, as in shipwreck, if the child be of the age of puberty, he shall be

presumed to have survived; but on the contrary, that he died first if he were under that age; regard being also had to the relation of the party who is to benefit by the decision. Indeed, the order of nature appears to afford the best general rule, and, therefore, in the absence of all evidence to the contrary, it is to be wished that it were established that the natural succession had taken place as if no accident had occurred; that the child survived the parent; the nephew, the uncle; descendants, ascendants; legatees, testators; and generally, that the younger had outlived the elder. (*Paris and Fonblanque*, Med. Jur. v. i. p. 391.) But since there is no enactment in force, it is well to inquire if medical science affords any assistance in the solution of this question.

For this purpose we may arrange our researches under two heads: — 1. the consideration of the state and condition of the persons who have perished by the same accident: 2. the examination of their dead bodies, and the observation of the lesions presented by them. Under the former we shall consider the age, sex, temperament, habit of body, diseases, bodily power, and mental affections to which the individuals had been subject during their lives.

Age.—It is true that in early youth we are endowed with much vivacity; that the vital powers, still new, often surmount serious diseases under which a more advanced age would probably have sunk; but the instruments are feeble, and have not yet attained that development and tone requisite for great trials: moreover, still unprovided with that experience which strengthens men in danger, and suggests numerous resources, young persons are easily frightened, lose self-possession, and often accelerate their destruction, and this the more in proportion to their youth. In old age, on the contrary, the solids have too much consistence in proportion to the enfeebled vital power. Such persons are aware of the manner in which to avoid danger; but their instruments no longer obey the will, and they die with a full consciousness of their state. It would appear, then, that in general very young persons, and those far advanced in age, sink more readily in a common danger than adults and those in the middle stage of life. Some exceptions, however, to this rule are occasionally observed. Thus Fodéré (Méd. Lég. t. ii. p. 236,) remarks that in the revolutionary war he observed very young drummers, and even infants, conduct themselves with the greatest courage and presence of mind in dangerous situations, such as crossing rivers, and during sudden surprises of the enemy.

Sex.—With respect to sex it appears reasonable to assume that, all things being equal, the female yields first in an accident common to both sexes. It is certain that man, in virtue of the superiority of his strength, courage, and energy, is in a condition to struggle against danger, and resist causes of destruction more effectually than woman. Feeble, timid, and without experience, she is naturally placed, with respect to man, in the order of mortality from a common accident, as infants are in relation to adults, the weak to the strong. There are, however, some circumstances capable of modifying this statement, which it is necessary to consider. Female life may be said to be divided into two stages; the first of which continues until the cessation of her characteristic function—menstruation; a stage devoted to the propagation of the race, and accompanied with all the attributes necessary to its fulfilment. The second is marked by an interruption of this important periodical discharge, a loss of many of the peculiarities of the female sex, and an approach towards the conformation of the male. In this latter condition, the timidity, sensibility, and excitability so remarkable in the former, are gradually enfeebled; and thus the grounds of distinction in the order of mortality in the two sexes is removed. It has been remarked that women suffer less from obstruction to respiration than men, and that it is more common to observe them continue a long time without pulse or manifest breathing; from which cause they have sometimes been restored to life, when men overwhelmed by the same accident have been found irrecoverably dead. Females are, moreover, liable to sudden loss of sensation or fainting from the least fright, and thus becoming unconscious of surrounding objects, they avoid a great part of the horrors of their danger, and hence are not unfrequently rescued alive from calamities, which those to whom they have been fully apparent have not been able to withstand. From which it would appear that, however specious the doctrine that the weak should be considered to have died before the strong, it is very possible that this very weakness may be oftentimes a means of the preservation of life.

Temperament.—Galen said that persons of a cold temperament were more readily oppressed by any violent cause than those of an opposite; and the assertion of this great master is generally true, except in the case of death by simple suffocation. By temperament we mean the greater or less degree of energy and irritability of the instruments of the vital power, the chief of which is the heart, along with which may be considered the arteries and veins, for they are but ramifications of a great trunk the root of which is the heart. Upon the force of this latter organ depends, in a great measure, the temperament. When it is great, it accelerates the circulation and respiration, increases the secretions, and produces heat. When it is feeble, it constitutes the cold, humid, and phlegmatic temperament, opposed to the former. Between these two extremes there are a number of varieties, which it is not necessary to allude to more particularly in this place. The bodily force depends materially on the nature of the temperament. We do not speak of the power of carrying great weights, for we often see persons possessed of the greatest strength in this respect endowed with very little vitality. A phlegmatic temperament is often observed combined with great muscular development, as in the Alps and some parts of Hungary; and the athletæ of Greece were neither the most courageous nor vivacious. It is a circumstance frequently observed that persons of such a description sink more quickly under diseases than those of an opposite character, and when called on to make great and continued exertion, they always fail the first. The temperament termed bilious, or those temperaments that approach it, in which the flesh is not exuberant, and which unite a facility of conception to a promptitude of action, are those

which appear endowed with the greatest sum of vital power, equally disseminated, and capable of concentration to struggle against a common danger. We may say then that, relatively to temperaments, in the order of presumption of survivorship, the phlegmatic died first, then the melancholic, then the sanguineous, and last of all the bilious.

Habit and variety of constitution.—Under this head we comprehend the relative proportions of the principal organs of the body, and its conditions of obesity or leanness. There can be no doubt that a just proportion of the dimensions of the head and chest, with that of the other parts of the body, is a necessary condition for the exercise of health. It is well known that a large head and short neck are circumstances which dispose to apoplexy and other cephalic maladies; and that a narrow chest, whether it be by original formation, or the result of spinal disease, produces difficulty of breathing and other pulmonary affections. Thus, according to the kind of accident that may have caused death, and the organ, whether it be the brain or lungs, that is first affected by it, we can judge, with some appearance of certainty, that he whose head or chest was disproportioned died before those who were furnished with these organs in just proportion. With respect to obesity, it has been always considered as accompanied with less vigour than the opposite state. Hippocrates laid it down that fat persons die sooner than lean, and when we consider that they are more disposed to apoplexy, and more quickly oppressed in their breathing by any great exertion or by very warm temperature, there appears to be some foundation for the assertion. A great deposit of fat is an effect of venous plethora, and usually accompanies a deficiency of vital force and energy, commencing when the venous system excels the arterial. There is a difference, however, between persons fat by nature and from consuming large quantities of nutritious food; in the former, the obesity depends on a cold humid temperament, endowed with feeble activity, the courage is weak, and the passions are torpid. With the second there may be combined much strength and vital energy, together with great courage and tumultuous passions. It should be observed that, in death by drowning, as in shipwreck, the fat may have an advantage over the lean from their lower specific gravity, such persons being sometimes found of a less specific gravity than water. This was the case with the celebrated Neapolitan priest Paolo Moccia, (*Fodéré*, Méd. Lég. t. ii. p. 244,) who weighed thirty pounds less than an equal volume of water. He was, in consequence, able to float in that element, and perform all movements as freely as in air.

Disease.—A knowledge of the state of health of persons overwhelmed by a common accident is of value in questions of survivorship, since it is natural to suppose that invalids would have less means to resist the event than those in good health. The diseases which concur to facilitate death in an accident of this kind, may be divided into acute and chronic. The first are fevers, either inflammatory or typhoid, of which the latter seem the most powerful, in consequence of the great prostration of strength with which they are accompanied, so that the least cause superadded, fright particularly, is capable of extinguishing the feeble remains of life. Fodéré (Loc. cit.) mentions a circumstance corroborative of this position. The chimney of a military hospital to which he was attached took fire. All the patients, in a state of alarm, rose from their beds, but one of them, the subject of a typhoid fever, was so overcome by fright, that he died on the spot. Fodéré says he has seen many other similar instances in persons affected with malignant fever. Among the chronic diseases, scurvy is placed by the above author in the first rank, from its resemblance to malignant fever. After it, come those that affect the functions of respiration, circulation, and those of the brain and spinal marrow. Persons affected with these diseases are supposed to perish soonest in a common accident, whether it be that the causes of death are of such a nature as to affect the organs already diseased, or simply by the fright they have occasioned.

Moral condition.—A knowledge of the relative strength of mind of persons dying together may afford some assistance in judging of the order of survivorship. It seems reasonable to ascribe to fear some influence in expediting the death of weak-minded timid persons, for such have been supposed, in great catastrophes which were sudden and unforeseen in their invasion, to have died of fright, without the receipt of any direct violence. Fear is one of the most powerfully depressing affections of the mind, debilitating the brain and nervous system, producing languid action of the heart, and arresting the power of the muscles. Hence arises the impossibility of motion or of flying from approaching danger. In reference to this subject, Haller makes the following remarks: "Mortuus est, eodem die, quo mors, ei fuerat præsagita; ut metus esset pro morbo; mortuus est cui judicium fatale erat pronunciatum; et cui in sepulchro pes esset retentus; et qui intuebatur tendines, sibi dissectus; et qui notas variolarum in se ipso conspexerat; et alii, ex aliis causis." (Elem. Physiol. v. p. 585.) Sennertus reports many instances where the fear of death had effectually produced it in individuals who had received but slight injury, which would have been of no moment had the mental affection been less. It should be remembered, however, that such a consequence is not always to be ascribed to fear; for it has been observed that fatal results sometimes follow slight wounds received in action from fire-arms, arising out of a peculiar nervous agitation from which even the bravest are not exempt. This remarkable condition formed the subject of an interesting thesis (De agitatione nervosa vulneribus sclopetariis quandoque inflicta,) by Dr. Burton, at Edinburgh, in 1820, who had ample opportunity for observing it during the peninsular war, at Waterloo, and New Orleans. He describes it as supervening sometimes on very trifling injury. In one case that of an officer who was wounded just above the left patella, so slightly that the injury did not extend to the tendons, a collapse took place, from which it was impossible to rouse him, and he died that night. In another officer, who was wounded at the battle of Salamanca, the ball entered below the right breast, and ran round the thorax, under the skin, without penetrating the cavity; he was

seized with a similar nervous depression, and rapidly sank under it. Other cases are given by Dr. Burton, in which injuries, more or less severe, were followed by similar results. As we have alluded to this subject, we shall beg leave to transcribe the description of it given by the author:—"Indicia quæ frequentissimè consternationem universi corporis vulnere tormento inflicto demonstrant hæc sunt:—Æger frigoris sensu ad horrores plus minusve graves accedente, corripitur, vultu pallido collapso, labiis colore defectis, oculis cavis, retractis; pulsus exiguus, quandoque adeo imbecillus ut ægrè tactu percipi potest; spiritus lentus oppressus, sudores, non tamen generales, erumpunt, vomitus; membrorum jactatio ita ut membrum jactatio ita ut membrum læsum sæpe (quantum fieri potest) huc illuc jactitetur, nec dolorem quemquam excitare appareat; quod quidem ex pessimis signis est. Nonnunquam æger difficillime ad respondendum excitatur; atque si tandem respondeat, monosyllabis vocabulis responsum reddit. Discriminis raro conscius apparet, atque monitis curantium quibuscunque plerumque concedit." Dr. Burton does not attempt to account for the occurrence of this nervous agitation, but he states what we consider of importance with reference to our subject,—namely, that it is quite independent of the courage or pusillanimity of the individual. He concludes by saying "Hoc igitur prolusionom finiam, me sanctè credere istam virium conditionem a spiritûs virilis, veræque fortitudinis defectu, nequaquam provenire." From this it appears that death speedily following a trifling injury is not in all cases to be ascribed to fear, but depends on some peculiar idiosyncrasy with the nature of which we are still unacquainted, and therefore a previous knowledge of the fortitude or timidity is not of as much value in judging of the priority of death among several individuals, as Fodéré seems inclined to ascribe to it.

A consideration of the manner of life and education of individuals, with reference to the cause of death, seems to promise more aid in determining their respective survivorships; for we often find the minds of different persons affected in different ways when exposed to the same danger; some surveying with great dread what makes little impression on others. This difference in the susceptibility of alarm depends in a great degree on the habits and pursuits of each. Thus men who have borne their part with firmness in battle will tremble at the name of a disease or a trifling operation; while many who freely expose themselves to contagious disorders would no doubt feel very uncomfortable on being for the first time opposed to the enemy's fire. If, therefore, we find a person of good constitution joined to a confidence in his own powers, the result of early training in athletic exercises, as running, leaping, swimming, &c., if he has been accustomed to a hard life, and exposed to difficult and trying circumstances, we may reasonably conclude that he will be the least alarmed at any sudden calamity, and will be the last to struggle against the horrors of inevitable death.

Degree of exposure to danger.—Some presumption as to survivorship may be drawn from a consideration of the manner in which an event that has destroyed a number of persons together has acted in causing immediate or more tardy death. The respective situations of the individuals in the place where the catastrophe occurred, and the blows, wounds, or bruises observed on the corpses should be also taken into account. Severe wounds of the head and of the heart must be considered as giving a precedence in the order of death. Such injuries being in themselves mortal, evidently point out that, independently of the general cause, the death of those who have received them has been accelerated. After these may be ranked wounds of the lungs, great arteries, and abdominal viscera.

Besides these indications there are others, consisting of certain changes which take place in bodies after dissolution, that may assist in determining priority of death, or survivorship. These are loss of temperature, the occurrence of cadaverous stiffness, fading of the eyes, cadaverous lividities on the surface, and commencing putrefaction. It might be imagined that a body being found cold and stiff, at the same time that another is warm and flexible, is a certain indication that the latter survived the former. But the reverse may have been the case, for we have already shown in a former article (see PERSONS FOUND DEAD) that these changes are influenced by different circumstances relating to individuals, such as age, temperament, habit of body, disease, accident, &c. On these points it is unnecessary to enlarge in this place, and we beg to refer our readers to the article just mentioned. It will be sufficient to observe that the bodies of young persons preserve their heat and flexibility longer than those of old, when the cause of death has been the same in both; but there are certain forms of death that accelerate or retard these changes. For example, apoplexy and asphyxia cause the rate of cooling to be slow, and protract the occurrence of muscular rigidity, while hemorrhage expedites both. Therefore, although, *cæteris paribus*, we should expect to find the body of an old person cold and stiff before that of a young person who died at the same time, yet if the former has died of apoplexy or suffocation, and the latter from sudden loss of blood, this order will be inverted. Hence the necessity of ascertaining and weighing well the cause of death before these indications are adopted as grounds for determining questions of survivorship.

We will now proceed to consider some of the more common accidents by which a number of persons may be simultaneously destroyed.

Drowning.—Death from this cause may overtake a number of individuals together in inundations, shipwreck, upsetting of boats, &c. In this case a knowledge of swimming certainly gives an advantage to those who possess it over those who do not; and when it is ascertained that some of the company were skilled in this art, of which others were ignorant, it affords reasonable grounds to suppose the survivorship of the former. In engagements at sea and in shipwrecks, where a number of persons are precipitated together into the water, it has been remarked that the most courageous, those who have preserved their presence of mind so as to enable them to lay hold of any floating body, and those who know how to swim, are the last to yield to their fate. Thus, at the blowing-up of the French ship l'Orient, at the

battle of the Nile, some of the men escaped by seizing spars and fragments of the wreck. The locality should be attended to in all these cases, and if there is an opportunity of examining the bodies it should be done, to ascertain whether any mortal injury have been inflicted from striking against rocks or other resisting objects. A severe wound of the head, for example, would incapacitate a good swimmer from exerting his powers, and thus invalidate his claim to survivorship. It has been supposed that some opinion as to priority of death may be formed from the floating and sinking of the corpses; for it is known that at first they go to the bottom, there to remain until the putrefactive process has generated gas sufficient to buoy them up, at which time they rise to the surface; then the body, having discharged this gas by bursting, descends again, until a further quantity is formed in its tissues, on the occurrence of which they again float; and this process may be often repeated. If there was an interval of a day or two between the deaths of two individuals, these facts might assist in determining which had precedence; but when all are supposed to have died so nearly at the same time, they cannot be considered of much value. Besides, the occurrence of putrefaction is influenced by so many circumstances, (see PERSONS FOUND DEAD,) that no dependence can be placed on its manifestation when the interval between the deaths has been so small.

Suffocation.—This may take place from the exposure of a number of persons to the effects of noxious or irrespirable gases, or by the falling in of caves or buildings in which they may have happened to be assembled. If the gas be possessed of positive deleterious qualities, such as sulphuretted hydrogen and carbonic acid gases, it may be presumed that death was rapid in all, and occurred nearly at the same time. If it be only irrespirable from deficiency of oxygen, then those in whom the function of respiration is in the highest vigour, who stand most in need of a due supply of vital air, are those who most quickly suffer by its deprivation. In this case adults may be supposed to perish before infants or very young persons. Dr. Edwards (on the Influence of Physical Agents on Life,) has shown that young animals will live for a much longer time in the same quantity of air than adults. He found, by enclosing young and old sparrows in separate but equal portions of atmospheric air, that the former lived for fourteen hours and a half, while the latter perished in one hour and a half; and he obtained nearly similar results in experimenting on some of the mammalia. Attention should be paid to the manner in which the cause may have acted on the subjects exposed to its effects, and to the opportunity of escape that each may have had. In the ruins of Pompeii the bodies of the inhabitants that were discovered were found in different situations; some in houses, others in the streets, and others at the gate evidently in the act of flying from the impending danger. These last may be presumed to have outlived the former. Fodéré, to whose writings we are indebted for much valuable matter on this subject, mentions an accident that occurred at Marseilles, in which several persons were suffocated in the same house at night, by the carbonic acid gas from a neighbouring lime-kiln. The bodies were found in the morning in different situations—some in bed, and others on the stairs, giving evidence of an attempt at escape; and thus affording grounds for the presumption that the former perished before the latter. (Dict. des Sciences Méd. art. *Survie*.) In all cases where the fatality has been owing to the falling of buildings, &c., an accurate examination of the bodies should be made, to discover any lesions that may have been inflicted; for a hard heavy body having fallen on the head, chest, or belly, would naturally point out the speedy death of the individual thus wounded.

Hunger or Thirst.—It is well known that individuals who have not reached their full growth suffer most from deprivation of aliment; and hence those advanced in age support hunger better than children. This fact has been observed in famines at sea and in besieged towns; and is no less correctly than beautifully illustrated by Danté, in his account of the death of Count Ugolino and his family, who, shut up in a dungeon and condemned to destruction by starvation, are represented as perishing in the order of their age, beginning at the youngest; the father having survived to witness the death of all. Women consume less food than men, and are capable of supporting themselves better under its privation: hence they may be supposed to be the last to sink when exposed in common with men to the effects of hunger. Persons of a full and fat habit of body are likewise better able to support a long fast than those of a lean and active disposition. In judging of survivorship in cases from this cause, regard should be had to the means of procuring any cordial, such as wine, or spirits, or even water. In the case of the celebrated Viterbi, who starved himself to death in the island of Corsica, he prolonged his life for some days by having yielded to the call of thirst, and taken a draught of cold water on the thirteenth day. If, therefore, it be discovered that some of the party had access to any of these fluids, from which the rest were debarred, it would afford strong grounds for the presumption of their survivorship. In death from hunger, as in most of the accidents of which we have taken notice, vigour of intellect, by which the presence of mind is retained, gives an advantage to those who possess it. This was exemplified in the crew which embarked on the raft, after the wreck of the Medusa, in the year 1816. Of one hundred and fifty individuals thus exposed to hunger during thirteen days, but fifteen survived, and these were not the strongest and most vigorous in appearance, but those possessed of the greatest courage, and who maintained their presence of mind the longest.

Excess of Heat.—Although it is well known that animals cannot continue to live when exposed to very high temperatures, yet the true cause of death from this agent does not appear to be satisfactorily explained. From an experiment of Mr. Brodie, it seems probable that it acts by destroying the muscular energy of the heart and diaphragm. He placed a rabbit in a basket in an oven, the temperature of which was not more than 150°, and it died in a few minutes without any apparent

suffering; the heart was afterwards found distended with blood, on both sides, as in syncope. (Paris and Fonblanque's Med. Jur. vol. ii. p. 63.)

It appears from many recorded facts that a heat of the magnitude just mentioned, although sufficient to kill a small animal in a short time can be borne by man for a considerable space with tolerable impunity. Thus, individuals have gone into ovens hot enough to bake bread, meat, &c., and have remained inside during the process without suffering much inconvenience. Tillet and Duhamel (Mém. de l'Acad. des Sciences, 1764,) state that at Rochefaucault in Angoumois, in 1760, a baker's daughter, in their presence, entered into an oven, the temperature of which they estimated at 264° Fahr., and remained about twelve minutes in this excessive heat without being much incommoded by it. A young man, in Dobson's (Philosoph. Trans. 1775,) experiments at Liverpool, remained for twenty minutes without great inconvenience in a stove, the air of which was at 210°. M. Berger (Exp. sur les Effets qu'une forte chaleur produit sur l'Economie,) supported, for seven minutes, an atmosphere of the temperature of 229° Fahr., and Blagden that of 260° for eight minutes.

In the volcanic district in the neighbourhood of Naples, there is a deep cave running a considerable distance under ground, at the bottom of which rises a boiling spring; and it is a common feat for the ciceroni to carry in a number of eggs, plunge them into the hot water, and remain until they are completely cooked. The writer has witnessed this performance, and has seen the man come out bathed in perspiration, and certainly exhausted, but not otherwise perniciously affected. In the course of Dr. Apjohn's interesting and important experiments on respiration, he entered the heated room of a calico manufactory, the temperature of which was 152°. He remained in it for thirty-seven minutes, at the end of which time his pulse beat at the rate of 116 strokes in a minute, and the number of respirations was raised to thirty in the same period. These changes, however, did not take place suddenly, for it was not until he was twenty-five minutes in the room that the heart's action attained that rate. This experiment is important, not only on account of the conclusions arrived at respecting the changes effected on the air by respiration, but also in reference to the length of time that such a degree of heat can be supported by man. The effects of watery vapour are more intolerable than those of a dry atmosphere. M. Delaroche could not support, above ten minutes and a half, a vapour-bath which, at first at 99°, rose in eight minutes to 124° Fahr.; and M. Berger was obliged, in twelve minutes and a half, to come out of a vapour-bath, of which the temperature had risen from 106° to 128° Fahr. These gentlemen, however, supported for a considerably longer time, without much inconvenience, higher temperatures in dry air. (*Dr. Edwards*, op. cit.)

The effects of a high degree of atmospheric heat are witnessed on a large scale in the deserts of Africa and Arabia, where caravans so frequently suffer from exposure to a burning sun. Fodéré alludes to the loss sustained by the French army from this cause in traversing the sands of Egypt and Syria. He describes the effects to be vertigo, syncope, rarefaction of the blood, passive hemorrhages, and death. It would appear that men exposed to this cause of destruction survive in an inverse order to what takes place in exposure to cold, that is, that adults and strong persons sink under it before the young and weak, an instance of which is given by the author last named. An Englishman and his daughter, aged seven years, joined a caravan which left Aleppo in the year 1814, to cross the desert of Syria to the Persian Gulf. Both father and child rode on camels, and were placed under exactly similar circumstances, but the former could not resist the effects of the heat, and died; while the girl was able to continue the journey, and arrived safe. Other members of the caravan suffered similarly, but they were the strong and robust; the young suffered least.

Cold. — It appears from the observations of Dr. Edwards, that the power of evolving heat in infants is less than that possessed by adults. Thus, in ten healthy infants the limits of variation of temperature taken by M. Breschet were from 93° to 95° Fahr., the mean of the whole number being 94° 55′, while the temperature of twenty adults was found to vary from 96° to 98°, the mean being 97°, which agrees with the best observations. The temperature of the former is, therefore, inferior to that of the latter; a relative difference which analogy would lead us to expect. It follows, as a consequence of this, that when the faculty of evolving heat is not the same, the vitality will be different; for the need of warmth, and the power of supporting cold, cannot be the same, where the internal source of heat has not the same activity. In one experiment Dr. Edwards exposed a kitten, newly littered, removed from its mother, to the air at the temperature of 51° Fahr.; it was cooled down in 9 hours to 64°, and had become stiff and almost incapable of executing the slightest movements. In another experiment he exposed two kittens of one day old, and having a temperature of 98°, to the air of a room at 50°; in two hours and twenty-five minutes the temperature of one was reduced to 62°, and that of the other to 64, and they had become stiff and almost insensible. It is superfluous to observe that the adult animal would not have suffered the same effects. Similar experiments cannot of course be made on infants, but it is fair to infer that they would exhibit similar results. This variation between ages, in the power of resisting cold, seems to be extended to sex and temperament, for males have been remarked to endure low temperatures better than females; and those of bilious and sanguine temperament better than phlegmatic and nervous. In questions of survivorship arising out of a number of individuals destroyed by cold, besides the circumstances just mentioned, it is necessary to take into account the state of health or disease of each; and also their relative moral powers, by which a resistance to sleep, and a capability of continuing in motion, are maintained; two circumstances of the greatest importance in combating the effects of cold. The relative amount of clothing of each, and the opportunities of procuring nourishment or cordials, should also be considered. If spirituous liquors have been at

hand, a great deal will depend upon the manner in which they have been used. In the disastrous retreat of the French army from Russia, it was observed that those soldiers who rushed greedily on the casks of brandy and drank to intoxication were the first to perish from the cold; while those who used it in moderation were revived by it. Fodéré (Dict. des Sciences Méd. art. *Survie*) mentions that he witnessed similar effects in crossing Mont Cenis with the French army in 1789, but that the practice of taking small quantities of brandy every two hours assisted most wonderfully in enabling him to resist the cold.

T. E. Beatty.

SUSPENDED ANIMATION.—(See Asphyxia.)

SYCOSIS.—(*Syn.* mentagra, herpes pustulosus mentagra, mentagre, dartre pustuleuse mentagre,) from συκον, *a fig*, denotes a cutaneous disease of the bearded parts of the face and throat and also of the hairy scalp; it is characterized by pustules, viscid discharge matting together the hairs, and forming crusts by inflamed tubercles, and sometimes by prominent granulated ulcerations. The mixture of colours and unevenness of the surface give to the affected parts something of the appearance of the pulp of a fig; and hence this disease has received the name of sycosis. Dr. Bateman, (Synopsis, &c. p. 291,) and it appears from his statement, Dr. Willan also, regarded the initial form of this affection as truly tubercular, but of that form of cutaneous tubercle which usually ends in suppuration; while Alibert, (Maladies de la Peau, fol; also, Précis Hist. et pratique des Malad. de la Peau, 2 tom. 8vo.) Rayer, (Traité des Maladies de la Peau,) and Biett, (Dict. de Médecine, art. *Mentagre;* also *Schedel et Cazenave*, Abrégé pratique des Maladies de la Peau,) maintain that the disease is originally pustular, and that the tubercles, which however they allow are diagnostic,* arise during the progress of sycosis. Thus it appears that the French and English pathologists differ chiefly in the precedence as to time, and the degree of importance which the former attach to the suppurated points, and the latter to the tubercular elevations of the skin.

Dr. Bateman has divided the disease into two species, that which is seated on the bearded portion of the face, and that which appears on the hairy scalp: but we have also seen an affection of the same character situated on the pubes of both sexes, more especially the female. This last is usually of syphilitic origin.

1. **Sycosis menti,** sycosis of the chin. This disease is often preceded for months, sometimes for years, by a morbid irritability of the skin of the face, and partial eruptions of inflamed pimples, which, after suppurating, fade and disappear, and after a time are succeeded by others. These attacks become more frequent and severe, till at length the disease establishes itself on the chin or upper lip. Most commonly the development of sycosis is immediately preceded by heat, redness and tension of the skin covered by the beard, with tingling and pricking pains; numerous inflamed pimples now make their appearance, which ripen into pustules in three or four days, and in seven or eight burst and become covered with thin brownish crusts; but the oozing of fluid is generally inconsiderable. The crusts by degrees separate, and according to Biett, (Dict. de Médecine, art. *Mentagre;* also *Schedel et Cazenave*, Abrégé pratique, &c.,) the disease ceases entirely from the tenth to the fifteenth day, provided no new eruption takes place. The pustules are conical and most frequently single; at other times they are clustered together in circular groups, and very numerous, covering the upper lip and chin with small prominent tumours of various sizes, filled with a yellowish white pus, and each penetrated by a hair. Most commonly successive partial eruptions take place, the skin becomes inflamed and thickened, tubercular eminences form, and at length even the subcutaneous cellular tissue suffers, and small phlegmons from time to time make their appearance. In some protracted cases even the bulbs of the hair become affected, and parts of the chin are rendered bald: but in most instances when the disease subsides, the hairs are reproduced, at first pale and slender, but they afterwards acquire their natural strength and colour.

The extent of the disease is very various: sometimes it forms only one spot on the middle of the upper lip, covered by a dark prominent crust; (dartre pustuleuse labiale—Alibert;) at other times the whole of the bearded portion of the face and throat is covered by pustules, crusts, superficial ulcerations, and tubercles; and in some cases even the eye-brows are not exempt from the disease. Sycosis of the chin occasionally appears in a much less acute form, the eruption presenting more of a tubercular than a pustular aspect. Many of the tubercles continue as red, smooth, conoidal tumours, about the size of a pea, for three or four weeks or longer; while others suppurate very slowly and imperfectly, discharging a little thick viscid matter, which glues together the hairs. (*Bateman*, Synopsis, &c. p. 293.) When to these appearances are added partial ulcerations, the lower part of the face exhibits a very repulsive appearance, from the mixture of tubercles, crusts, ulcerations, and the strong hairs of the beard matted together; while the patient, in the mean time, suffers considerably from the hot itching and tenderness of the parts.

It has been supposed that the anatomical seat of sycosis is the sebaceous follicles; and it is probable that they often participate in the disease of the adjoining tissues, but this does not appear to take place in all instances. M. Gendrin made a dissection of a case of sycosis which had existed for a considerable period, and found that the diseased skin was thicker than natural; the rete mucosum under the pustules presented in different places small infiltrations of a yellowish substance like jelly, and each of these was observed, by means of a lens, to be surrounded by a very delicate net-work of vessels. The bulbs of the hairs appear, in this instance, to have been unaffected, and the sebaceous follicles are not stated to have been in any way diseased. (Histoire Anatomique des Inflammations, t. i. p. 457.)

2. **Sycosis capillitii,** sycosis of the scalp. This has been described by Dr. Bateman; but it

* "Enfin dans l'impetigo figurata, on ne rencontre jamais les tubercules, comme dans le Mentagre." Schedel et Cazenave, Abrégé pratique, p. 226.

does not appear to have been distinguished by French writers on cutaneous diseases from the porriginous affection of that part. It consists of the eruption of clusters of soft acuminated tubercles on the hairy scalp near to its margin and on the temples; sometimes spreading so as to involve the external ear. Perhaps they ought to be termed pustules rather than tubercles, for they all pass into suppuration in eight or ten days, run together, and form for each group an irregular elevated spongy ulceration, often presenting a granulated appearance, and discharging a quantity of thin fluid of a rank offensive odour. This uniform tendency to ulceration forms one of the diagnostic marks which distinguish sycosis from porrigo: they differ also in the more inflamed and elevated base of sycosis, and in the absence of contagion. The last is a diagnostic of no practical value, and one which can seldom be proved to our satisfaction.

Causes. — Sycosis of the chin has been met with, though very rarely, among women: it occurs chiefly in young men, soon after puberty; and in adults, having a coarse skin with a dark-coloured strong beard. Indulgence in the luxuries of the table and in strong liquors, gross dissipation, filth, and misery may all be regarded as powerful exciting causes of this affection: but even individuals of the most correct habits, and uniformly attentive to cleanliness, are not altogether exempt from its attacks. Those who are much exposed to the scorching glare of fires and furnaces, as cooks, glass-blowers, founders, steam-engine men, are most frequently affected with this disease. It has also been ascribed to the use of a foul or rough-edged razor, but probably on no sufficient grounds, although such an irritation must obviously hasten its development in those already disposed to it. Thus the causes of sycosis of the chin are to be sought for partly in a disordered state of the digestion and of the general health, and partly in local irritation; few cases, we believe, are met with, in which constitutional as well as topical influences do not concur to produce the disease.

[M. Gruby, of Vienna, has recently announced the existence of a new cryptogamic plant in mentagra. It is found at the roots of the hairs of the beard, and around that portion which is contained in the hair follicle. By the transmission of the seeds of this plant he considers the disease to be contagious, and he proposes for it the name *mentagrophyte*. The disease, according to M. Gruby, is limited to the hairy part of the face, but is most frequently seen on the chin, upper lip, and cheeks,—covering the parts with white, greyish and yellowish scales, which are slightly raised at the middle, have angular borders, and are pierced at all points by hairs. Examination with the microscope shows that the scales are composed of epidermic cells; but the whole of the dermic portion of the hair is surrounded by cryptogamic formations, which form a vegetable sheath around it in such manner that the hair implanted in the sheath may be likened to the finger surrounded by a glove. These cryptogamia are never seen to rise above the surface of the epidermis; they originate in the matrix of the hair, and in the cells of which the follicle is composed; and they ascend so as to surround all that portion of the hair which is included within the derma. They present every where a prodigious number of sporules, which are adherent, on the one side, to the internal surface of the follicle, and on the other to the cylinder of the hair. This disease of the skin M. Gruby regards as of purely vegetable nature. It may be so: but further evidence is needed. (E. Wilson, *A Practical and Theoretical Treatise on Diseases of the Skin*, Amer. edit. p. 300, Philad. 1843.)]

Sycosis of the scalp is of more obscure origin: the few cases of this nature which we have seen were in children of a delicate appearance; and the beautiful delineation of the disease given by Dr. Bateman is obviously taken from a child; yet it is remarkable that in his diagnosis of the disease he speaks of it as occurring *exclusively* in adults. (Synopsis, p. 294.)

Treatment.—The first step towards a cure is to remove, as far as lies in our power, all those circumstances which appear to have occasioned or aggravated this affection, as intemperance, neglect of cleanliness, exposure to scorching heat, and the irritation of the razor. It is of great consequence to get rid of the hair, in order to clear away the crusts and discharge, and to apply topical remedies with effect; shaving, however, is exceedingly painful, and in most cases quite impracticable; but the object may be gained by clipping the beard with scissors, which ought in no case to be omitted. The parts should then be cleansed with tepid milk and water, emollient poultices, and the topical vapour-bath. This last, both simple and combined with sulphur, will be found of great utility in soothing the affected skin and promoting the softening and absorption of the tubercles, which it often effects with remarkable rapidity. The raw and ulcerated parts ought to be bathed with the black mercurial wash, or with Bates's red lotion,* and dressed with ointment of white precipitate of mercury, or, if there be much irritation, with ointment of oxide of zinc, or subnitrate of bismuth. When the discharge is considerable, we have found great benefit from applying a strong solution of sulphate of copper. The removal of the tubercles is also much hastened by the application of sulphate of copper and nitrate of silver in substance; but the concentrated acids, which have been proposed, cause sloughing of the tumours, increase the inflammation, and retard the cure.† Such of the tumours as appear particularly prominent and fiery ought to be punctured with a lancet; thus the blood-vessels will be unloaded, and in many cases small collections of pus or gelatinous fluid discharged. When sycosis possesses an inflammatory type, as it usually does in its early stage, and the strength of the patient permits, it will be of service to apply leeches around or even upon the affected skin; and when the individual is robust, venesection or cupping will be proper; and the tartrate of antimony ought to be

* Sulphatis cupri.
Boli armen. aa dr. ii.
P. camphoræ, dr. ss.
Aquæ ferventis, O. ii. M. s. a. et cola per linteum.

† An ointment composed of iodine sc. ss, and hydriodate of potass dr. ss, with oz. i of lard, has proved successful in a case of some years' duration. See Lond. Med. Gazette, Dec. 7. 1833.

given in frequent small doses. In all cases of this disease it is of consequence to commence the treatment by a smart mercurial purgative; and after the bowels have been cleared out, and the inflammatory symptoms have abated, our efforts ought to be directed to restore the digestive organs to a healthy state by bitters, alkalies, and, in more obstinate cases, by the continued employment of minute doses of mercury. When sycosis occurs in persons whose strength is much reduced, a nourishing diet with tonics, such as the preparations of cinchona and steel, has been productive of speedy amendment. If the disease be obstinately protracted, the arsenical liquor ought to be had recourse to, and a blister applied over the diseased surface; or this last may be tried in conjunction with a course of corrosive sublimate.

Sycosis of the scalp being more ulcerated, and accompanied with a thinner and more abundant discharge than that of the chin, it requires a more liberal application of astringents and caustics; and the same remark applies with nearly equal force to the corresponding affection of the genitals. In this last, cooling washes and the free use of sulphate of copper, conjoined with the internal employment of mercury, will very rarely fail to accomplish a speedy cure.

W. Cumin.

SYMPTOMATOLOGY, [*Semeiology*, or *Semeiotics*, is the branch of general pathology which treats of the symptoms or signs of disease. The word *symptom* is often—perhaps, generally—used in the same sense as *sign*; but, by many, *symptom* signifies the functional or vital phenomena of disease, whilst *sign* is applied to that which is more directly physical. A recent writer (Raige-Delorme, art. *Semeiologie*, in *Dict. de Méd.* 2d édit. xxviii. 297, Paris 1844.) considers every symptom to be a sign of disease, and defines semeiology to be "that branch of pathology whose object is the knowledge, the particular study of the phenomena, which occur in disease; or of symptoms, that is to say, of the perceptible changes that take place in the material state of the organs or in their action, and which being connected with the existence of diseases, become the indexes or signs of them." There certainly is convenience in the employment of the expressions, *vital phenomena* or *symptoms*, which are dependent upon the vital properties of organs, and *physical signs*, or the evidences that are afforded by percussion, auscultation, &c., which reveal the physical condition of the parts, and their vital manifestations. The writer is in the habit of employing these phrases, originally suggested by Bayle and Laënnec, on account of their convenience. (Dr. Williams, *Principles of Medicine*, § 601, Philad. 1844.)]

The diagnosis of disease constitutes the first part of the office of the physician in his actual visits to the sick. The sources of diagnosis are, the history, the symptoms, or changes in function, [the physical signs], the effects of remedies, and the morbid anatomy, or changes in structure.

The history teaches much of the probable progress of the disease, and of its effect in inducing changes in structure and devastations of the powers of the general system. The symptoms designate the organ principally affected. [The physical signs indicate altered mechanism.] The effects of remedies, carefully considered, throw an important light upon the nature and force of the disease, and upon the condition and energies of the system. The examination of the changes of structure affords an invaluable confirmation or correction of our previous opinions.

The study of the history of the disease greatly aids the diagnosis. The constitutional causes, which involve the hereditary predisposition, previous attacks, &c.; the external causes, which embrace those circumstances which induce and modify the disease; the duration, the past course of the morbid affection, &c. are all events which greatly assist us in forming the diagnosis, and in determining the particular condition of the organ principally affected, and of the general system, in the individual case.

But the symptoms doubtless constitute the chief source of the diagnosis. The form and violence of the symptoms, the particular order in which they appear, the particular manner in which they are conjoined, offer additional means of diagnosis.

[The physical signs are most important elements in the diagnosis of diseases of the chest more especially. They indicate various changes in the physical properties or actions of organs; for example, their density, greater or less capacity of causing or conducting sound, &c. Physical signs reveal "the nature, extent, and degree of organic affections, and may be regarded as the means or instruments of pursuing morbid anatomy on the living body. (Walshe, *The Physical Diagnosis of Diseases of the Lungs*, Amer. edit. p. 2, Philad. 1843.)]

One of the sources of diagnosis enumerated constitutes a department of knowledge which may be termed *new*: it is that of the effect of remedies, and especially of bloodletting, as a diagnostic of diseases, and as a criterion of the general powers of the system. In cases in which it is doubtful whether the pain or other local affection be the effect of inflammation or of irritation, the question is immediately determined by placing the patient upright and bleeding to incipient syncope: in inflammation much blood flows; in irritation, very little. The violence of the disease, the powers of the system, and the due measure of the remedy, are determined at the same time. There is, in our opinion, no single fact in physic of equal importance and value, in the diagnosis of acute diseases and the use of an important remedy.

But it must be acknowledged that it is to the study of morbid anatomy that we are principally indebted for the recent progress, and, indeed, for almost all that is solid, in medical science. It is by the investigation of morbid anatomy that we are principally enabled to establish correct species of disease; but it is equally true, that all the advantages which spring from our knowledge of changes of structure, must flow through that of the history and symptoms, as the channel to our individual patients. The progress of medicine as a science—might we not say, as an abstract science?—may be considered as greatly dependent on that of our knowledge of morbid anatomy; but the advancement of physic, as a practical art, is intimately linked with our knowledge of the history, symptoms, and the effects of remedies—with the diagnosis of the disease in the living patient.

The sources of diagnosis may be arranged in the following manner:—

I. *The history.*
II. *The symptoms, or changes of function.*
III. *The effects of remedies.*
IV. *The morbid anatomy, or changes of structure.*

I. *The history of diseases* comprises
  i. The causes, which are
    1. Constitutional.
    2. External.
  ii. The course, which is
    1. Acute.
    2. Chronic.
    3. Insidious.
    4. Sudden, &c.

II. *The symptoms, or changes of function,* are observed in
  1. The countenance.
  2. The attitude.
  3. The tongue.
  4. The general surface.
  5. The general system.
  6. The functions of the brain, the spinal marrow, and the nerves.
  7. The respiration.
  8. The circulation.
  9. The functions of the alimentary canal.
  10. The physical condition of the abdomen.
  11. The functions of the urinary organs.
  12. The functions of the urinary system.
  13. Examinations,
    1. Of the abdomen,
    2. Of the rectum,
    3. Of the vagina. &c.

III. *The effects of remedies* are
  i. Immediate.
  ii. Remote.
  iii. Curative.
  iv. Morbid.

They are principally seen in the administration of
  1. Bloodletting.
  2. Purgatives.
  3. Opiates.
  4. Mercury.
  5. Digitalis.
  6. Alcohol.
  7. Quinine, &c.

It is the *immediate* effects of bloodletting which are chiefly valuable in a diagnostic point of view.

IV. *The changes of structure* are
  1. Febrile.
  2. Eruptive.
  3. Inflammatory.
  4. Congestive.
  5. Arthritic,
  6. Rheumatic·
  7. Scrofulous—Tuberculous.
  8. Scirrhous.
  9. Encephaloid.
  10. Melanotic.
  11. Dropsical.
  12. Hemorrhagic, &c.

The observation of the history, symptoms, and effects of remedies, is strictly clinical, and can alone be beneficial to our immediate patient. The examination of the morbid anatomy may be viewed as the proper corrective of our clinical opinions, whilst it contributes, more than any other species of investigation, to the advancement and exactness of the science of medicine.

The true value and importance of the history and symptoms of diseases, and of morbid anatomy, depend alike on a due and correct association. The most perfect knowledge of symptoms would be utterly useless unless considered as signs and indices of the internal disease; and the most perfect knowledge of morbid anatomy would be inefficient, unless we were enabled by the symptoms to ascertain its existence in the living body. Our object, in both these studies, ought, therefore, to be to make them useful by the establishment of distinct associations of the symptom or the sign, and of the morbid state as the thing signified. It is in this manner only that the diagnosis and identification of diseases in the actual practice of physic will become more and more correct and complete.

The objects embraced in the history and symptoms of diseases are certainly more transitory and less palpable, and require more caution and reserve in the association as effects of diseases, than those of morbid anatomy. But, from the observation just made, that it is only by association of the morbid anatomy with symptoms indicative of the morbid change that even this becomes cognizable in the living body and useful in the practice of medicine, it is plain that the same difficulties apply in fact to both.

The study of the history and symptoms of diseases embraces an object unconnected with morbid anatomy, viz. such instances of morbid affection as consist in derangement of function and leave no trace under the scalpel of the anatomist. (See Baillie's Morbid Anatomy, Pref. p. 1.) And it is one of the objects of the history of diseases especially, to trace the transitions, in mixed cases, of deranged function into deranged structure, the extensions of diseases of structure from one organ or part to another, and the superinductions, from accident or natural consequence, of one disease upon another. It is a point of great importance, but of great difficulty, in the study of the history and symptoms of diseases, to determine the times of these transitions and extensions of disease.

It is an object of the history and symptoms of diseases to ascertain, in the coincidence of different morbid affections, whether their coexistence be accidental, or the result of their mutual relation as cause and effect.

Such is an imperfect sketch of the objects and relations of this department of medical science. It would be wrong to argue against the importance of the study of the history and symptoms of diseases from the imperfect manner in which they have hitherto been treated; whilst to consider perfection in this study to be unattainable would be to suppose that medicine cannot exist as a safe and useful art. It would be wiser and more true to say, that, hitherto, we have been too apt to form and to state our opinions, and to regulate our practice, on insufficient evidence; and then to

turn our attention to the real nature of the evidence for facts in medical science, and especially in clinical medicine, and to inquire whether its sources may not be multiplied, and its results rendered more sure and conclusive.

It is in this way alone that we can hope to remove from the practice of medicine the reproach of vacillation and uncertainty, and contradiction. [See the writer's remarks at the end of the Article Statistics, Medical.] The first step is clearly to distinguish and to identify the disease; the second, to appropriate the remedy, in its purity and simplicity, and with a due attention to the strength and constitution of the patient. When experiments have thus been carefully instituted, and the results collected by an assiduous observation, we may expect to become acquainted with the real effects of those agents which we consider as remedies,—both good and bad. An investigation conducted in this spirit would, we feel convinced, lead to some important results. We still want an essay on the morbific effects of remedies,—1. when misapplied, 2. when even appropriately, but perhaps injudiciously, administered, and 3, from idiosyncrasy. We may instance bloodletting, and purging, and opium, as productive of morbific effects of the most serious character, to which our attention has been particularly directed: it is needless to add to the list, mercury, digitalis, cantharides, &c., with which every practitioner has learnt to associate certain morbid conditions of the system. But this subject will be more particularly noticed in a subsequent part of this paper. We shall now proceed briefly to notice the advantages which result from each of the departments of the present article more distinctly.

The principal circumstances more particularly embraced by the history of diseases, are, the cause,—the progress, the stage,—the effect of remedies,—the season of the year, the prevalence of epidemics,—the constitution, and habits, and previous diseases of the patient, &c.

The principal subject in the history of diseases, in a diagnostic point of view, is its congruity or incongruity with the supposed disease. We frequently arrive at a negative result, especially, by observing such incongruity in the history; and in this manner, by excluding certain diseases, we narrow the sphere of our inquiries and have our attention directed upon a less numerous class of objects.

In the study of the symptoms, every circumstance which can become the subject of observation, and which is at all characteristic, must be considered as important. It is with this view that we carefully examine the countenance and the attitude of patients, as well as those other points which are more usually considered amongst the class of symptoms. The attempt to analyze, distinguish, and describe all the external appearances of disease cannot fail to assist the clinical student and the young practitioner, whilst it serves only to recall to the mind of the experienced those sources of evidence on which his judgments have been ever, though perhaps unconsciously, founded. For without having undertaken any distinct analysis of the general appearances in disease, the experienced physician has, notwithstanding, been struck with them in the coup-d'œil he has taken of these appearances and of the general manner of the patient. By these means he has recognised and identified the affection, when he may have been almost unconscious of the sources from which his discrimination flowed.

The countenance of the patient, although a source of information too much neglected by writers on medicine, is very peculiar and highly characteristic in many diseases, and affords to the physician of experience and observation an important means of diagnosis. The kind, the stage, the changes, the mitigation, and the progress of many morbid affections are accompanied and denoted by corresponding states of the countenance. Let us recall to mind the varied and distinctive appearances in the different kinds and stages of fever, in affections of the head, of the thorax, and of the heart, in inflammation of the abdomen, and in colic and other affections accompanied by spasmodic pain, in icterus and in chlorosis, and that class of morbid affections which, originating in derangements of the digestion, are accompanied by changes of complexion so characteristic of the original disorder. It is impossible not to be impressed with the importance of changes in the countenance so observable, so diversified, and so diagnostic, with a view to every practical purpose in the art of medicine.

Hippocrates, (Vide Προγνωστικον,) and Celsus, (Lib. ii. cap. 2, 6,) and other ancient writers, have, in their great attention to the study of symptoms, paid particular regard to the appearances of the countenance. Celsus observes, "medicus neque in tenebris, neque a capite ægri debet residere; sed illustri loco adversus eum, ut omnes notas, ex vultû quoque cubantis, perspiciat." (Lib. iii. cap. 6.)

[What may not inappropriately be styled *medical physiognomy*, or the changes of features indicative of, and peculiar to, different diseases and stages of diseases, is a subject of moment, and has not yet met with sufficient attention. In diseases of infancy, in particular, the appearance of the countenance will often materially aid us in discriminating the seat of the affection. There is a marked difference between the facial expression of one labouring under violent pain in the head, and one suffering from excruciating pain in the abdomen, even in the adult. Less degrees of pain are, of course, disregarded; and it is only in severe cases that physiognomy can be inservient to diagnosis; but in the infant, which readily gives expression to any pain or uneasiness, the countenance is an excellent medium of discrimination, and will frequently indicate, at the first glance, the seat of the derangement. The character, too, of the countenance, in serious disease, as to anxiety, convulsion, &c., is often a subject of watchful interest with the physician.

To what he termed *La Semeiologie Physiognomique*, in the study of the diseases of childhood, M. Jadelot, Physician to the *Hôpital des Enfans-trouvés*, of Paris, paid great attention, and was firmly impressed with its great importance. A work on the subject, from his pen, was promised upwards of twenty years ago, but it has never appeared. So satisfied was M. de Salle of its value, that he conceived the diseases of infancy would be recognised with such facility, that the

possessor of the most mediocre talent might know and cure them as readily as he who is more highly gifted. (*Traité des Maladies des Enfans de Michael Underwood;* par E. de Salle, p. 36; or a view of M. Jadelot's system, in the Prefatory Observations to the Writer's *Commentaries on Diseases of the Stomach and Bowels of Children.* Lond., 1824.)]

These observations are equally applicable to the subject of the attitude and motions of the body in general, in different diseases; for, although the attitude, in certain diseases, is so remarkable as absolutely to have challenged observation, yet, in general, this point has been too little noticed, and its indications too little explored. Hippocrates, (Vide Προγνωστικον,) and Celsus (Lib. ii. cap. 3, 4, 6,) have particularly noticed the attitude of patients.

It is useful to examine the state of the hands and feet of the patient, in connection with that of the general surface. But it is not our intention to enumerate all the subjects of the following pages in this place. We proceed, therefore, to notice in a cursory manner some points rather connected with the investigation of the symptoms of diseases than forming a part of them.

It is proposed, in the first place, to make each particular symptom the object of distinct and separate inquiry, and, considering it as a general phenomenon occurring under numerous and different circumstances of disease, to investigate, distinguish, and arrange its varieties, modifications, and peculiarities, in each.

It is insufficient to give to a particular symptom a particular name, and notice its occurrence in particular diseases; it is necessary to describe each symptom in general, and to distinguish each modification and peculiarity of it in particular. Dyspnœa is noticed as a symptom of inflammation within the chest, of hydrothorax, of asthma; but how widely different is the dyspnœa of pneumonia from that of asthma—how distinct the difficulty of breathing in asthma from the dyspnœa of hydrothorax, and from that of the numerous other affections in which this symptom is observed! How desirable, then, must it be to seize and describe these distinctions, and make the application of them to the discrimination of diseases!

It can seldom be said that any particular symptoms of disease are truly pathognomonic; but the kind and character of the symptom are frequently so. To ascertain, therefore, the form of each symptom as peculiar to different diseases, would be to establish that system of pathognomonics so much desired by the more ancient physicians. (*Cullen*, Nosologia Methodica, p. vii.)

The varieties and modifications in the form of symptoms must be traced, too, in immediate reference to particular instances of disease. Much has been written on the different states of the pulse; and numerous artificial divisions of this symptom have been formed; but in general this has been done in too abstract a manner. To study the pulse to any practical purpose, it should be constantly considered in relation to some individual disease, its character noticed, its changes traced, and its indications ascertained. Every thing must be as little general and as little abstract as possible.

A proper and full arrangement of the symptoms and their varieties must be of great importance in the investigation and identification of diseases. Some symptoms have been considered as real diseases, and it must be absolutely necessary to draw just distinctions between them, with a view to their cure. A similar arrangement and discrimination of the varieties of each symptom are of essential importance to the diagnosis, and of the greater moment in this place, because the investigation has been hitherto pursued in a very partial and inadequate degree. Dyspnœa, icterus, hydrops, &c. must be distinguished, as symptoms merely, from real diseases, and each form and variety of these affections must be carefully distinguished from the rest, and accurately associated with its particular cause.

There are also some other circumstances which claim our attention. The particular combination of symptoms, and the influence of one symptom in inducing and modifying the others, are observed to be characteristic of certain affections and stages of disease.

In our clinical visits, we naturally resort to the principles of analysis and synthesis, in order, first, to seize some particular points, such as several prominent and important symptoms, from which we proceed, in the second place, to collect such other symptoms as usually concur, and complete the character of the disease we have in view. We are thus confirmed or corrected in our opinions by the congruity or incongruity of the several parts; we perceive that the disease is simple or that it is complicated; and we trace its progress in itself, or its extension, and involution of other diseases, or of parts of the system not originally affected. It is, indeed, comparatively easy to observe and describe symptoms, or appearances in morbid anatomy, abstractedly; the task of difficulty, as well as of utility, is the proper and just association of them as signs of diseases.

Some symptoms are not only incongruous but incompatible; and by a careful and patient observation we often satisfy ourselves on a point which we could not decide by any inquiries. When a patient has complained of pain of the side, for instance, and it has been doubtful whether the pain were inflammatory, a spontaneous sigh has decided the question. In the same manner writhing of the body is unusual if not incompatible with inflammation. At least, although, as Celsus observes, "vix ulla perpetua præcepta medicinalis ars recipit," these circumstances afford great assistance in the investigation of diseases. We are thus frequently enabled to circumscribe our inquiries by ascertaining what the disease is not, before we have actually discovered what it is.

But without entering so minutely and carefully into this subject, there is something in the coup-d'œil, or general sum of appearances, which is of great utility to the experienced physician. There is in practical medicine a circumstance of the first importance, the recognition of a disease. The general appearance of the patient, the peculiar modification, the particular combination, and the mutual influence of the symptoms, give a general character to the whole disease, which is recognised and felt by the physician of experience and observation.

Accurately to discriminate the symptoms of

diseases, and their various forms, is to apply to the objects of clinical medicine the principle of analysis; and accurately to describe them will be to render the knowledge of them and of medical experience in general more communicable to others. It has long been remarked and regretted that practical knowledge in medicine is peculiar in this respect,—that it cannot be taught, and that the precious fruits of experience necessarily die with their possessors.* How unfortunately true this remark is to a certain extent, must be universally acknowledged. And from this admission, the importance of devising the means of rendering medical knowledge more capable of being imparted from one person to another is sufficiently manifest. Now it has happened to us that the difficulty in effecting this object may be in some degree obviated. On considering the nature of experience in medicine, it is plain that it consists, in a great measure, in an acquired capacity for receiving and acting on general impressions induced in the mind by the repeated contemplation of disease. The inexperienced practitioner is incapable of receiving these general impressions; the experienced are, in general, incapable of explaining them. Is it not, however, probable that, by presenting to the young clinical student an analysis of those general impressions which constitute the object of experience, he may be very materially assisted, and that experience may not only thus become more communicable, but that the young practitioner may thus also sooner become experienced, and earlier capable of acting on similar general impressions! If this be true, such an analysis of the general impressions of experience must prove highly useful. But such an analysis implies the observation and detail of every particular constituting the general sum of morbid appearances,—the enumeration and description of every phenomenon which can be presented to the observation of the physician.

It is true this general view of disease is inadequate to the purposes of practice; it is, however, of great assistance and utility; and the most experienced must not rest satisfied with his general knowledge, but must make the most particular inquiries, in the case of each individual patient; "etiam vetustissimus auctor Hippocrates dixit, mederi oportere et communia et propria intuentem." (Celsi, Præf. lib. i.) The general impression in question is chiefly useful by contracting the circle of our inquiries, and by leading us nearer that centre which consists in the individual case before us. It is especially useful in dispensary practice, in which many patients must be seen in a short time, and in which there is not, consequently, sufficient opportunity for entering fully into particulars.

In conclusion, we may remark that the objects of the history and symptoms of diseases may be divided into those of observation and those of inquiry on the part of the physician; the former are the more satisfactory; the results of inquiries are apt to partake of the vagueness and incorrectness of the answers of the patient. In conducting these inquiries, we ought to be careful not to put leading questions, and not to receive the replies implicitly, but to try their truth by ascertaining their congruity or incongruity with the character and history.

We must now revert briefly to that source of diagnosis which is afforded us in the effects of remedies. It chiefly refers to the effects of bloodletting, and consists in the fact, that inflammatory affections of the serous membranes and parenchymatous substance of organs induce great tolerance of loss of blood, in the perfectly erect position. The institution of bloodletting in this position affords therefore a diagnosis of acute diseases of the utmost moment. But the subject has been noticed more at length in its proper place.

I. The History of Diseases.

The principal objects of the history of diseases are, their causes and their course. We do not propose to enter now into details upon these subjects, as they will be treated of in a subsequent part of this article, but, supposing them known, to point out some of their practical applications.

It is of the utmost importance to observe the causes of prevailing epidemics,—as contagion,—season of the year,—state of the weather, &c.,—and of endemics, as marsh effluvia, peculiarity of situation,—prevailing occupations, &c. It is important to know what we may expect in our visits to the sick.

The influence of local situation in inducing typhus, intermittent fever, dysentery, phthisis pulmonalis, bronchocele, calculus, &c. is now well understood; the effects of sedentary occupations is to lead to the different forms of the dyspepsiæ. Typhus is frequently observed in new comers into crowded cities; (*Louis*, Recherches de Gastro-entérite, t. ii. p. 452. *Andral*, Clinique Médicale, ed. 2, t. iii. p. 448;) and intermittents, in the visitants or inhabitants of marshy districts. There seems to be good reason for supposing that where intermittents prevail, phthisis is less frequent in its occurrence. (Trans. for the Improvement of Med. and Surg. Knowledge; vol. iii. p. 471.) Calculus is less observed in sailors than in persons residing on shore. (Medico-Chirurgical Transactions.) It cannot be doubted that the careful observation of these external causes, and of their effects, must contribute materially to a knowledge of the diagnosis of diseases and of their various forms.

The next class of causes, which we shall briefly notice, are those of the habits and of the constitution of the patient. The habits of the patient relate chiefly to his occupation, and are sedentary or active, and to his mode of living with regard to diet, wine, &c. It has already been observed that sedentary persons are subject to the dyspepsia; those who eat and drink freely, are of course exposed to diseases of fulness, as apoplexy; whilst the spirit-drinker is exposed, on one hand, to attacks of the delirium tremens, or, on the other, to the slower inroads of organic disease of the liver, dropsies, purpura, &c.

The constitutional causes are chiefly those of the form, and of hereditary tendency or taint. The tendency to apoplexy, to phthisis, to gout, and even to calculus and gall-stones, is sufficient to illustrate the present subject. Nor can it be doubted that a careful inquiry into these points

* See Pearson on Cancer, Pref. p. vi. *Ουτε τεχνη ουτε σοφιη αφικτον, ει μη μαθη τις.* ΔΗΜΟΚΡΑΤ. ΦΙΛΟΣΟΦ.

must materially conduce both to the prognosis and to the diagnosis of these morbid affections.

In some diseases, however, both the character and prognosis are apt to be modified by complication, or by changes in the original affection. Typhus and other fevers are apt, from a simple form, to become complicated by some local organic affection. The dyspepsiæ are particularly apt to have their most prominent symptoms removed from one organ to another.

It is a point of great interest and importance to study the early history of insidious diseases, in order to prevent errors in the diagnosis and prognosis. It is of still higher importance to trace with accuracy the previous history of sudden and impending diseases, in order that we may, if possible, prevent them.

In other diseases, as inflammation, and especially organic diseases, the course is comparatively more regular and uniform.

The course of mesenteric disease is perhaps the slowest, and most regularly progressive, of all diseases eventually fatal; it usually occupies a space of from three to five years.

In many diseases it is necessary to watch the course or extension of the primary disease, as it involves different organs. It is a point perhaps of still greater interest, to trace the gradual superinduction of organic disease in cases originally consisting of derangement of function. True asthma may lead to disease of the heart. Protracted dyspepsia is, after excess in spirits, the most frequent cause of hepatic disease.

There is a point in the history of the diseases which still requires attention; viz. what has been termed the metastasis or conversion of diseases. This event has occurred in gout, rheumatism, erysipelas, cynanche parotidea, some cutaneous affections, suppressed hemorrhoids, (see the Edinburgh Journal, vol. xv. p. 106,) &c. But we think some of the events of the morbid affections which accompany the dyspepsiæ have been mistaken for metastases of diseases; and some of the effects of the treatment, as will be noticed immediately, are very apt to be mistaken for changes or consequences of the disease.

Various diseases are apt to succeed to each other from originating in one common cause; phthisis is apt to follow fistula ani; [such at least is the common opinion; yet M. Andral (*Clinique Médicale*, 4 ème édit. iv. 308,) met with it in but one of 800 cases; and M. Louis affirms (*Researches on Phthisis*; Sydenham Society, edit. p. 89, Lond. 1844,) that he had not been more successful,] syphilitic and syphiloid affections variously succeed to each other.

The study of the history of diseases, it has been already observed, is of essential service in dispensary practice, in which, from the considerable number of patients seen in a limited time, a prompt diagnosis is required. The following rules will be found extremely useful to the young physician on such occasions. It is only, however, as an approximation to the diagnosis, that such rules can be attempted. It will still be necessary to inquire into the particulars of the individual case.

The first question to be asked of the patient is, how long he has been ill. The reply resolves the case into the class of acute, or of chronic affections. The former are principally fevers, the acute dyspepsiæ, or acute inflammations; the latter are the chronic dyspepsiæ, the insidious organic diseases, or the insidious forms of inflammation, — especially of the brain, the pleura, and the peritoneum.

Having thus ascertained the class of the disease, we must proceed, in the case of the acute, to investigate the individual nature of the case. In chronic affections we may ask—

In the second place, whether there be a material and progressive loss of flesh.

The reply to this inquiry divides the cases into such as may subsist without influencing the nutrition, and such as gradually reduce the patient. The former cases are chiefly the chronic and protracted forms of dyspepsia, or diseases of such organs as are not engaged in the process of assimilation. The latter are merasmus, phthisis, mesenteric disease, chronic inflammation of the peritoneum, and, in general, diseases of the 'organs of supply.'

A third inquiry is into the state of the pulse. Increased frequency of the pulse is the usual attendant on the insidious forms of organic disease, whilst it is not observed in the less serious cases of the chronic dyspepsiæ.

Other questions are, what is the seat of pain or uneasiness?—what are the functions disordered?

It is needless to enter more minutely into the subject, as it would be only repeating the observations, to be detailed forthwith, on the general aspect of the patient, and the general character and course of the disease.

II. The Symptoms of Diseases.

The Morbid Appearances of the Countenance.—The particular circumstances embraced in an examination of the morbid states of the countenance, are the changes induced in the cuticular surface, the cutaneous circulation, the cellular substance, the muscular system, some particular features, and the general expression.

The cuticular surface is morbidly affected in some long-continued disorders, chiefly of the digestion, especially round the eye and the mouth, giving a peculiar appearance to the complexion. But the complexion, as well as the surface of the countenance, is principally affected by the condition of the cutaneous circulation; on this depend chiefly the state of pallor or flushing, and of the sallow and icterode hues of the complexion observed in some disorders, — the state of tumidity or shrinking,—of heat or coldness, — of dryness or moisture, or cutaneous exudation.

The state of emaciation, so important to observe and trace in chronic diseases, depends on the loss of cellular and muscular substance, and must be always distinguished from mere vascular shrinking.

The muscular system is principally affected by diseases attended with pain, languor, or paralysis.

Amongst the particular features, it is of moment to observe the eye, the prolabia,—the brow, the nostrils, the lips, &c. The eye, in particular, affords the opportunity of judging of the degree in which the serum is loaded with bile, in cases of icterus, and of distinguishing that disease from those morbid affections in which the complexion becomes sallow and icterode from the state of the cuticle and cutaneous circulation. The state of

the prolabia affords an index of other states of the blood,—as of a too serous condition, or of a defective arterialization. The nostrils, carefully observed, denote the condition of the respiration.

Of the general expression of the countenance we shall rarely venture to speak. It affords an important and essential source of information in dispensary practice, and assists the experienced physician in discerning the nature of the diseases where the superficial observer sees only the general look of indisposition.

The morbid condition of the cuticular surface and of the cutaneous circulation is accompanied with peculiar affections of the hands, and of the general surface, and of the tongue. These associations it will be our object to trace in the subsequent pages. We now proceed to describe the appearances of the countenance in reference to particular diseases; we have already stated, that it is with such reference alone that the knowledge of symptoms becomes of practical utility.

In the acute synochus there is a diffused, vivid flushing of the countenance, frequently with considerable turgidity, especially in the young and sanguineous; the tunica albuginea is apt to be suffused, and there is great febrile heat. There are also general anxiety, tremor of the lips in speaking, and a rapid movement of the nostrils from hurry in the respiration. The tumidity diminishes as the fever runs its course, and either declines or assumes the slow and protracted character.

In the acute inflammations, especially of the serous membranes, or parenchymatous substance, the countenance has a very different aspect, which it is important to observe, especially in a diagnostic point of view. The heat, turgidity, and flushing, the suffusion of the eyes, the tremor of the lips, and the hurried movement of the nostrils, are absent, whilst the surface is frequently affected with perspiration. There is also usually an appearance peculiar to the primary disease.

From the state of countenance described, the transition is often imperceptible to that observed in the protracted synochus; sometimes, on the contrary, the appearances of this febrile affection come on insensibly from similar causes, without being preceded by the acute form. Instead of tumidity and suffusion, there are shrinking, partial flushing of the cheeks only, emaciation, and frequently a pallid and sallow hue; the cheeks become fallen, and the malæ, maxillæ, and other bony parts, appear prominent; the surface becomes dry and rough; the lips, like the tongue, are dry and tremulous, and not moved with the usual freedom in articulation; the teeth are frequently somewhat affected with sordes or mucus.

In chronic inflammation the appearances are peculiar. There is a characteristic expression of disease which strikes the common observer, and still more the experienced physician; the surface and complexion are cool and pale, or affected with transient or partial heat and flushing, usually without sallowness, frequently with slight lividity, sometimes with cool moisture; there are emaciation and shrinking, the cheeks falling in, the action of the muscles becoming apparent, and the skin forming into greater or smaller folds. These appearances of the countenance are, however, greatly modified by the nature and seat of the original disease, as will be particularly noticed hereafter.

In the milder form of typhus the countenance is equally unattended by deep flushing and tumidity, or with shrinking; but it is highly characterized by an expression of languor, feebleness, anxiety, and indisposition, and by tremor observed in the lips and on speaking; the eyes are frequently suffused; the cheeks slightly flushed; the surface is affected with a moderate degree of warmth. (See Currie's Medical Reports, vol. i. p. 12. Bateman on Contagious Fever, p. 28, &c.)

In the severe forms of typhus the countenance is marked by great debility and tremulousness of the muscles, and by great shrinking; the bones are more prominent, the intervening spaces more sunk and depressed than natural; the surface is sometimes slightly flushed, and sometimes cool and clammy. The eye-lids are frequently partly closed, and the eyes suffused, dull, and covered with a film of mucus; the mouth is apt to be partly open, the teeth and lips affected with dark-coloured glutinous sordes; the articulation is difficult and imperfect, and attended with great effort, and with tremor and an inadequate action of the lips and of the tongue, which is put out with tremor and difficulty. There is often superadded the appearance of delirium, or of coma, of congestion, or of collapse or sinking.

The countenance in continued fevers is liable to receive a modification from their complication with a morbid affection of the head, the viscera of the thorax, or of the abdomen, the detection of which is amongst the most important objects in the study of these diseases.

The different stages of intermittent fever are attended by peculiar states of the countenance, and especially of the cutaneous circulation. In the cold stage there are shrinking and paleness, pale lividity of the prolabia, trembling of the lips and maxillæ: in the hot stage there are heat, flushing, and tumidity, and suffusion of the eyes, and the features are restored from their collapsed condition: in the sweating stage the surface, complexion, and heat become more natural, whilst there is greater or less perspiration. In the interval there are, at first, languor and slight paleness; after a time paleness, shrinking, and emaciation.

The different fevers are so varied in themselves, and so various in their different stages, and in different individuals, ages, and habits, that the countenance, together with the symptoms of the disease, must necessarily be much diversified. But of all the diagnostics of the different fevers, and of all the indications of their progress, stages, and changes, none is more distinctive and characteristic than the appearance of the countenance. From this source the diagnosis and prognosis of fevers equally flow; and it cannot, therefore, be too strongly recommended to the attention of the clinical student and young practitioner.

The same remark may be extended to some of the eruptive fevers, in which there is, exclusively of the rash, a characteristic modification of the features. In rubeola the eye-lids are frequently red and swollen, and the eyes injected, before the appearance of the rash, and there is usually catarrhal affection; the rash begins in spots on the

face; and there are sneezing, intolerance of light, &c. In scarlatina the rash becomes more general and less interrupted, and it is accompanied with more general tumidity and fulness; there is frequently an appearance of fulness about the throat, and the voice is affected; but the symptoms of catarrh are usually absent.

We now proceed to notice some morbid appearances, chiefly of the complexion, which appear to us not to have obtained hitherto the degree of attention which they deserve. The appearances to which we allude occur in the very varied forms of disorder of the digestion, or dyspepsia, of which we have treated in another work, (Commentaries on the Diseases of Females); the especial object of which was accurately to trace their distinctive characters, as seen in the countenance, the tongue, the hand, &c.

The most severe, or acute form of this affection is accompanied with some paleness and sallowness, and a dark hue about the eye; the cutaneous vessels exude a little oily perspiration; the prolabia are slightly pale and livid; the muscles of the face, and especially of the chin and lips, are affected with a degree of tremor, particularly on any hurry or surprise, or on speaking. With this state of the countenance there are conjoined peculiar morbid states of the tongue, and of the hands, which will be described in their proper place.

A state of sallowness of complexion, unaccompanied with the appearances just described, usually attends the more chronic form of this affection, denominated dyspepsia.

The next variety of this morbid affection is that which is usually denominated chlorosis, of which we have described three stages. The incipient stage is denoted by paleness of the complexion, an exanguious state of the prolabia, a slight appearance of tumidity of the countenance in general, and of puffiness of the eye-lids, especially the upper one. There is sometimes superadded a tinge of green, or yellow, or of lead colour, and frequently darkness of the eye-lids. In the confirmed stage the countenance is still more pallid, the prolabia and the gums are exanguinous; or the prolabia, and especially the upper one, have a slight lilac hue, and the integuments in general are puffy and tumid. In the inveterate stage these appearances are gradually modified by the supervention of emaciation, or œdema. With each of these stages is associated a peculiar state of the tongue and general surface. These appearances in the different stages of chlorosis seem to depend partly on the state of the cutaneous capillary vessels, and partly on the state of the blood itself; at least, this fluid has become, in some instances, so serous as scarcely to tinge the linen as it has dropped from the nose.

In the more chronic form of this morbid affection, to which the epithet *decolor* is very applicable, there is a state of sallowness, of yellowish or icterode hue, of darkness or of lead colour, of a squalid or sordid paleness of complexion, or a ring of darkness occupying the eye-lids, and extending a little perhaps towards the temples and cheeks, and sometimes encircling the mouth. There is in this form of the affection little or no tumidity, pallidness of the prolabia, or tendency to œdema; and the tunica albuginea of the eye is free from the tinge of icterus. This morbid state of the complexion appears, indeed, to depend principally on the condition of the cutaneous surface of the countenance. The tongue is apt to be affected chiefly in the form of its surface only, in a peculiar manner, to be described hereafter; and the general surface of the body is apt to be more or less affected in the same manner as that of the countenance.

From this icterode appearance of the complexion it is important to distinguish the different shades of icterus itself: in this disease the tunica albuginea are tinged proportionately to the general surface; and it is in this manner that these two morbid affections are discriminated. The term icterus is merely expressive of a symptom of disease, although it is daily named and has long been arranged as a distinct disease. The shade varies from yellow to green or blackish. But the most important and only practical distinction with regard to icterus is that of its causes, or of the primary disease; the principal of these are,—1. constipation, or loaded bowels; 2. acute disorder of the digestive functions; 3. diseases of the liver; 4. gall-stones; 5. hydatids in the gall-ducts; 6. organic tumours in the abdomen, situated near the biliary ducts; 7. the pregnant uterus; 8. diseases of the right kidney; 9. or even of the right lung, or cavity of the pleura.

Besides the morbid affections of the complexion already mentioned, there are others consisting in different shades of lividity, and depending principally on a languid circulation, on a defective arterialization, or on a venous fulness of the blood.

In some cases of acute dyspepsia, there is a remarkable tendency to a livid hue of the prolabia, nose, and cheeks, as well as of the hands, accompanied with coldness and apparently dependent on languor in the cutaneous circulation.

A similar state of lividity, but frequently much greater in degree, is observed in cases of tuberculous disease of the mesentery, attended with great tendency to coldness and great sensibility to external cold.

A degree of lividity in the prolabia is frequently, though not universally, observed in phthisis pulmonalis. This appearance seems to depend on the part and on the extent of the pulmonary structure involved in the tuberculous disease, and on a defective arterialization, as well as a languid cutaneous circulation of the blood.

Besides the diseases attended with lividity of the countenance already mentioned, this appearance occurs, for the most part together with tumidity, in cases in which the brain, the lungs, and the heart are severally oppressed, in apoplexy, in pneumonia, and in some diseases of the principal organ of the circulation. The appearances in these diseases will be noticed immediately.

In the attack of apoplexy there is usually at first general tumidity, flushing and lividity of the countenance; the pupils are contracted, then dilated, and often unequal; the features frequently lose their symmetry, those of one side of the face being unusually acute, whilst those of the other are relaxed; and the whole countenance is drawn, of the expression lost in coma. At a subsequent period the countenance becomes pale, fallen, cold,

and often variously distorted. Heberden observes, "apoplectici, qui prope absunt a morte, in spirando ambas buccas inflare solent;" and indeed the oppressed state of the respiration always adds a characteristic appearance to the countenance: the pupils are dilated, perhaps unequal, or irregular in form; the eye is dull and flaccid; the jaw frequently falls, the saliva flows, the lips are pale, and the mouth is foul. A similar state of the countenance to that last described sometimes exists from the beginning in cases of what has been termed the serous and nervous forms of apoplexy.

Paralysis is a usual concomitant or consequence of apoplexy. The effects of cerebral paralysis on the countenance are very various: the muscles of one side of the face fall into a state of relaxation, whilst those of the opposite side are unusually contracted from want of power in their antagonists; the forehead is often unequally affected by wrinkles, the eye-brow of one side falls down, the eye-lids do not open or close so readily as usual, or the eyes are not converged on the same object; one nostril, one angle of the mouth, and one cheek fall, whilst the others are usually drawn, especially on speaking; the tongue is frequently protruded awry, and with difficulty; the articulation is indistinct, and some particular letters, especially the labials, as *b* or *p*, cannot be pronounced. Deglutition is also sometimes affected, and there is a danger of choking; frequently mastication is impeded by the collection of the bolus of food into one side of the mouth; sometimes the saliva flows out of that angle of the mouth which is now become the lower one. There is frequently a difficulty in shaving, from the torpor of the skin, and the loss of power in the muscles which in health put it upon the stretch.

The countenance in epileptic coma has sometimes the deep suffusion observed in apoplexy, but it preserves its symmetry; the lip or tongue is liable to be bitten and wounded, and there is then frequently a bloody foam in the mouth, a point of great importance in the diagnosis.

The countenance in deep intoxication is at first bloated and suffused, then pallid and sunk; the muscular power is defective, the expression lost, the articulation indistinct, and the saliva flows from the mouth; the sensibility is impaired or lost; the breath tainted with the intoxicating liquor.

Hysteric stupor is distinguished by the absence of the suffusion, distortion, and loss of character, observed in apoplexy.

Syncope is characterized by pallor, coldness, cold perspiration, pale lividity, shrinking, and collapse of the integuments and features,—appearances which do not concur in the commencement of any other morbid affection.

In inflammation of the brain there is at first an expression of pain or uneasiness manifested usually by knitting of the eye-brows, with delirium or coma: afterwards the pupils, from being contracted, become dilated; there are strabismus, grinding of the teeth, spasms or distortions of the muscles of the face, &c. with profound coma, and without the appearances observed in idiopathic fever.

In pleuritis the degree of the pain is marked by a proportionate contraction of the features in general, and by acuteness and elevation of the alæ nasi; the nostrils are moved and dilated by the alternate acts of the respiration; there is sometimes a degree of vivid flushing, terminating abruptly and bounded by whiteness towards the nose; the heat is inconsiderable, and there is frequently perspiration.

In pneumonia there is less contraction of the features, but there is greater appearance of dyspnœa, very important to be observed in this disease, and the nostrils are widely dilated before each inspiration: there is little heat, but frequently a degree of perspiration.

In inflammation of the chest with clogged bronchi or air-cells, there is usually a general and deep suffusion of the countenance, sometimes amounting to great lividity, conjoined with turgidity; there is great anxiety and dyspnœa, the nostrils are widely dilated on inspiration, and drawn in above the lobes; during inspiration the pomum adami, and even the chin, are sometimes drawn downwards; the surface is cool and sometimes damp.

The dawn of phthisis pulmonalis is marked by a delicate and often waxy paleness, alternated with transient gentle flushing, slight lividity of the prolabia on exposure to cold, an appearance of indisposition, frequently motion of the nostrils from the respiration, and frequently a quivering of the chin and lips on speaking. Its progress is denoted chiefly by gradual emaciation, in addition to an aggravated state of the other morbid appearances just mentioned.

In hæmoptysis there is usually a florid state of the complexion, and frequently the effects of dyspnœa are observed in an acuteness and movement of the nostrils. If the hemorrhage has been very great, there may be paleness, lividity, coldness, and a clammy perspiration, with great anxiety.

In hæmatemesis, on the contrary, the complexion is generally pale and sallow, and frequently affected as already described; there is less anxiety and an absence of the movements of the nostrils.

In organic diseases of the heart the expression and complexion are frequently much affected.* In those cases in which the pulmonary circulation is not impeded, the complexion simply becomes unusually vivid and florid. But when the nature of the disease affords an obstacle to the freedom of the pulmonary circulation, this vivid colour passes into a livid or violet colour, especially in the prolabia, cheeks, and nose; and there is superadded more or less of turgidity, and frequently of coldness. There is great anxiety on mental emotion and bodily exertion, with an increase of the appearances just enumerated, and the head, the ends of the patient's cravat, &c. are frequently moved by the violence of the beating of the heart. During the progress of the disease, these appearances become aggravated, the complexion is still more livid, the turgidity of the countenance passes into œdema, the eyes at length start, and the head

* M. Corvisart observes, "la figure, la physionomie, le *facies propria* enfin, sont, pour le practicien exercé, le guide le plus sûr, à mon avis, pour arriver au diagnostique d'un assez grand nombre de maladies tant aiguës que chroniques; mais c'est surtout dans les cas de maladies du cœur qu'il importe de considerer attentivement ce signe, qui, je le repète, peut seul, dans bien des cas, les faire reconnaître."—Essai sur les Maladies du Cœur, ed. 2d, p. 371.

is often moved about, denoting great distress and inquietude.

In the paroxysm of true asthma there is the most urgent anxiety of expression, and a great and rapid movement of the nostrils, usually without lividity; the breath is generally tainted, the tongue much affected, and there are frequent eructations.

In inflammation of the abdomen with severe pain there is a continued state of contraction of the muscles of the face, inducing an unnatural acuteness of the features; the forehead is wrinkled and the brows are knit; the nostrils are acute, drawn upwards, and moved by the alternate and irregular acts of the respiration; the wrinkles which pass from the nostrils obliquely downwards are deeply marked; the upper lip is drawn upwards, (see Laennec, ed. 1st, tom. i. pp. 90, 398,) and the under one, perhaps, downwards, exposing the teeth; the chin is often marked with dimples. This state of the features is aggravated on any increase of pain, from change of position, muscular effort, or external pressure. Indeed, in cases of abdominal affection, it is better to press on the abdomen, or to beg the patient to raise the head and shoulders, and watch the effect on the expression of the countenance whilst the patient's mind is occupied with some other subject, than to ask the direct question whether pressure induces pain, as is usually done; for patients naturally suppose that every painful part must also be tender, and are therefore apt to answer in the affirmative, although incorrectly. In cases attended with spasmodic abdominal pain the contractions of the muscles of the countenance are more violent but less permanent; during the paroxysms, the distortions of the countenance take place in a degree scarcely observed; in the interval, the countenance recovers a calm, unusual, if not incompatible, with inflammation. The transition of spasmodic into inflammatory pain may often be traced with great distinctness, by carefully observing these changes and modifications in the expression of the countenance.

The degree, increase, or diminution of the disease may also be observed and ascertained by the concomitant increase or diminution of the acuteness and contraction of the features.

The transition of inflammation into the state of sinking, or the supervention of gangrene, is denoted by a fallen state of the features, the muscles becoming relaxed, the surface cold, with cold perspiration, shrinking, and pale lividity, the cheeks sunk, the malæ prominent, the nostrils, &c. affected by a laboured respiration.

The appearance of the countenance affords a valuable source of distinction between the chronic dyspepsiæ and insidious organic disease. In the former, the appearances are as have been already described; in the latter, there is a characteristic, early, and progressive loss of flesh, with paleness, perhaps slight flushing, but without sallowness, the bony and muscular parts become exposed, the integuments are drawn into deep wrinkles, and there is often coldness and perhaps lividity. Such a state of the countenance, with an expression of pain, uneasiness, or anxiety, often leads to the detection of slow and insidious pleuritis or peritonitis, as well as of other diseases which would long remain hidden, from being unattended with acute pain.

Scirrhus and cancer are apt to induce sallowness [straw colour] and emaciation — a circumstance by which they are sometimes distinguishable from other tumours or ulcers.

Polysarcia is distinguished from anasarca in the face, by observing that in the former the tumour is deposited with a certain regularity, so that in general the symmetry of the countenance is not destroyed, nor the features much disfigured. In anasarca, on the contrary, an inelastic tumour is dispersed unequally over the face, the features are obscured, the symmetry of the countenance is destroyed, the expression lost, and the person is scarcely recognised: the posture of the patient during sleep influences the distribution of the swelling, and often occasions one side of the face to be more affected than the other; but the eyelids, the lips, and the cheeks, and in general the parts of loosest cellular texture, are most distended.

In general it may be observed that the brow is contracted by pain within the head, the nostrils are drawn acutely upwards by pain of the chest, and the upper lip is raised and stretched over the gums or teeth in painful affections of the abdomen.

Alternate dilations and contractions of the nostrils arise from any effort in respiration, and are observed in great debility, in the synochus and typhous fever, in acute inflammations of the chest or abdomen, in organic diseases within the thorax, &c.

Extreme pallor of the prolabia is observed in excessive hemorrhage, purpura, chlorosis, &c.; deep lividity denotes a defective arterialization of the blood, and occurs in disease of the heart, &c.; pale lividity occurs in cases in which the circulation at the surface is languid and imperfect.

One of the most important points embraced in the symptoms of diseases, and one particularly observed in the countenance, is the circumstance of emaciation. It may be said to be the surest index to the detection of those diseases which are characterized at once by their insidious character and serious and dangerous tendency.

It may be observed, in conclusion, that to notice every morbid appearance of the countenance would be almost impossible, and even useless. The object of such an attempt as the present is rather to lead to observation; the remarks which have been made are sufficient, we trust, to point out the importance of the inquiry. Many of the morbid appearances of the countenance, like the morbid states of the pulse, respiration, &c., are, after all, to be observed and felt, and scarcely admit of description. Our object has therefore been to select a few instances of morbid affections particularly distinguished by the state of the countenance, in order to invite the attention of the medical student more particularly to a source of judgment and information applicable also to those fainter shades of diversity and change, the perception of which so much distinguishes the physician of observation from the mere practitioner. Sufficient has been done, however, to prove that the countenance, in its various morbid conditions, affords characteristics of many diseases, and denotes, in a remarkable degree, the state, course,

increase, or decline of nearly all. The prognosis is greatly prompted by the condition of the countenance, as may still be learnt from the writings of Hippocrates and Celsus.

2. On the Morbid Conditions of the Attitude.—We employ the term attitude in rather a comprehensive sense, intending to embrace, under this head, the consideration of the postures and motions of the body, the state of muscular debility, power, contraction, and motion, some particular actions, and the general manner of the patient.

In general, the supine position, and tremulous motions of the body, denote muscular debility,* and distinguish, in an early stage, the acute forms of idiopathic from symptomatic fever.

Augmented power and action of the muscular system, with quick and forcible changes of position, denote a state of delirium, of spasmodic pain, of internal suffering, or of inquietude.

Certain positions adopted and retained with caution, and restrained movements of the body, are the usual effects of inflammatory pain: other fixed positions depend on the state of the respiration, and of the circulation through the heart.

Certain movements of the head, certain actions of the hand, and certain peculiarities of the general manner, also occur as characteristic of particular diseases, and will be noticed hereafter.

The morbid states of the attitude will appear more distinctly marked, by being contrasted with the more usual and natural positions of the body.

In healthy and undisturbed sleep, the usual posture is that on one side, the body being frequently inclined rather to the prone than to the supine position; the head and shoulders are generally somewhat raised, and, together with the thorax, bent gently forwards; the thighs and legs are in a state of easy flexion. The position is apt to be changed from time to time, the person lying on one or other side alternately.

In acute synochus, one of the earliest and most characteristic symptoms is a deep sense of debility, with tremour, and an incapability of supporting the erect position; this posture, if assumed, induces also the feelings of vertigo and faintness.

In acute inflammation there is comparatively little or no tremour or muscular debility, or tendency to vertigo or faintness; the patient is capable of moving, and even of walking, even in a late stage of the disease.

In protracted synochus there is, in some cases, for a considerable time, a supine position, with scarcely the ability to change or support the position on the side; there is tremour, consisting of less rapid but more considerable movements than those observed in the acute form; the knees are apt to be raised.

In the milder form of typhous fever the patient sometimes gets up or continues out of bed, but appears feeble and trembling, and as if incapable of such a degree of exertion, whilst he draws near the fire from susceptibility to cold. In cases in which, however, the patient cannot get out of bed, he experiences vertigo, and perhaps faintness, on being requested to sit up in bed for a minute or two.

In the severe forms of typhous fever the position of the patient becomes gradually more and more supine, and the actions more and more tremulous: from being able to retain the posture on the side, perhaps, the patient falls upon his back, with the lower extremities extended, and sometimes with a tendency to sink towards the bottom of the bed; the hands and arms are moved with effort and tremour, and at length there is constant subsultus tendinum. To this state, picking of the bed-clothes, or flocci volitantes, delirium, or coma, is superadded.

Hippocrates (Προγνωστικον,) and Celsus (Lib. ii. cap. 3, 4, 6,) have accurately described the posture of fever. Celsus observes, "ubi vero febris aliquem occupavit, scire licet non periclitari si in latus aut dextrum aut sinistrum, ut ipsi visum est, cubat, cruribus paulum reductis, qui fere sani quoque jacentis habitus est; si felice convertitur, &c. Contra gravis morbi periculum est, ubi supinus æger jacet, porrectis manibus et cruribus," "ubi deorsum ad pedes subinde delabitur; ubi brachia et crura nudat et inæqualiter dispergit." As this position is occasioned by extreme debility, any change of posture is of favourable omen, as denoting a return of strength. The patient perhaps raises the knees, or puts the arms out of bed, or places them above his head. These movements are amongst the first symptoms of recovery. At length the patient is capable of supporting the position on the side—a certain mark of returning muscular strength, and an indication of favourable change in the disease.†

Tremour is amongst the first and most characteristic symptoms of continued fevers; but it occurs also in some other morbid affections, united with less muscular debility. It forms so remarkable a symptom in the delirium tremens, as to have been adopted as part of its designation. In one instance the tremour had preceded the delirium several days, and we were enabled to predict the occurrence of delirium: in another case, the effect of drinking, the affection consisted of great tremour, and, being cut short, delirium never occurred. It is scarcely necessary to advert to the more constant state of tremour observed in hard drinkers.

Tremour on holding out the hand, in writing, in carrying a cup to the mouth, in walking, and in articulation, is a usual symptom of acute dyspepsia; it is generally conjoined with an appearance of nervousness and of susceptibility to hurry and agitation.

Tremour is far less and later observed in cases of local inflammation or organic disease; it does, however, occur in phthisis pulmonalis, and in cases in which the general strength suffers.

* We restrict, in this place, the application of the term debility by the epithet muscular, because it is now well known that this species of weakness is frequently the effect of oppression and the associate of increased vascular action: just as a throbbing pulse may accompany the state of exhaustion.

† There are two points in the treatment of typhous fever, connected with the attitude, of the utmost importance:—sometimes the supine position is retained so long, that ulceration takes place on the compressed parts, especially about the sacrum or pelvis. Dr. Arnott's very ingenious proposal of the hydrostatic bed seems admirably adapted to obviate this calamity. The second point is cautiously to guard against the effects of muscular exertion during the period of convalescence. By far the greater number of relapses are occasioned by early and undue exertion and fatigue: the effect is speedy, or gradual, sinking of the powers; the inference is obvious, and of the utmost consequence.

The form of tremour which we have described seems to depend on muscular debility, and perhaps on a morbid condition of the brain and nervous system. There is a kind of tremour of a more spasmodic character, which occurs from various causes, and which we shall notice towards the conclusion of the present section.

The effect of particular postures is of importance to be noticed as distinctive of affections of the head. In the idiopathic affections, as in the state of threatening of apoplexy, vertigo and other morbid feelings are apt to be experienced on stooping: in the symptomatic affections, as in fever, acute dyspepsia, intestinal irritation, exhaustion, &c. vertigo is usually experienced on assuming the erect position.

An attention to the posture of the patient is also of importance in the treatment: the recumbent position is as injurious in the case of apoplexy, as it is beneficial in that of syncope.

It is scarcely necessary to point out the effect of hemiplegia, paraplegia, or partial paralysis, on the attitude. In hemiplegia the patient is apt to lie or fall more or less upon the paralysed side, and especially upon the paralytic arm. In paraplegia the posture in sitting is manifestly marked by the defective muscular power, the patient being constantly apt to slide off the chair or sofa. In the partial paralysis it is found that the hand cannot be moved so freely or clasped so firmly, or the foot and toes are lifted imperfectly from the ground in walking.

The attitude is peculiar in the different forms of inflammation of the chest. In pleuritis the patient usually reposes on the affected side, which is thus kept free from movement. In pneumonia the patient almost invariably assumes and retains the posture on the back. In those cases which are attended with much dyspnœa, the patient is frequently obliged to have the head and shoulders raised, and even to assume the erect position. We have observed, in some cases attended with great dyspnœa, that the patient has lain on the side, with the arm of the other side placed upright before the chest, the hand pressing forcibly on the bed: in this manner the shoulder became fixed, and afforded a firm attachment from which the pectoral muscles acted to expand the chest.

In phthisis pulmonalis the posture is various. Frequently, however, one particular position is chosen and preserved — pain, cough, dyspnœa, or oppression, being induced in any other: this is usually on the side most diseased, as that in which pleuritic pain is most apt to exist, early in the disease, or cavities, in its later stages.

In extreme hydrothorax, the position of the patient is frequently highly characteristic; it is less so probably, according as the effusion has taken place more gradually and slowly. In the less severe form, the patient, when in bed, usually lies with the head, shoulders, and chest gently raised by additional pillows; when out of bed, he is often observed to sit up, with the arms placed along the side, and the hands fixed and pressing forcibly on the chair, or sofa, on which he sits: in other cases he leans a little backwards, still supported by the arms and hands, which are placed behind the back. This kind of posture is often constant, or immediately resumed if any accident occasions it to be changed: it gives rise to an elevation of the shoulders, from which the body is supported, or as it were suspended. In the severer forms, the attitude varies with the degree and progress of the disease: at first, the patient lies with the head and shoulders greatly raised; afterwards the posture becomes more and more erect; at a still more advanced period, and in a more aggravated form of the disease, the patient is sometimes incapable of remaining in bed, and is obliged to sit up, with the legs hanging down; sometimes an arm-chair is obtained, on each arm of which the patient presses and supports the hands or elbows, thus suspending the shoulders; sometimes a second chair is required, on the back of which the patient reposes the forehead, or both hands and forehead, pressing with considerable force, thus fixing the upper attachments of the sterno-mastoid muscles. This aggravated state of the attitude is certainly most frequently observed in cases of hydrothorax complicated with organic disease of the heart or lungs, or of the liver or other organ situated in the abdomen. In some cases of hydrothorax in its simpler forms, the patient has retained a nearly horizontal position; in cases of complicated hydrothorax, he has even expired out of bed, supported by his friends.

In organic diseases of the heart, the attitude—at first the effects of bodily exertion, and afterwards the particular posture of the patient—is very characteristic. In incipient and dubious cases, the diagnosis is assisted by observing the effects of muscular effort, especially such as involves much change of position and general motion of the body: if the patient be requested to run up stairs, the symptoms are invariably produced in cases in which they would be quiescent in a state of repose, or aggravated if permanent. In a more advanced stage of the disease, the sufferings of the patient become more acute and permanent; a certain restlessness, anxiety, and dyspnœa, aggravated extremely by every muscular effort or motion, take place, and distinguish the case from simple hydrothorax, in which muscular motion induces far less inconvenience. In a still more aggravated form of the disease, the patient requires to be raised in bed more and more, until the erect posture, or even a posture inclined upon the thighs, becomes necessary; and at length there is an inability to sit erect even, while the lower extremities are placed horizontally, and the patient is obliged, perhaps, to sit on the side of the bed, with the legs hanging down and the feet on the floor; the night, as well as day, is sometimes spent sitting up in a chair near the fire, sometimes with the head supported on the back of a chair, and the body leaning considerably forwards; in this stage of the complaint there are an inexpressible restlessness and anxiety. At any period of disease of the heart, a sudden change of posture from the horizontal to the erect frequently becomes necessary, from the aggravation of the symptoms and general agitation induced by a turbulent or terrific dream; frequently, too, the patient is obliged to get out of bed and repair to the window to respire the open air.*

* It need scarcely be observed how important an attention to the attitude becomes in the treatment of diseases of the heart. In the incipient stage, the patient ought

In the paroxysm of asthma, by which term we designate the cases of sudden attack of dyspnœa arising, at first, from a disordered state of the digestive organs, the erect position is usually necessary; and there are great anxiety and urgency of suffering, frequently with active restlessness.

In inflammation in the abdomen with acute pain, a certain position of the body is chosen and retained, and all muscular exertion, motion, or change of position, is carefully avoided:—the patient lies on the back with the thighs raised, or he is supported in a somewhat elevated posture by means of pillows placed under the head and shoulders, or he lies on the side, with the thorax and the thighs in a state of gentle flexion on the abdomen; if he be desired to raise the head by muscular effort, an expression of aggravated pain is immediately visible in the countenance: the hands, and perhaps the bed-clothes, are carefully removed from pressing on the abdomen; the arms are put out, and the knees raised or depressed with great caution; the manner is soft, and the voice low and plaintive, with moaning, and a suppressed kind of complaining.

In spasmodic pain of the stomach, or in colic, the reverse of this state of general attitude is observed: the patient usually writhes to and fro, and constantly changes his position or mode of lying, instead of observing the cautious stillness of inflammation; he often lies on the abdomen, or in the supine position, pressing violently on the bowels, or even grasping a portion of the abdominal parietes with the hands; or he sits in bed, bending forcibly forwards on the thighs; he cries out during the paroxysm of pain, and speaks in a loud and irritated tone of voice. All this violence, both in general manner and posture, forms a remarkable contrast with the subdued motions of inflammation.

After the paroxysm of pain in colic, the patient resumes an easy position; in the absence of an aggravation of pain in inflammation, the same cautious posture and manner are still observed as before. The transition from spasm or colic into inflammation may be easily traced by cautiously observing the characters of these different affections.

The termination of inflammation in gangrene, or sinking, is marked by the fallen and supine position, and extreme debility; the patient lies extended on the back without the flexion and precaution previously observed in the stage of inflammation; the manner of the patient still remains soft and plaintive.

In strangulated hernia the posture is at first, perhaps, attended with writhing, but soon becomes the same as in inflammation, especially with the precaution of bending the thighs on the abdomen.

In inflammation of the kidneys, the patient, when up, often inclines somewhat to the side affected, and a little forward, especially in walking: and, in a painful state of the affection, he walks with unusual precaution.

In inflammation of the bladder, the patient frequently bends forward on the pelvis, evidently with the view of giving protection and relief to the parts contained in it, and of using as little as possible those muscles whose action might give pain; he walks cautiously, and often bends forward still more during this action of the muscles.

Retention of urine, as a symptom in acute diseases, is often denoted by a state of constant elevation of the knees, which is inexplicable until the cause is discovered.

In organic diseases in general, the patient soon becomes affected with a serious, continued, and unvaried debility, stoops in walking, and moves with slowness and caution. All deep-seated pain or uneasiness is often experienced from the succussion induced by sitting down or making a false step in walking, especially when there is a state of tenderness from inflammation.

In the appearance of the *hand* it is often easy to read a state of pain, anxiety, or other suffering: it is closed or expanded, or variously moved. We do not, however, deem it necessary to enter into any detail respecting points so perfectly obvious.

There is another symptom of importance to be noticed, viz. the state of jactitation and inquietude; it occurs in different states of the system, and in some diseases, but principally in cases of irritation, exhaustion, and sinking, and in diseases of the heart.* We reserve the consideration of these subjects for a subsequent part of this article.

Besides the morbid states of the general attitude already described, there are some other more partial affections, chiefly of muscular action, which deserve to be noticed; these are principally spasmodic tremour, paralysis, and contraction. And there are some more general affections of a similar kind constituting convulsion and rigidity. It may be sufficient to enumerate the principal cases of these morbid affections, observing that the subject still presents ample scope for resumed inquiry.

Spasmodic tremour occurs in a remarkable degree in the shaking palsy, (see Mr. Parkinson's interesting pamphlet on this subject,) in chorea, as an effect of the poison of mercury, (Bateman's Reports of the Diseases in London, p. 192,) of drinking spirits, &c.

Paralysis, the usual consequence of disease of the brain, the spinal marrow, or the nerves, is observed as an effect of the poison of lead, of exposure to cold, &c.

Contraction, of the hand for instance, is a rather remote effect of paralysis, epilepsy, chorea, hysteria, of the various morbid affections termed fits, &c., and is usually observed on one side of the body only. A singular state of contraction of the hand occurs in children, and is described by Dr. Kellie. (Edinburgh Medical and Surgical Journal, vol. xii. p. 448.)

General convulsion occurs in cases of diseases of the brain, especially of the parts about its base, epilepsy, puerperal convulsion, hysteria, hooping cough, &c. The effect of convulsive action on the circulation within the head has not hitherto been sufficiently attended to by physicians. Hysteric convulsion assumes, from long and frequent

to vegetate, as it were, and carefully avoid every kind of exertion, as well as of emotion: in this manner, life and a comfortable state of existence may frequently be long insured. In the latter stages, every attention should be paid to enable the patient to support with ease the position which affords the greatest relief.

* In all cases of this kind, as well as in the erethismus mercurialis, death sometimes occurs from suddenly assuming the erect position, or from other muscular effort or exertion.

repetition, an epileptic character; epileptic convulsion often induces an apoplectic coma; and pertussis, from the violence of coughing, frequently leads to fits, and even to hydrencephalus, &c.

General rigidity occurs in tetanus, and in some cases of epilepsy and hysteria.

3. **On the Morbid Appearances of the Tongue, &c.**—The circumstances to be noticed in an examination of the morbid conditions of the tongue, and in immediate connection with them, are, its surface, form, papillæ, colour; its mode of being protruded; the teeth, gums, and internal parts of the cheeks; the taste; the breath, &c. The surface is apt to be affected with whiteness, load, fur, dryness, blackness, chaps, &c. The form of the tongue is frequently modified by its becoming swollen, indented, fissured, and lobulated. The papillæ are, in some cases, morbidly prominent and enlarged, and in others almost obliterated, leaving a smooth and perhaps tender surface. The tongue is protruded with difficulty, from dryness, tremour, or paralysis, and is left protruded in cases of imperfect sensibility.

The internal mouth, the breath, and the taste are apt to be affected, conjointly with the tongue, especially when the latter is swollen and indented.

In the acute synochus, the tongue is usually extremely white and loaded, with much thirst, an impaired taste, and sometimes a tainted breath, but usually without dryness.

In acute inflammation, the tongue is not necessarily much affected; in some cases it has preserved nearly its natural state; it is, however, frequently whitish or furred; it is frequently moist, and free from indentation, unless it be modified by the conjunction of a disordered state of the alimentary canal.

In the protracted synochus, the tongue is at first white and perhaps loaded; afterwards it is apt to become clean, red, and dry, and sometimes unnaturally smooth, and perhaps tender; the teeth become a little affected with mucous sordes.

In chronic inflammation, the tongue, mouth, taste, and breath are frequently unaffected; in the later stages, there are frequently aphthæ and soreness of the tongue, internal mouth, and fauces.

In the milder form of typhus fever, the tongue is white and rather loaded, with a tendency to dryness: it is generally protruded with tremour.

In the severer forms of typhus fever, the tongue becomes dry, parched, and tender, and dark brown or black; it is often protruded with great difficulty, from its state of dryness and of tremour; the internal mouth is also dry and foul; the teeth are affected with brown mucous sordes; the breath has a peculiar odour. The state of dryness is increased during sleep, the mouth being then usually open. It is important to remark whether, with a given state of the tongue, the tendency is to an augmentation or diminution of its morbid character.

In intermittent fevers, the condition of the tongue varies greatly in the different stages and in the interval. In the cold stage it becomes dryish and clammy; in the hot stage the tendency to dryness is still greater; in the sweating stage and in the interval the tongue approaches more to its natural state, remaining only whitish and rather loaded.

It may be justly remarked that the tongue affords one of the best diagnostics of the different kinds and degrees of idiopathic fevers, of idiopathic from symptomatic fevers, and of their complications; and its changes and tendencies denote, in a particular manner, those of the fever itself.

Scarlatina is frequently distinguished from rubeola by numerous, elongated, florid papillæ, which protrude through the white load.

In variola, pustules sometimes appear on the tongue and in the internal mouth. The occurrence of salivation and of tumefaction of the countenance, followed by swelling of the hands and feet, is familiar to all.

The most ordinary effect of an occasional or accidental derangement in the stomach and bowels is a loaded state of the tongue, the superior surface of this organ becoming covered with a layer of whitish, soft, mucous substance, admitted of being partially removed by the tongue-scraper; the whole internal mouth is at the same time more or less disagreeable and clammy, the taste depraved, and the breath offensive; and frequently the substance of the tongue is a little swollen, œdematous, and marked by its pressure against the contiguous teeth.

In the acute dyspepsia noticed above, the state of the tongue already described is observed, with some modifications: the tongue is in general loaded, the mouth clammy, the taste bitter or nauseous, the breath fetid, whilst the surface of the face is frequently oily. In some severe cases the load has been very thick, and has eventually pealed off, leaving the tongue red, smooth, and tender: the substance of the tongue is generally swollen, œdematous, and impressed by the contiguous teeth; the gums are often red, tumid, and somewhat separated from the teeth by tartar, and are easily made to bleed; the inside of the cheeks, also, frequently partakes of the œdema, and receives, like the tongue, impressions from the adjacent teeth; sometimes the cheeks and the gums of the posterior part of the mouth have been so swollen as to protrude a little over the teeth, and are either ulcerated by the pressure or wounded by being bitten—circumstances which are apt to be induced or aggravated by cold. Through the load on the tongue the red papillæ are frequently seen, either over its whole surface or at its point principally; frequently the tongue is not only indented, but formed into creases or folds; sometimes deeper and more numerous sulci are formed, the edges of which are sharp and the sides in contact, requiring to be separated by the two fingers, or by protruding the tongue farther; in some cases the tongue is less loaded and indented, and its edges are red and even.

In cases of the acute dyspepsia, we have seen the tongue affected with deep foul ulcers, resulting from the slow suppuration of hardnesses about the size of a horse-bean or nut, situated just under the surface of the tongue, which is loaded, swollen, and foul, with a copious flow of saliva, and a fetid breath.

In chronic dyspepsia the tongue is sometimes affected, in a slighter degree, in the manner just described, being somewhat tumid, indented, and sulcated; it is in general, however, less pasty and œdematous; it is frequently covered with a sort

of viscid mucus; sometimes it is slightly white, from numerous, minute, white points crowded over its surface; it is also frequently affected with fur, consisting of short fibres resembling those of coarse velvet, and admitting of being separated by the finger. In this affection the tongue is frequently rather dry; and I have seen it, in several instances, sulcated longitudinally.

In very protracted cases, the tongue assumes several remarkable modifications of form and surface. In the first case there is a universal enlargement of the papillæ over its surface, which is now generally clean; in two instances the papillæ at the most posterior part of the tongue became particularly enlarged, causing pain on swallowing, and some alarm to the patients; in the second modification the surface of the tongue is formed into lobules, sometimes deeply intersected and resembling in form those of the base of the cerebellum, at other times of less regular form, and, lastly, assuming the form of squares; in the third variety the tongue acquires an absolute and morbid smoothness of surface, which appears as if glazed, and is tense and unyielding. In all these cases the tongue is morbidly clean—the mouth, taste, and breath being nearly natural—and its colour, although perhaps rather paler, frequently little changed; the complexion is usually rather pale and sallow, but the surface of the face is free from oiliness, and the integuments from tumidity.

The condition of the tongue in chlorosis is very characteristic: in the beginning, the tongue becomes rather pallid and tumid, and has frequently enlarged papillæ over its surface; it is somewhat loaded, indented, and sulcated; the gums and prolabia are pallid, and the breath is somewhat tainted. At a more advanced period, the tongue becomes cleaner, smoother, still more exanguious, and acquiring a peculiar semitransparency, and a very pale lilac hue; it remains a little swollen and indented, but the papillæ disappear and give place to a morbid smoothness; the complexion, prolabia, gums, and tongue are alike exanguious, and perhaps a little tumid; the breath is still less tainted, and even acquires an odour of new milk; and the mouth becomes less clammy and disagreeable.

It has already been observed that a particular state of the tongue accompanies a particular condition of the complexion and general surface, and that, by observing the latter, the state of the former may frequently be anticipated; the loaded and swollen tongue is usually associated with an oily and swarthy state of the surface and complexion; the pale, tumid, and clean tongue, in chlorosis, is accompanied by a tendency to tumidity of the integuments in general and œdema of the ankle; and the clean, papulated, lobulated, fissured, or morbidly smooth tongue is united with a nearly natural state of the general surface. The morbid secretions of the mucous membrane of the tongue and internal mouth are thus connected with a morbid secretion of the skin; the exanguious and tumid state of the tongue, with a similar condition of the integuments, both apparently originating in the same state of the capillary circulation; the nearly clear tongue accompanies the icterode complexion without tumidity or extreme pallor; and the morbidly clean tongue is attended with little change of the complexion and general surface.

The appearance of the tongue in these cases denotes, in a particular manner, their duration:—the mere load is often soon induced and soon removed; a swollen tongue has required a longer time for its formation, and demands a longer use of remedies; the states of tongue in chlorosis are of still slower formation and removal; and those described in protracted cases of chronic dyspepsia are often the effect of years of disorder, and are probably never totally remedied. By an accurate knowledge of the different morbid states of the tongue and of their concomitant morbid affections, the physician is frequently enabled to speak to his patients in a manner which excites their surprise, by indicating his distinct and accurate information respecting their diseases, especially in respect to the history and symptoms.

In true asthma the tongue has, at first, the appearances observed in the acute dyspepsia.

In long-continued cases, both of disorders and of diseases, it is not unusual for aphthæ to occur, and they are occasionally seen in acute affections. The tongue, inside of the cheeks, posterior part of the mouth, and the fauces, are covered with white, minute, tender vesicles, which are apt to be recurrent, soon assume the form of white exfoliations, and leave the subjacent parts smooth, red, sore, and tender. Sometimes the œsophagus, stomach, and alimentary canal appear affected, and obstinate sickness and diarrhœa occur, with a sense of burning. The affections in which aphthæ are most apt to occur, are protracted cases of the more serious forms of dyspepsia, phthisis, mesenteric disease, and chronic pleuritis or peritonitis.

As an effect of cold, and especially in conjunction with disorder of the digestive organs, there is frequently an eruption of one, two, four, or more aphthæ, or small circular ulcers, of from one to three or four lines in diameter, on the inside of the lip or cheek, on the point or near the root of the tongue, &c.; there is great tenderness, and a minute slough, surrounded by an inflammatory border; the state of tenderness continues several days, and the whole course of this affection, like the one about to be mentioned, occupies from six to ten days.

With or without the last-noticed affection, and from similar causes, there is frequently an eruption of herpes, or of a cluster of small vesicles, occupying some part of the prolabium or the angle of the mouth. It generally denotes that the patient has taken cold.

There is a chronic affection of the prolabium and immediately adjoining skin, which we have not seen described:—it consists of a repeated dry splitting, and exfoliation of the cutis of these parts, and occupies a ring, of about one-fourth of an inch across, all round the mouth; it varies in severity at different times and in different cases; it is long-continued, and appears to result from a protracted state of disorder of digestion; it occurs chiefly in early youth.

Fur, with a tendency to dryness of the tongue, usually denotes great local irritation,—such as violent inflammation,—from an accident,—of a joint, &c. This appearance is also common in cases of intestinal irritation. It occurs in some

forms of the dyspepsia, especially the chronic and cachectic. The state of fur of the tongue appears to arise from very different causes from that of load; its indications are therefore very different too; it is also in general more difficult of removal.

In disease of the heart, with great lividity of the prolabium and countenance, the tongue and internal mouth frequently participate in the general discoloration.

There are sometimes great peculiarities in the odour of the breath. We have mentioned the fetid odour observed in acute dyspepsia; and in some very protracted cases of chlorosis, we have observed an odour of the breath resembling that of new milk; in some morbid affections of the lungs, the breath has an extremely offensive taint; and there is occasionally in some diseases, and we may particularize dysentery, a cadaverous odour, affording a most unfavourable prognosis.

An attention to the odour of the breath is of great use in detecting the case of intoxication, and even of some cases of poisoning.

The mode of protruding and of withdrawing the tongue is often worthy of notice. We have already named the tremour of idiopathic as distinguished from symptomatic fever. In cases of stupor from fever, or from disease of the brain, the tongue is sometimes protruded imperfectly, and not immediately; and sometimes it is left out until the patient is told in a loud voice to draw it again within the mouth.

In cases of paralysis the tongue is often protruded to one side, and frequently the saliva flows from the angle of the mouth.

The tongue is frequently severely bitten during the fit of epilepsy.

4. **On the Morbid conditions of the General Surface.**—The objects comprised under this head are the temperature, the state of dryness or moisture, of tumidity or shrinking, or of roughness or smoothness of the skin, the colour, the occurrence of emaciation, or of œdema or anasarca, and the condition of the hands and feet.

The temperature of the general surface and of the hands and feet is greatly modified by febrile, functional, and organic affections, and has been found, in some affections of the heart, to form a striking contrast with that of the internal mouth or of the rectum. (Farre's Essay on Malformations of the Heart, p. 32, et seq.)

The state of heat, tumidity, dryness, and roughness seems to characterize the idiopathic fevers and to distinguish them from the symptomatic, in which an opposite state of the surface is more usual.

The colour is modified by the condition of the cutaneous circulation, of the blood itself, and of the cuticular surface.

It is of the utmost moment to remark the occurrence of emaciation or of œdema, as important sources of the diagnosis of functional and organic morbid affections.

The condition of the hands and feet, and the appearance of the nails especially, vary with the state of the blood and of the circulation, of which they afford a sort of index, and, in some protracted cases, with that of the cuticular and cutaneous surface.

The acute synochus is characterized by a tumid, smooth, soft, and dry state of the surface, with a sense of glowing heat and a florid colour: this state is apt, however, to be modified by the occurrence of rigor or of perspiration.

In acute inflammation, the surface is, on the contrary, frequently nearly natural, of moderate heat, and inclined to perspiration.

Profuse perspirations have been particularly observed in the acute fever symptomatic of rheumatism, inflammation of the mamma, and in some affections of the kidney.

In the protracted synochus, the surface gradually becomes dry, rough, and harsh; the cellular substance shrinks; the skin communicates a sense of acrid heat; and the cuticle is often in a state of exfoliation, and sometimes raised on the neck and breast into miliary vesicles.

[In the typhoid affection, rose-coloured spots—*taches rouges*—are seen over the abdomen and thorax. At times these can only be detected by careful examination. Sudamina are also often present.]

In chronic symptomatic fever there is usually an absence of this state of the surface, copious perspirations being opposed to the constant dryness, and a natural warmth or even coldness to the acrid heat; the perspirations are apt to be peculiarly profuse in the last or early morning sleep; the coldness, often joined with lividity, is sometimes constant, at other times the consequence of the least exposure to cold.

The chronic symptomatic fever is, however, much modified by the nature of the primary disease; in tuberculous phthisis there is often the alternation from chilliness to hectic heat and perspiration during sleep; in strumous disease of the mesentery there are greater chilliness and sensibility to cold, and cold lividity, with early morning perspirations; and in organic disease of the liver there are frequently few or none of these symptoms.

In typhous fever, the state of the general surface is various, and usually less distinctly characterized than in the morbid affections already mentioned. In the milder form the temperature is moderately augmented, especially in the young or plethoric; but there is rarely great heat or dryness. In the severer form the surface is sometimes a little parched and the cheek flushed; sometimes cool and affected with clammy perspiration; sometimes there is an eruption of miliaria with a dry skin; and sometimes there are petechiæ. In the state of sinking a cold and clammy perspiration affects the nose, cheeks, hands, and general surface. In the fever described by Dr. Currie, "the temperature rose, in one case, to 105° Fahr.; but was in general from 101° to 103°, and towards the latter end of the disease scarcely above that of health."* Dr. Bateman observes, "the

* Medical Reports, vol. i. p. 11. Dr. Currie observes, with regard to continued fever, that "one exacerbation and one remission in the twenty-four hours seem generally observable. The exacerbation usually occurs in the afternoon or evening, the remission towards morning. These exacerbations are marked by increased flushing, thirst, and restlessness. If the heat of the patient be, at such times, taken by the thermometer, it will be found to have risen one or two degrees in the central parts of the body above the average heat of the fever, and still more on the extremities."

heat seldom exceeded 99° or 100°." (On Contagious Fever, p. 36.)

The three stages of intermittent fevers are highly characterized by the state of the general surface; in the cold stage there is great shrinking, and the skin becomes pale, cold, and rough, and in the state termed cutis anserina, and the temperature has been observed as low as 74°; in the hot stage the integuments become tumid and injected, and the skin is hot and dry, and the temperature has sometimes been as high as 105°; in the last stage the tumidity, heat, and injection cease and yield to a general perspiration.

It is in the scarlatina anginosa that the greatest degree of tumidity, injection, and temperature is observed; the rash is continuous and imparts a deep red hue, and the surface in general is turgid, hot, smooth, soft, and dry—a state which is succeeded, on the decline of the fever, by dryness, roughness, and exfoliation. There is much diversity in the degree of these appearances, as in that of the fever itself; but in severe cases the heat and tumidity are greater than in any other febrile affection of this climate; the thermometer applied to the surface of the body rises to 105° and 106° even in mild cases, and in the more violent cases to 108°, 109°, 110°, and even 112°, the greatest heat ever observed in the human body by Dr. Currie. (Medical Reports, vol. ii. p. 46.)

In the scarlatina maligna there is frequently an entire absence of tumidity, injection, and heat of the surface; sometimes there are shrinking, cold moisture, and a pale or livid rash. It is of the greatest importance to attend to the state of the surface, in a curative as well as a diagnostic point of view.*

After the decline of the tumidity and rash of scarlatina, an anasarcous welling of some parts of the surface is occasionally observed; it usually affects the extremities and face, and sometimes the sole of the foot has been raised into one entire blister.

In rubeola there is comparatively little tumidity, injection, and increased temperature of the general surface; the face, and especially the eyes and eyelids, are, however, often considerably tumid; the heat of the skin is in this disease, and in the influenza, from 99° to 101° and 102°. (Medical Reports, vol. ii. p. 78.)

In the variola discreta, except in its mildest forms, there are considerable general tumidity and heat, frequently a warm perspiration, a full state of the pustules, and a soft condition of the intervening portions of skin.

In the variola confluens, the surface is shrunk and flaccid, the temperature little or not at all augmented, and the skin is frequently affected with a clammy perspiration, whilst the pustules are flat and flaccid, participating apparently in the state of the cutaneous circulation.

In the course of variola, and usually about the eighth day, there is frequently a state of tumefaction of the face and eyelids, with a flow of saliva; this state recedes, and about the eleventh day the tumefaction affects the hands and feet.

In the morbid affections already noticed, the temperature of the surface is, for the most part, augmented. There are some diseases, however, in which there is a tendency to diminished temperature and frequently great sensibility to cold.

There is a certain degree of this tendency in acute dyspepsia, and perspiration is excited by the slightest hurry or fatigue.

In some cases of protracted dyspepsia, the nose is livid and cold, and the feet are habitually cold. The case is distinguished from that to be next noticed by the absence of frequency of pulse, and of progressive emaciation.

But the case in which this peculiarity is most observed is the tuberculous disease of the mesentery. In this disease the patient is highly sensitive to external cold, and to the least draught of air, and, in cold weather especially, constantly draws near or hangs over the fire,—sometimes until the hands and legs assume a brown colour from the influence of its heat. With this sensibility to cold, there is also frequently a great tendency to early morning perspirations, which appear to be induced by sleep, and to be in part avoided by keeping awake, which is often done purposely.

A slighter degree of chilliness is observed in phthisis pulmonalis, and in other organic diseases, together with a greater or less tendency to perspiration.

Decided shivering occurs in the commencement of febrile and inflammatory diseases in general; [although it is not uncommonly absent] in the beginning of each paroxysm in intermittents. This symptom also occurs in cases of intestinal irritation, and in a more marked degree than in inflammation. It is an attendant upon suppuration; and then, being repeated, frequently excites the idea of intermittent.

There is no point of deeper interest, in a practical view, than that of the loss or return of flesh. The continued loss of flesh adds, in obscure cases, to the fear of organic disease, whereas the least return of flesh determines the question favourably. [This, however, is a rule liable to exceptions. The author has known many pounds of flesh regained even in fatal pulmonary phthisis, under change of climate, or some agency, which has arrested or diminished for a time the morbid action.]

In acute dyspepsia it is highly interesting to watch the gradual return of flesh under judicious treatment. In tuberculous disease, on the other hand, there is a daily loss of flesh, however slow. In hepatic disease, the case is favourable or unfavourable according as the patient continues to lose or begins to regain flesh. In doubtful cases, the patient's weight may be registered, and the result will frequently be contemplated with anxious feelings. In the study of all, but especially of chronic diseases, there is, indeed, no point of greater importance than that of emaciation. Much might

* Dr. Currie observes, "Before I conclude the subject of scarlatina, I must *again* enforce the superior advantage of using the affusion early in this disease; and the propriety of ascertaining that the skin is dry, and the heat of the patient greater than natural, in all cases, especially in such as are advanced, and where, of course, the strength is considerably impaired. It has come to my knowledge, that in two cases of scarlatina, of the most malignant nature, the patients have been taken out of bed, under the low delirium, with the skin cool and moist, and the pulse scarcely perceptible. In this state, supported by the attendants, several gallons of perfectly cold water were madly poured over them, on the supposed authority of this work! I need scarcely add, that the effects were almost immediately fatal."—Vol. ii. p. 76.

certainly be learned by a constant attention to this subject.

The degree of emaciation which takes place in patients, depends in part on the nature of the disease, and in part on the nature and office of the organ affected. Emaciation is more observed, in a given space of time, in fevers than in inflammations. Loss of flesh takes place in the acute dyspepsia, but is scarcely observed in the chronic forms of that disorder—a circumstance by which they are therefore distinguishable from insidious organic diseases or protracted inflammations. Emaciation is the usual effect of tuberculous and scirrhous affections of any organ; it is less early observed in some other diseases, as in the encephalosis, (*Laennec*, de l'Auscultation, tom. ii. p. 62), &c. Emaciation is little observed in diseases of the head, heart, and even the lungs, compared with those of the mesenteric glands, the stomach and bowels, the liver, the pancreas, &c. In diseased mesentery the emaciation and loss of strength are nearly, if not absolutely, although very slowly, progressive. In disease of the liver there may be, for some time, even for years, a degree of recovery; and weakness and loss of flesh, and even icterus and anasarca occasionally disappear.

There are some highly interesting remarks on this subject in Dr. Pemberton's work on the Diseases of the Abdominal Viscera. (Chapter vi.) He observes that, in the organic diseases of the liver, the pancreas, the mesenteric glands, the stomach, the small intestines, and the spleen, as "glands of supply," there is considerable emaciation; whereas in the diseases of the kidneys, of the breast, and of the large intestines, which are "glands of waste," the loss of flesh is less, and less rapid.

Next to emaciation as a consequence of disease, it is important to remark the occurrence of œdema, or of its aggravated form of anasarca. The principal causes of this affection are organic disease of the heart or lungs, enlargement of the liver, phthisis pulmonalis, organic tumours in the abdomen, pregnancy, &c.

Anasarca is frequently observed in the late stages of chlorosis. It is often, indeed, an effect of debility merely, and occurs, consequently, in the last stages of chronic diseases in general, from want of nourishment, and in old age, and as an effect of profuse hemorrhage or purging. Anasarca is also occasionally the effect of long exposure to cold and wet.

The causes of anasarca sometimes induce other kinds of dropsy, as hydrothorax, ascites, &c., which are, indeed, like anasarca itself, far more frequently effects of diseases than primary diseases themselves. It is important to trace the succession of links in this chain of causes and effects; but it is to be observed that these morbid states come at length to constitute diseases in themselves, and produce, in their turn, their peculiar effects and symptoms.

The appearances of the general surface in cases of cachexia are peculiar; but they do not appear to require description in this place.

There is a singular morbid affection of the surface, which has not, we think, been noticed by any practical writer; the face, and some parts of the surface of the body, become suddenly and remarkably puffed and swollen; this affection appears to be occasioned by the presence of some indigestible substance in the stomach, and generally yields to the operation of an emetic and purgative.

We now proceed to notice some morbid states observed chiefly in the hands and feet, although partly, too, over the general surface. The nails, like the prolabia, afford an opportunity of observing the state of the blood; the hand, in general, often denotes, by the condition of its surface, the degree of force or feebleness of the circulation, at least in the capillary vessels, and by its steady or tremulous movements, the strength or weakness of the muscular system.

Continued fevers and inflammations in general are distinctly characterized by the morbid affection of the surface, and by the state of tremour, so generally observed in the former, and so little, comparatively, in the latter.

In the acute synochus there is generally considerable tremour and burning heat; in acute inflammation these affections are usually absent. In the slow synochus the hand is still more tremulous, and its surface becomes dry, parched, and exfoliating; in chronic inflammations the surface is generally totally different, and there is only the tremour of weakness. In typhous fever the tremour frequently assumes the aggravated character of subsultus tendinum. It is scarcely necessary to make any allusion to the circumstances of the picking of the bed-clothes, flocci volitantes, &c.

There is one morbid affection in which tremour is so characteristic as to have been chosen for its denomination,—the delirium tremens. From the occurrence of this symptom in a remarkable degree, we were enabled, in one case, to foretell that delirium would follow.

In acute dyspepsia, a degree of tremour is observed on desiring the patient to extend the hand and arm; the surface of the hand is apt to be cold and clammy, and the nails to assume a lilac hue, and their tips to become white and opaque. These appearances are, in some instances, very long continued, and they are always very characteristic.

In chlorosis, the hands, fingers, and nails become characteristically pale and exanguious; the skin is frequently opaque and puffy, and usually dry; there is a tendency to œdema, and at length to anasarca.

In very protracted cases of dyspepsia, the skin becomes gradually dry, branny, and sallow, or brownish, and the nails become brittle, break off in lamellæ, so that the patient is incapable of taking a pin out of her dress, and sink in irregularly in their middle part. This state of the nails is by no means unfrequent.

In common dyspepsia even, the hands and feet are apt to be cold.

In organic disease of the heart, the hands, like the nose and cheeks, frequently become deeply livid and very cold, whilst the heat within the rectum and under the tongue is sometimes even higher than natural, (see Dr. Farre's Essay on Malformations of the Heart, pp. 32, 34); in young subjects the finger-ends become expanded, especially laterally.

The finger-ends are swollen, and perhaps affected with a sense of tingling, especially in young

subjects, in some cases of organic disease of the liver, and sometimes in tubercular phthisis pulmonalis, and in the latter disease they become adunque.

In inflammation of the bowels, and in cholera, and dysentery, there is a characteristic tendency to a cold, clammy, and livid state of the surface of the hands and feet, and of the nose, whilst the pulse is frequent and small.

We have already mentioned the tendency to coldness and lividity of the extremities in tuberculous disease of the mesentery.

There is a loss of temperature in cases of paralysis, sometimes with lividity and shrinking.

In the action of the hand and fingers we may frequently observe the expression of pain, of anxiety, or of suffering; but this subject properly belongs to a subsequent section.

5. On some Morbid Conditions of the General System.—Before we proceed to notice the symptoms of disease referable to the functions of the encephalon, and of the viscera of the thorax and abdomen, we wish to call the attention of the reader to some morbid affections of the system at large.

In the first place we shall just refer to those various morbid states of the general system denominated fever. But we shall principally, though briefly, notice some other conditions of the system, which have not hitherto obtained the degree of attention they demand, and which may be denominated the states of irritation, of exhaustion, of erethismus, and of sinking.

All these morbid states are characterized by affecting many or all of the organs and functions of the body at once, although one particular organ frequently suffers much more than the rest.

Continued fever is particularly distinguished from inflammation by the characteristic just mentioned. The contrast has already been drawn between the states of the countenance, of the attitude—including the muscular system,—of the tongue, and of the general surface, in these different affections; and differences not less marked will be observed in the functions of the encephalon, and of the organs of the thorax and abdomen.

A similar remark also applies to the dissimilar but characteristic effects of local irritation and inflammation on the general system. These effects, although in general sufficiently distinct, are frequently confounded. How often have we known that symptom stated as evidence of the existence of inflammatory action, which, in fact, was connected with irritation, and with nothing so remotely as inflammation!

It is, perhaps, of still greater moment to observe that some affections of the system in general, resembling and often mistaken for local inflammation and effects symptomatic of inflammation, are, in fact, effects of exhaustion. The mistake, in both these cases, is full of danger; the investigation of the diagnosis is, therefore, of the utmost importance.

It is also a remarkable circumstance, as we shall observe hereafter, that the phenomena and effects of exhaustion are extremely similar to those of erethismus, and especially of the erethismus mercurialis.

Lastly, there is a state of constitutional affection which may be termed the state of sinking, which occurs in various diseases, and is characterized frequently by inducing false appearances of amendment, dissolving as it were the series of morbid actions, and, in a certain sense, curing the disease, but subsequently leading to sudden, or at least early, dissolution.

We shall now proceed to sketch the principal phenomena observed in these states of the constitution. It would require too great a space to enter into their detail; and it is unnecessary, because we have attempted this, in some measure, in the latter part of this article.

The principal sources of irritation to which we shall allude here, are the presence of indigestible substances in the stomach, and especially intestinal disorder or load. The effects of these sources of irritation are either gradual or sudden. The gradual effects are, those observed in the dyspepsiæ, in chlorosis, &c. It is the more sudden effects of intestinal irritation to which we wish to direct the attention in this place.

The more sudden effects of intestinal load and irritation are, acute pain of the head, of the side, of the loins, of the iliac region, or of some other part of the abdomen; attacks of vertigo, of dyspnœa, of palpitation, fainting or feeling of dissolution, of vomiting, and of hiccup; there are often anxiety and distress; and there are severe rigors, followed by great febrile heat, jactitation, and flushing. The attack is apt to be mistaken for a disease of the organ principally affected, and bleeding is injuriously prescribed when enemata and purgative medicines are the only remedies. The effects of intestinal irritation are particularly apt to occur after any exertion or agitation, after the pain and fatigue of delivery, and especially when this cause is conjoined with any cause of exhaustion, as misapplied or undue bloodletting, hemorrhage, or purging, and in the course of diseases; and we are persuaded that their influence in these circumstances is still only half apprehended.

The principal sources of exhaustion are undue bloodletting and uterine hemorrhage, especially when they occur with intestinal irritation,—hypercatharsis, and diarrhœa. The effects of exhaustion may be referred to the head, heart, the viscera of the thorax and of the abdomen, and the muscular system. The symptoms which affect the head are, severe pain; beating and throbbing; rushing or cracking noises; vertigo or turning round of the room, especially on raising the head or assuming the erect position; intolerance of light and of sound; wakefulness; starting during sleep; awaking hurried and alarmed, with faintness, palpitation, feeling of sinking, of impending dissolution, &c.; being overcome by noise, disturbance, or even thinking; and delirium. The heart is, in different cases, affected with palpitation, fluttering, irregular and feeble action; there are beating and throbbing of the carotids, and sometimes even of the abdominal aorta; a frequent, bounding, and sometimes irregular pulse; faintishness or fainting, urgent demand for the smelling-bottle, fresh air, fanning, bathing of the temples; feeling of impending dissolution; incapability of bearing the erect position, and sometimes early fainting from the use of the lancet. The respiration is affected,

in different cases, with panting, hurry, sighing, great heaving, gasping, blowing, moaning, catching, &c., and, as has been stated, with urgent demand for fresh air. There is sometimes a sense of great and alarming oppression about the chest. There is in some cases an irritative cough, in violent fits, or in the form of continual hacking; this cough appears to originate in the larynx or trachea. The stomach is liable to become affected with irritability, sickness, retching, vomiting, hiccup, and eructation; the bowels with constipation or diarrhœa, pain, flatus, distension, &c. There are very frequently urgent restlessness, tossing about, and jactitation. In some cases, various spasmodic affections have occurred. We have often to combat the effects of exhaustion in the puerperal state, and in cases in which bloodletting has been improperly employed for diseases not inflammatory, or too lavishly in cases of inflammation.

There is an extraordinary similarity, as we have already observed, between the effects of exhaustion, as just noticed, and the symptoms of the disease termed erethismus mercurialis, so well described by Mr. J. Pearson, (Observations on Lues Venerea, 2d edit. ch. xii.) and so painfully experienced, and so amply and accurately detailed by the late Dr. Bateman. (Medico-Chirurgical Transactions, vol. ix. p. 220.) The descriptions of these authors do not, however, enumerate the affections of the head; otherwise they would be almost identical with that of exhaustion just given: disturbed sleep, hurried wakings, palpitation, languor, fainting, feeling of impending dissolution, want of air, fits of coughing, and of retching, &c. occur in both these morbid states; and sudden and unexpected death from muscular effort has alike terminated the patient's sufferings.

The morbid effects of digitalis, and of some other vegetable remedies, are also not dissimilar from those of exhaustion and erethismus.

The constitutional symptoms in some cases of local disease, as in the phagedenic and sloughing ulcers, appear also to partake of the characters of erethismus.

The state of sinking occurs under very different circumstances, and accordingly presents very dissimilar phenomena. It occurs sometimes as a gradual and simple feebleness of the brain, decline and cessation of the functions of circulation and of respiration, as in cases of dissolution in very advanced age: at other times it takes place with the more active symptoms of inquietude and jactitation, catching respiration, hiccup, &c.: sometimes it has the remarkable effect of dissolving the chain of morbid actions and sensations constituting the disease under which the patient has laboured, and of presenting to his friends, and perhaps to his unwary physician, the appearance of amendment, when life is soon to terminate in an unexpected dissolution: lastly, the appearances of sinking quickly follow the accession of gangrene.

The gradual decline of the powers and functions of the heart and of the respiration scarcely requires any description: there are dozing, and insensibility to external impressions; the breathing becomes irregular; there is a collection of phlegm in the trachea or larynx, with cough, rattling, and hoarseness; the powers of the bladder are often impaired, with retention of urine; the pulse becomes small and feeble, and the extremities and the nose and cheeks cold.

In the second form of sinking, there are constant restlessness, with throwing about of the arms and throwing off of the bed-clothes, delirium or incoherency of mind, catching, sighing, or gasping breathing; a frequent, small, and perhaps intermittent pulse; hiccup; an indescribable feeling of approaching dissolution; a constant necessity for the windows to be opened, and for the fan, and sal volatile, &c.; the countenance becomes pallid and sunk, and, with the extremities, cold, clammy, and perhaps livid, especially the prolabia.

In the third case, the pain and symptoms of the disease often cease, and the patient has even got up or enjoyed sleep, and yet dissolution has been at hand; the pulse, perhaps, suddenly becoming very frequent, and the extremities cold, pale, livid, and clammy. This phenomenon is, we think, most frequently observed in cases of inflammation and other diseases of the intestines, as we had remarked long ago.* It also occurs in other states of the disease: delirium, cough, and pain have ceased, and suppression of urine has yielded, under the influence of the state of sinking.

That extraordinary man, Mr. J. Hunter, had accurately observed the state of sinking, and has described it under the term dissolution. (Hunter on Inflammation, part ii. ch. ix. sect. 3.) "The first symptoms," he observes, "are those of the stomach, which produce shivering: vomiting immediately follows, if not an immediate attendant; there is great oppression and anxiety, the persons conceiving they must die. There is a small, quick pulse, with every sign of dissolution in the countenance: as it arises with the symptoms of death, its termination is pretty quick." "I have seen dying people whose pulse was full and strong as usual on the day previous to their death; but it has sunk almost at once, and then become extremely quick, with a thrill: on such occasions it shall rise again, making a strong effort, and, after a short time, a moisture shall probably come on the skin, which shall in this state of pulse be warm, but, upon the sinking of the pulse, shall become cold and clammy: breathing shall become very imperfect, almost like short catchings, and the person shall soon die." "It would appear in many cases that disease has produced such weakness at last as to destroy itself: we shall even see the symptoms, or consequences of disease, get well before death." Sir Henry Halford has also noticed this subject in a late paper published in the Transactions of the College of Physicians, (vol. vi. art. 15,) and has applied it to the prognosis of diseases.

The symptoms of sinking in cases of gangrene are familiar to every observer.

From the preceding observations it will appear that there is a similarity in the symptoms attending intestinal irritation, exhaustion from loss of blood, the erethismus mercurialis, the morbific effects of digitalis and other poisonous vegetables, sinking, and dissolution, which is really remarkable. It is a question of great importance how far

* See the first edition of the Treatise on Diagnosis, part i. p. 47. See also Dr. Abercrombie's paper in the Edinburgh Journal, vol. xvi. p. 22, 185.

the existence of one of these states tends to the superinduction of another: the effects of exhaustion are certainly very apt to supervene in cases of intestinal irritation, and are far less liable to occur, from the same application of its causes, during the existence of internal inflammation; a given degree of intestinal irritation, on the other hand, produces unusual effects in cases of exhaustion. We do not know whether the same relation exists between irritation or exhaustion, and the erethismus of mercury or of digitalis.

The symptoms of irritation or of exhaustion are not only particularly apt to supervene when the cause of the other state respectively coexists; but it appears to us that the causes of one state are also apt to induce those of the other. Thus the state of intestinal disorder and irritation, at least, is very liable to steal on in cases of exhaustion from loss of blood; and when it exists primarily, it is extremely apt to induce diarrhœa, and even some kinds of hemorrhage, as epistaxis, hæmatemesis, and melæna, and even uterine hemorrhage or discharge.

When the state of exhaustion terminates fatally, it is either by sudden death or by more or less gradually passing into that of sinking. Sudden death is apt to occur from any muscular or bodily effort in a change of the position; one patient rose up to make water, sank down, and soon afterwards expired. The transition of the state of exhaustion into that of sinking we have an opportunity of witnessing at the moment of writing these lines: great pain of the head, with beating, throbbing of the carotids, agitation from sudden noises, as knocks at the door, violent palpitation of the heart, with fulness and bounding of the pulse, alarm and hurry on awaking, &c., have gradually subsided and passed into a tendency to doze, first with snoring, then with blowing-up of the cheeks and lips, and moaning; slight rattling or crepitus heard in the trachea and bronchi during respiration, becoming gradually augmented; slight catching, laryngeal cough, especially when asleep, gradually increasing and becoming painful and almost incessant, but afterwards almost ceasing; oppression in breathing, with blowing through the mouth and lips, the nostrils being very acute, and dilated below and drawn in above the lobes; much flatulency: at length the fæces are passed at each attempt to void urine, of which there may be retention or involuntary flow, conjointly or separately. The countenance is pallid and sunk, the features acute, there is much inquietude, sometimes jactitation, and delirium, especially on awaking, and, to employ the patient's own expression, "a dying feel."

The subjects sketched in this section, we do not hesitate to say, are of extreme importance. We should not have devoted so much space to them, did we not consider it an imperative duty to call the attention of the profession to them in the most earnest manner of which we are capable.

6. **On the morbid states of the Functions of the Brain.**—The consideration of the morbid affections of the functions of the brain embraces a view of the derangements observed in its energies in general, the sleep, the mental faculties and the temper, the senses and sensations, and the motions—voluntary, functional, and sphincter.

It is extraordinary that the energies of the brain should become affected in a very similar manner from the two opposite states of undue action or fulness, and of depletion of that organ. Stupor and morbid obtuseness of the nerves and senses on one hand, and delirium and morbid sensibility on the other, occur alike, varied only in form and degree, in each of these states of the encephalon; and the remark equally applies to the function of respiration as influenced by these different and opposite conditions of the brain; indeed, the affections of the respiration just described as obtaining in the state of sinking from exhaustion, bore the most marked resemblance to those observed in apoplexy, the difference being chiefly observed in the state of the countenance, general surface, and pulse, and in the degree of the mental stupor.*

Augmented energy of the brain, denoted by delirium and augmented sensibilities, occurs in cases of fever and of irritation, and in the opposite states of this organ observed in inflammation and exhaustion.

Diminished energy of the brain, on the other hand, occurs in apoplexy and in the state of sinking from exhaustion; in both cases there are stupor or dozing, rattling in the breathing from defective absorption of the mucus of the bronchi, oppressed and laboured respiration, snoring, blowing-up of the cheeks and lips, defective power of the sphincters, &c.

In regard to sleep we observe, in different morbid affections, the opposite states of lethargy and wakefulness, the occurrence of frightful dreams and hurried wakings, and various effects on the functions of the skin, of the heart, &c.

The return of sleep must, in general, be deemed a good sign; but a longer sleep than usual is frequently an effect of exhaustion, and the patient awakes from it 'overcome;' dozing and sleep again are frequently observed in the state of sinking, and then only give rise to a false hope of amendment.

Drowsiness is frequently an antecedent sign of apoplexy; it may forebode icterus, and it may arise from a disordered state of the stomach. It is in other cases, and especially in the diseases of children, one of the first symptoms to awake alarm and fear of disease within the head.

Profound sleep, which has received various names, as somnolentia, coma, lethargy, veternus, cataphora, carus, &c. according to its degree, usually denotes a state of oppression of the brain from vascular fulness, effusion upon the membranes, &c. and occurs as a symptom in apoplexy and organic disease of the brain in general; as a complication in typhous and other fevers; as an effect of the convulsive efforts in epilepsy, puerperal convulsion, fits, hysteria, the hooping-cough, &c.

Heaviness for sleep also occurs, as has been stated already, in a state of the brain the opposite

* A similar remark is made by Dr. Percival in relation to the opposite states of congestion and collapse of the brain, in his interesting Essay on Typhus Fever. He observes, "in truth, the state of congestion and the state of collapse, which resemble each other both in vascular and sensorial appearances, deserve a fuller comparison than has yet been made of their common character."—p. 69.

to fulness, and is observed in some cases of exhaustion, in the state of sinking, and in syncope.

Wakefulness and restlessness occur in mania, in puerperal delirium, in the delirium tremens, &c. in connection with delirium, as their names import; but they also arise, independently of delirium, in cases of great irritation or exhaustion, especially intestinal irritation and exhaustion from loss of blood: the same observation applies to the erethismus mercurialis, (see Dr. Bateman's case, Med. Chir. Trans. vol. ix. p. 223,) which, as we have had occasion to remark before, resembles in so many particulars the morbid effects of the causes just mentioned.

But perhaps the most extraordinary phenomena belonging alike to these three morbid affections, in connection with sleep, are frightful dreams and hurried wakings; these circumstances sometimes occur in the form of incubus, sometimes with great palpitation of the heart and hurry, and sometimes with the feeling of impending dissolution.

There is often much starting in the sleep in cases of indigestion; and children frequently start, get up in bed or even out of bed, or perhaps scream violently, and are affected with fright or temporary delirium from this cause.

Hurried wakings, with a sense of suffocation or of impending dissolution, also occur in organic disease of the heart; the patient, agitated and alarmed, hastens to the open window for air.

Sleep would appear to exercise a peculiar influence over the circulation: many children perspire profusely during sleep, especially in a state of weakness; sleep often induces flushing during the progress of febrile complaints; and in cases of hectic or tubercles, the last morning sleep, as we have already observed, is particularly apt to be attended with profuse perspiration, to prevent which many patients purposely keep themselves awake.

The mental faculties are affected in various ways,—by delirium, stupor, imbecility, unfounded hope or despondency, &c.

Delirium occurs in fevers, in most violent affections general and local; and in inflammation or disease of the brain. In the former case delirium is often long continued; in the latter it usually, earlier or later, passes into stupor, as increased action induces effusion. Delirium is also observed in some cases of exhaustion with reaction; and, in its low and muttering form, it occurs in the state of sinking.

Not only fever, and any severe derangement of the general health, but a violent accident, a severe operation, the occurrence of gangrene, &c. are generally attended by delirium.

It is scarcely necessary to allude to the occurrence of this symptom as a frequent puerperal affection, and as the effects of habits of drinking spirits. In the former case it is frequently an effect of the loss of blood.

Stupor also occurs in fevers, but especially in apoplexy, and towards the termination of all affections of the brain inducing compression of that organ.

Imbecility of mind, with talkativeness or with lethargy, is not unfrequent in old age. In these cases there is often a state of chronic inflammation of the substance or of the membranes of the brain. Paralysis is apt to be superadded to the other symptoms.

After attacks of apoplexy a state of mental imbecility often remains, with loss of memory, unmeaning laughter, proneness to tears, &c.

The temper of the patient is singularly modified by different disorders and diseases. The state of despondency in cases of indigestion forms a remarkable contrast with that of hopefulness in phthisis pulmonalis and other serious organic diseases.

Despondency on the part of the patient may, however, excite a well-founded alarm in cases of great debility and inquietude.

In cases of serious and fatal disease, and especially, we think, in diseases of the intestines, the patient frequently expresses his conviction of an approaching dissolution—"tanquam conscia foret natura, vitam ad finem properare."

The senses and sensations become preternaturally acute or defective.

Acuteness of hearing and of sight, and intolerance of sound and of light, are usual symptoms in the dawn of inflammation of the brain, and frequently occur in idiopathic fevers: but they occur in the most remarkable degree as effects of intestinal irritation and of exhaustion.

The physician is often called to cases in the following circumstances:—Straw is spread before the door, the knocker is tied, the lights are screened or the room is darkened, and every source of noise or disturbance is carefully avoided. The cases in which these precautions are necessary are principally those of intestinal irritation and exhaustion; but they are also frequently necessary in the acute synochus, and in some forms of puerperal affection; and the precautions respecting noise and disturbance are sometimes requisite in diseases of the heart, not from increased susceptibility of the nervous system, but of the action of the heart itself.

The sense of hearing becomes defective and obtuse in some cases of typhous fever; defective vision is a usual occurrence in diseases of the brain; and torpor or defective touch is a usual precursor or consequence of apoplexy or paralysis, and occurs in some instances of hysteria. We need scarcely allude to the *flocci volitantes*, *tinnitus*, the *epileptic aura*, &c.

Under the head of deranged sensations may be noticed pain and vertigo. Pain of the head in the recumbent, and vertigo in the erect posture, are usual and early symptoms in typhous fever and acute synochus, in cases of intestinal irritation and of exhaustion, and in the dyspepsiæ; and they are frequently precursory and admonitory signs of apoplexy or paralysis.

Pain of the head alone is usually amongst the first symptoms of inflammation of the brain. Severe pain of the head occurs in the dyspepsiæ, and especially in chlorosis; it is then attended by the other symptoms of those affections; but it is frequently so severe as to lead to the erroneous employment of the lancet.

We need scarcely advert to the frequent occurrence of headach and vertigo in hysteria, hypochondriasis, asthenia, syncope, &c. It is important, however, to remark that they rarely

occur in local or organic diseases, except those of the head itself.

Intermittent headach constitutes a peculiar affection, and is removed by the arsenic.

The sense of an iron finger on some part of the head, or of an iron hoop round the head, is an effect of exhaustion from loss of blood.

7. On the morbid affections of the function of Respiration.—In treating of the morbid affections of the function of respiration, we shall attempt a description of the different kinds of dyspnœa, of cough and expectoration, of the effects of full inspiration and expiration, of the affections of the voice and articulation, &c.

Healthy respiration is performed with ease and freedom, and without the aid of the auxiliary muscles, in any of the usual positions of the body. It is effected by a nearly equal elevation of the ribs and depression of the diaphragm, except in females, in whom the thorax is observed to move more than in men; each side of the thorax moves also in an equal degree; and inspiration and expiration occupy nearly equal spaces of time.

The kinds of dyspnœa, and the other morbid affections of the act of respiration, are so numerous, that it would be difficult to discuss them fully. In treating the subject, we shall proceed on the practical principle already pointed out, and describe the different modifications of the respiration in reference to particular diseases.

In the acute synochus there is generally a little hurry in breathing, and sometimes a degree of anxiety and of panting.

The respiration in typhous fever is generally anxious and tremulous; when the fever is complicated with stupor, the respiration becomes still more affected—frequently deep and sibilous, irregular and unequal, still more tremulous, and sometimes each inspiration is begun by the diaphragm and completed by the thorax; in the other complications of this fever the respiration is variously affected according to their seat and nature.

In apoplexy the respiration becomes irregular, slow, deep, frequently suspended, and sighing, with rattling or stertor, or blowing of the cheeks and lips, or with catching in the larynx. M. Serres observes that, when there is paralysis, the two sides of the thorax are moved unequally, the muscles of the paralytic side having lost their power. (Annuaire Medico-Chirurgical, 1819.)

We have already noticed the similarity which obtains between the breathing in apoplexy and that observed in the state of sinking.

In other diseases of the head with congestion or compression, as inflammation or hydrencephalus, the breathing gradually becomes irregular and unequal, with alternate suspension and sighing; the duration of the interruption appears sometimes to be commensurate with the degree of oppression of the brain.

In inflammation of the chest, with acute pain, the respiration is sometimes performed exclusively by the diaphragm, the chest or part affected being quite motionless; the alternate movements of the respiration are also short, cautious, and suppressed. This peculiarity of the breathing is proportionate to, and varies with, the degree of acuteness of the pain.

The part affected is sometimes carefully kept unmoved, the rest of the thorax or abdomen being moved as usual. This is observed in ordinary respiration, still more in a deep inspiration: the patient can draw a deep breath without causing pain; but if this be done incautiously, pain is immediately induced. The patient is frequently awoke from sleep by this cause: the caution ceases, perhaps a deep sigh is drawn, and acute pain being induced, the patient starts and awakes.

In inflammation within the abdomen, with acute pain, the respiration is, on the contrary, performed principally and often exclusively, by the chest, the abdomen remaining unmoved. This peculiarity of the breathing may be distinctly observed by looking on the chest and binding the bed-clothes tight over the abdomen. The respiration has sometimes the appearance of heaving of the chest: every movement of the diaphragm is cautiously avoided. In this disease the patient is also frequently observed to rest, for a few seconds, on a full breath. The abdomen begins to move as the pain diminishes, whether from a mitigation of the disease, from sinking, or from gangrene. By an attentive observation of the modifications of the respiration, inflammation of the pleura is distinguished from inflammation of the peritoneum covering the liver, &c. The very part inflamed is frequently ascertainable by a simple but careful inspection. Nothing is more interesting than this exercise of the faculty of pure observation. The thorax and abdomen should be exposed and watched.

Inflammatory pain within the abdomen is, in the same manner, distinguished from spasm or colic, in which there is a state of breathing altogether incompatible with inflammation attended with acute pain and tenderness.

In inflammation of the lungs, the respiration is characterized by labour, and by crepitus heard on applying the ear to the chest: these peculiarities are augmented as congestion and hepatization take place; and when much mucus is secreted, bronchial rattle is superadded. In chronic cases of pleuro-pneumonia, the shoulders are elevated, the pomum adami is drawn downward, and the lower part of the sternum retracted toward the spine, on each inspiration—the abdomen being, at the moment, suddenly protruded, and the upper part of the chest raised.

In tuberculous phthisis pulmonalis, an effort is early visible in the respiration, and its effects are seen in a movement of the alæ nasi: the breathing is also early observed to be short on any muscular exertion, especially on going up stairs; at a late period of the disease there are generally constant labour and shortness of breathing, and sometimes attacks of suffocating dyspnœa.

On examining the chest in a recumbent position, it will frequently be found that its motions are not free, and that respiration is more than usually performed by the diaphragm. Sometimes one side of the chest moves more than the other.

In the later stages of hydrothorax, there is, in connection with the peculiar state of the attitude, a characteristic affection of the respiration:—the acts of respiration are performed with very unusual

degrees of labour; inspiration is often quick and sudden, effected with great effort, principally or exclusively by an elevation of the thorax, and afterwards by a forcible contraction of the auxiliary muscles of respiration; in expiration these movements are reversed, the chest appears to fall spontaneously and without effort; the action of the auxiliary muscles—the sterno-mastoids, the pectorals, &c., is seen or may be felt on applying the finger; the head is often moved, and the chest has, in protracted cases, the appearance of being unusually high.

A state of the respiration not dissimilar from that just described is observed in cases of complicated disease in the thorax and in the abdomen—the latter giving origin to what may be termed the thoracic breathing, and to a suppression of the action of the diaphragm. A painful affection of the upper portion of the peritoneum would be apt to induce the state of breathing observed in hydrothorax; whilst the latter affection, by pressing the diaphragm downward, has often been mistaken for disease of the liver. (*Portal*, Mémoires sur plusieurs Maladies.)

In diseases of the heart, the dyspnœa is generally first experienced, and is ever particularly aggravated by any particular muscular exertion or mental emotion, and especially on going up stairs: it appears, therefore, to be particularly liable to recur in paroxysms, and it is thus distinguished, in some degree, from the dyspnœa of hydrothorax, which increases progressively perhaps, but more uniformly and slowly.

Besides the kinds of dyspnœa already described, there are others which require to be accurately distinguished from them:—

In the acute dyspepsia, and in the more accidental cases of indigestion, a paroxysm of dyspnœa often takes place, and appears to us to constitute, in the greater number of instances, the first attack of true asthma.

The dyspnœa of asthma is extremely peculiar:—there are great anxiety and almost gasping; the inspiration is quick, the expiration longer, laboured, and wheezing. In extreme cases, the chest is raised, the scrobiculis cordis retracted, and the abdomen protruded, with abruptness, on inspiration; expiration reverses these movements, and is attended with labour and wheezing. In protracted cases a state of constant dyspnœa is observed, denoted by labour and wheezing, with a peculiar cough. At length, organic disease of the heart and of the lungs is superadded to the primary state of disorder of function.

In the other forms of dyspepsia, and especially in chlorosis, paroxysms of hysteric dyspnœa are observed, frequently attended with pain and tenderness of the chest or of the abdomen; it combines a degree of hurry and heaving in the respiration, altogether incompatible with inflammatory pain. With this state of the respiration there is often a total loss of voice, and occasionally the cough and crowing of croup.

In the cases of intestinal irritation, and in those of exhaustion from loss of blood or other causes, the respiration becomes affected with hurry, panting, sighing, heaving, moaning; laboured, and gasping; and there is an urgent demand for the fan and the fresh air.

As these states pass into that of sinking, a gasping, catching, laryngal cough, snoring, blowing, slight rattling in the larynx or trachea, &c. supervene, and increase as the energies of the brain, heart, and lungs decline. There are three symptoms connected with the exhaustion, which denote the sinking state, and which are consequently of the most unfavourable omen:—the first is an audible, hurried breathing; the second gasping, however slight, with descent of the pomum adami; the third, a slight crepitus heard in the breathing, with, or even without, the stethoscope.

A similar state of catching in the respiration occurs, as a fatal symptom, towards the termination of many diseases.

Rattle occurs not only in apoplexy, bronchitis, &c. but also in the last and fatal stages of debility and sinking, and of many diseases.

The different modifications of the breathing which have been described, might be designated and distinguished by some epithet chosen from their most prominent character. But we have avoided this from the fear of fixing the attention too exclusively on one point, which, however prominent, still only obtains in common and in connection with others little less remarkable.

There is one remark respecting the respiration which we think important. In some instances of chronic inflammation of the larynx or trachea, we have observed that the patient is incapable of performing the action of snuffing-up the nostrils so as to draw in the alæ nasi, (see Medico-Chir. Trans. vol. x.); this was not observed in some cases of ulcer of the larynx. The remark may not only enable us to determine the degree, but the diagnosis of the morbid effects of laryngitis.

The respiration is tracheal or croupy in inflammation of the larynx, and in cases in which a tumour, as aneurism or scirrhus, presses upon the larynx. The latter case is often distinguishable by the addition of dysphagia to the dyspnœa, or the tumour may be obvious to the eye or touch. In ulcer of the larynx the sound of respiration is rather hoarse and husky than croupy.

We now proceed to notice some of the more remarkable varieties of *cough*.

This symptom is modified by the seat and nature of the disease, and, in the same disease, by the state of pain, or of expectoration, and by the strength of the patient.

The laryngal cough often occurs in fits, with hoarseness and incapability of speaking, and is sometimes so violent as even to induce vomiting. The tracheal cough is lower, less violent, and without hoarseness. The bronchial is deeper still. By observing the kind of effort, and the particular character of the cough, the seat of irritation or disease is often distinctly observed to be in the larynx, in the trachea, in the bronchi, or in the cellular structure of the lungs.

Not only the seat but the nature of the disease, is frequently ascertained by an attention to the peculiarity of sound of the cough. Ulcer in the larynx induces a very different sound from that of inflammation of the same part, the former being hoarse, the latter croupy; the sound of the cough in tuberculous phthisis is very different from that of catarrh or of some forms of bronchitis; the

cough in asthma has a very peculiar dull sound; and the sound of the cough, or rather the resounding of the chest on coughing, frequently serves to indicate a healthy state of the lungs and thorax in general, and to distinguish it from various morbid conditions. The presence of mucus or of pus in the bronchial passages also gives a characteristic sound to the cough.

The effort of coughing is sometimes repressed. This occurs in acute inflammations of the pleura, of the peritoneum, &c. in rheumatic and hysteric affections of the muscles about the thorax, &c.

Sometimes the cough assumes a spasmodic character. This occurs in pertussis, hysteria, in cases of intestinal irritation, or of irritation about the larynx or trachea, &c.* In other cases the coughing is continued, but not sufficiently violent to be termed spasmodic. Cough of this character is observed in some cases of less severe irritation in the intestinal canal, or in the larynx or trachea; it occurs also from circumstances of exhaustion and sinking, and appears to originate in the larynx; it is observed in some instances of bronchitis, and of asthma, and frequently when the strength of the patient is too much reduced to enable him to expectorate.

In catarrh the cough is often violent, and there is an abundant resonance of the thorax; in tuberculous phthisis the cough is less frequently violent; but when it is, the sound is flattened, and as it were tearing.† The cough is generally violent with a thin and scanty expectoration, and becomes easier as the expectoration becomes more viscid and copious.

Cough may be said to be a symptom in all cases. But it by no means always denotes an affection of the organs of respiration originally. Perhaps no circumstance, however, illustrates better the transition of a sympathetic and functional affection into one of real disease. In some instances, a disordered state of the stomach and digestive organs induces a cough: this state of things, if neglected, leads to a copious secretion from the mucous surface of the air-passages, and ultimately to actual disease. In some instances, a state of inanition of the stomach, like other circumstances of exhaustion, induces cough. One patient termed such a cough a "want-cough," and always removed it by eating. We have already alluded to the catching, laryngal cough observed in the state of sinking.

Every one must have remarked the peculiarity of the cough which affects very old persons, and especially old asthmatics.

With the consideration of the different kinds of cough is naturally conjoined that of the varieties observed in the expectoration.

Mucous expectoration appears to arise from various sources of inflammation and irritation of the bronchial membrane. It occurs in bronchitis, frequently from the effects of intestinal irritation long continued, or from the irritation of a diseased liver, or of tubercles in the lungs in a quiescent state, or of other sources of irritation, near or remote. Slight mucous expectoration is frequently observed in protracted cases of exhaustion, combined, of course, with cough and with rattle. In some instances we have observed a copious mucous expectoration alternate with one more puriform, on different days,—even in tuberculous phthisis. It frequently happens that large globules of puriform expectoration are observed to float amidst a fluid of a more aqueous or mucous appearance,—especially in tuberculous phthisis.

In all these cases an expectoration of blood is frequently observed. In many, especially in bronchitis, this appearance gradually declines without serious consequence. It is generally, however, of a most unfavourable augury, (*Heberden*, op. cit. cap. lxxxiv.) even when it appears merely in dots or streaks [in one of a tuberculous diathesis]; and the more so, we think, as the previous disease is more protracted. The expectoration of blood is also very alarming when it occurs without previous symptoms, and without muscular effort.

Besides the mucous, puriform, and bloody expectoration, there is an appearance, occasionally observed, of a serous nature: it is that of a scanty, and, if the term may be allowed, friable and whitish matter, easily divided with a probe, and sinking in water: it occurs in some cases of tuberculous phthisis.

The expectoration in pneumonia is frequently quite distinctive and pathognomonic of this disease: it consists of a transparent fluid, reddish from the intimate admixture of blood, sometimes so tenacious as to admit of turning the vessel, in which it is received, upside down, without flowing out: at first there may be the expectoration of a little mucus; afterwards the degree of tenacity and red colour frequently denotes the degree of violence of the disease.

An experiment was proposed by the late Dr. Young as distinctive of pus from mucus, which has not sufficiently arrested the attention of the profession. It is of the simplest kind, and may have many useful applications in practice. If a minute drop of any fluid, containing globules, be placed between two portions of plate glass, and if we look through it, placed near the eye, at a distant candle, we observe the most distinct and interesting phenomena of circles coloured like the rainbow. Blood and pus present this phenomenon: mucus does not. We have, therefore, a diagnostic between mere laryngitis and bronchitis and mucous discharges from the stomach, rectum, kidney, bladder, or uterus, and ulcer in these several organs; and it remains, perhaps, to be determined whether tuberculous, and encephaloid, and melanotic matter, possess globules, and present the phenomenon dependent upon them.

A few remarks are required on the effects of a full inspiration and expiration.

The former is useful in the detection of slight attacks of inflammation of the pleura, or of the peritoneum, and in determining, by comparison at different periods, its increase or decline. A deep inspiration is apt to induce cough, when the structure of the lungs is affected with inflammation or disease. But this morbid state is more distinctly ascertained by an attention to the effects of a full expiration. In many cases of morbid affection of the lungs, indeed, in which a deep inspiration in-

* "Hujus generis tusses, ut et illæ quæ a distillatione nascuntur, vehementiores sunt, et magis sonoræ, quam quæ fiunt ex tabe, sive incipiente, seu deplorata."—Heb. Com. cap. xcii.

† Ibid. cap. xcii.

duces neither cough nor other inconvenience, a full expiration not only occasions cough, but other effects which vary according to the nature of the pulmonary disease. In inflammation of the bronchi or of the lungs, in tuberculous phthisis, &c., cough and rattle are induced. These effects are also observed in some cases of chronic affections of the bronchi, arising either from slight but protracted inflammation, or from disorder of the digestive organs; in cases of asthma too, in which the ordinary breathing, or a deep inspiration even, is unattended with any peculiarity, a full expiration excites both cough and the wheezing sound so characteristic of this affection.

It is particularly useful to watch the effects of a full expiration in the slighter affections of the pulmonary structure, and in the decline of pulmonary disease.

The modifications of the voice and articulation, as symptoms in diseases, may be considered as denoting—1. the state of strength, debility, or sinking; 2. the existence and the kind of pain in the chest, abdomen, &c.; 3. some affections of the mouth, palate, throat, nose, &c. The voice is also modified in some cases of typhus fever, cholera, and dysentery, in which it is apt to become feeble and husky; in phthisis and diseases of the larynx and trachea, in which it frequently becomes extremely hoarse; and in hysteria, in which it is often suddenly and sometimes long lost and inaudible.

The articulation is affected by paralysis and spasmodic diseases, and, like the voice, in cases of great debility.

These hints may assist in an examination of the subject, and the reader will find an account of some other affections of the voice in the works of M. Portal. (Mémoires sur plusieurs Maladies, tome i. p. 273; ii. p. 109; iii. 159, 165. Anatomie Médicale, tome iv.) [For the physical conditions of the thorax, see Auscultation, and Chest, Exploration of the.]

8. On the Morbid Affections of the Circulation.—The morbid affections of the function of the circulation are observed in the pulse, in the pulsations of the heart, and of the carotids and abdominal aorta, and sometimes of the jugular vein, and in the capillary or extreme vessels.

The varieties in the pulse have formed the subject of many and even voluminous works. In the present place we shall pursue our accustomed plan of noting down those varieties of the pulse which have struck us as being of most practical importance. The first point to be noticed in this place is its frequency.

We have generally observed that the pulse is much more frequent in the early periods of fever than of inflammation. In fever with congestion of the brain there is frequently an unnatural slowness of the pulse. In fever complicated with inflammatory affections, the pulse is, on the contrary, more frequent than in the simpler cases of fever. In acute inflammatory diseases, in general, the pulse is usually slightly frequent and hard; but it is modified by various circumstances, of which the principal are the part affected, the stage of the disease, and the treatment. In diseases of the brain the pulse is often very peculiar and characteristic. In the first stage of inflammation of this organ, the pulse is frequent, and sometimes of unequal frequency: as effusion and compression take place, the pulse becomes slow, and it attains a still greater frequency than before towards the conclusion of the disease. In apoplexy the pulse is slow, and often irregular in the beginning, and more frequent in the later periods. In inflammation of the bowels we have known the pulse to remain of nearly its natural frequency until the stage of sinking has taken place; so that the pulse must be regarded as a very unsafe guide in this morbid affection: it is more usually, however, of increased but variable frequency, and small and feeble. In pleuritis and peritonitis, and most other inflammatory diseases, the pulse is generally somewhat increased in frequency. The pulse is generally more frequent as the disease is more advanced, unless its violence has been subdued. The peculiarities in the cases of encephalitis and enteritis have been already noticed. In the later stages of inflammatory diseases the pulse is also apt to become or to remain unnaturally frequent, as an effect of the loss of blood from repeated venesection; it is therefore important to observe every symptom, not to be misled by a continued frequency of the pulse.

It is not unusual to observe, that in various diseases the frequency of the pulse remains when the morbid actions have apparently subsided: in such a case it is necessary to continue our attention, and watch and wait for the diminution of the frequency of the pulse; and, if this event do not take place in a moderate space of time, to ascertain whether the disease be in fact subsided, or only mitigated and pursuing its course in an insidious form. This watching is particularly necessary in cases of pleuritis and peritonitis. Frequency of the pulse is apt to be observed as an effect of intestinal irritation: in that case, as in erethismus and in exhaustion with reaction, there is also perceptible palpitation of the heart. This affords, indeed, a criterion by which such a state of frequency of pulse is distinguished from that observed in phthisis and other organic diseases.

Frequency of the pulse is the effect of repeated bloodletting. The first effect of a copious bloodletting is a state of syncope with slowness and feebleness of the pulse: the cumulated effect of repeated bleeding, when there is reaction of the system, is a frequent, full, and throbbing or bounding pulse; but if the powers of the system be broken, the pulse is frequent and feeble, with the other symptoms of the state of sinking already repeatedly noticed. In the case of sinking, the pulse very often retains its frequency until five or ten minutes before the patient expires, when it suddenly falters and soon ceases altogether. It is of the utmost importance to appreciate the effects of loss of blood, and distinguish them from those of the disease, in the course of inflammations. In a case of peritonitis, the pain became mitigated, but the pulse increased from one hundred and twenty or one hundred and thirty to one hundred and forty-five or one hundred and fifty. What was the cause of this increase of pulse? The carotids and afterwards the aorta were observed to beat, and there was a beating movement of the chest during expiration. We were of opinion that these were the effects of loss of blood;

and so it proved: the number of the pulse diminished, but the throb continued for several days longer.

We have now to remark the degree of frequency of the pulse in morbid affections of a more chronic character.

The frequency of the pulse affords an important diagnostic mark of disorder of function from organic disease, and of different organic diseases from each other.

In all the chronic forms of the dyspepsiæ, the pulse in general retains its natural frequency; it is apt, however, to be frequent in the acute dyspepsia; and it is apt to become frequent in the later stages of the chronic, when the affection leads to great loss of flesh, to dropsical affections, or to organic changes; and the case may be considered as assuming an alarming character as the pulse thus becomes unnaturally frequent.

Some organic diseases induce an early and characteristic frequency of the pulse, especially tuberculous phthisis, tuberculous disease of the mesentery, and chronic inflammation of the pleura and of the peritoneum. Others often proceed with very little frequency of the pulse, as some organic diseases of the liver, and especially of the ovarium, &c.

There is a variety of the pulse which may properly be termed the nervous; and to which the elegant and often-quoted observations of Celsus particularly apply: "venis enim maxime credimus, fallacissimæ rei; quia sæpe istæ leniores celerioresve sunt, et ætate, et sexu, et corporum natura: sæpe eas concitat et resolvit sol, et balneum, et exercitatio, et metus, et ira, et quilibet alius animi affectus: adeo ut, cum primum medicus venit, solicitudo ægri dubitantis quomodo illi se habere videatur, eas moveat. Ob quam causam periti medici est non protinus ut venit, apprehendere manu brachium: sed primum residere hilari vultu, percontrarique, quemadmodum se habeat; et si quis ejus metus est, eum probabili sermone lenire; tum deinde ejus corpori manum admovere. Quas venas autem conspectus medici movet, quam facile mille res turbant!" (Lib. iii. cap. vi.)

The frequency of the pulse in phthisis, mesenteric disease, &c. is, on the other hand, permanent, neither easily augmented, nor becoming diminished. We have, indeed, observed nervous excitement to lower the number of the pulse of phthisis for a short space of time.

The next peculiarity of the pulse is its state of irregularity.

This affection of the pulse occurs principally from disease within the head, disease of the heart, and disorders of the digestion, and from various diseases affecting the respiration, as hydrothorax. In inflammation of the brain the pulse is often of unequal frequency, (see Dr. Abercrombie's excellent paper, Ed. Med. and Surg. Journal, vol. xiv. p. 267); in cases of compression, it is frequently irregular. Irregularity of the pulse is very usual in diseases of the heart, and especially of its valves: it is sometimes merely intermittent, and sometimes extremely irregular in its beats, and in its size and force. In these diseases the peculiarity of the pulse is generally permanent. Nothing is more common than occasional intermittence and irregularity of the pulse from indigestion, and from the various disorders of the bowels, as diarrhœa, &c. Dyspnœa is frequently attended with intermission in the pulse probably from its mechanical effect upon the action of the heart. A very deep inspiration and a full expiration have, in some persons, the effect of arresting the action of the heart in a temporary manner. The pulse is, probably from a similar cause, frequently irregular in cases of asthma, or hydrothorax, and in very corpulent persons, an interruption being often observed on inspiration. Irregularity of the pulse is apt to occur in cases of erysipelas, gangrene, &c. in the state of sinking, and in the last stages of many diseases.

The next peculiarity in the pulse, which we shall notice very briefly, is its state of fulness or smallness.

The pulse is frequently very full on the attack of apoplexy, but gradually loses this character as it becomes more frequent. In organic disease of the heart the pulse is either full or small, according to the nature of the affection. Enlargement of the heart with thickening of its parietes, sometimes induces a full and strong pulse; whilst mere dilatation of the heart is attended with a soft and feebler pulse; and, in some other diseases of this organ, especially of its valves, the pulse becomes very small, and sometimes almost imperceptible.

In inflammation of the intestines there is a characteristic smallness of the pulse.

In cases of exhaustion with reaction of the system, we have already stated that the pulse is large and bounding: this characteristic ceases as the reaction subsides and the state of sinking occurs.

The smallness of the pulse is sometimes so remarkable as to have given origin to the terms "thready" or "wiry."

The most extraordinary degree of palpitation and of pulsation of the carotids, and even of the abdominal aorta, is observed in some cases of exhaustion from reiterated loss of blood.

Palpitation is a common symptom in cases of hysteria and other nervous disorders; a still more frequent symptom is a feeling of "fluttering" at the heart, and in the region of the stomach, and throbbing of the temples. In some cases there is a preternatural pulsation in the epigastric region: Dr. Baillie observes, "it is perhaps difficult to ascertain, in many instances, the cause of this increased pulsation of the aorta in the epigastric region; but in most cases it will be found to be connected with an imperfect digestion, and an irritable constitution." A similar pulsation is sometimes the effect of aneurism of the aorta, or of a tumour situated over the aorta. In this case the general health may be unimpaired. Pulsation of the jugular veins [the *venous pulse*] has been observed in hypertrophy of the right ventricle [and in morbid insufficiency of the tricuspid valve].

In the capillary circulation we are enabled to observe a characteristic symptom of certain diseases, and to ascertain, in some degree, the powers of the circulation and the state of the blood. We are presented with an opportunity of observing the condition of the capillary circulation by examining the condition of the extremities — the

nose, the cheeks, the ears, and the hands and feet, the prolabia and the finger-nails. Some diseases have a peculiar influence over the capillary circulation, inducing coldness and lividity of the extremities. This is particularly observed in some cases of enteritis, of cholera, and of dysentery,—in the acute dyspepsiæ, in tuberculous disease, &c. In other diseases, the same tendency to coldness of the extreme parts denotes a failure in the general strength of the system, and should be carefully watched. It is to be observed, however, that flushing and heat sometimes occur during a state bordering on that of sinking.

In some old persons we have observed a remarkable tendency to lividity of the finger-nails. It appears to us to be from defective powers of the capillary circulation that cold is so difficultly borne by infants and very old persons.

Whilst a livid hue of the prolabia and nails denotes feebleness of the circulation, an exanguious paleness is the frequent attendant on an aqueous state of the blood, or the effect of some morbid affections, as chlorosis, purpura, &c. or of considerable loss of blood.

There is, in the capillary circulation, a peculiarity which may be denominated the tendency to hemorrhage. This state is sometimes the effect of intestinal disorder and irritation, and then it leads to epistaxis, hæmatemesis, melæna, menorrhagia, and even hematuria. (See an instance of this in Bateman's Reports of the Diseases of London, p. 123.) In other cases the state of exanguious paleness precedes and forebodes the hemorrhage, as in some instances of purpura, in which the tendency to extravasation of blood is more general, and occurs, in different cases, in all or each of the cutaneous and mucous textures, together or singly.

Another effect of an enfeebled capillary circulation is œdema or anasarca. This is a frequent occurrence in protracted cases of chlorosis, of repeated bloodletting or protracted hemorrhage, and of the failure of the vital powers in disease, and in old age. [For the physical conditions of the thorax, &c., see Auscultation, and Chest, Exploration of the.]

9. **On the functional affections of the Alimentary Canal.**—In this division of the subject we shall briefly notice the symptoms which may be taken from the morbid affections of the pharynx and œsophagus, the stomach and bowels, and the sphincter ani.

The act of deglutition is performed by the pharynx and œsophagus, with the aid of the cheeks, fauces, &c. Sometimes this act is liable to be interrupted by diseases of some part of the canal itself, or of the adjacent organs. By observing the kind of effort made by the patient, we may often ascertain pretty nearly what is the situation of the causes of obstruction. If the fauces be defective, the substance attempted to be swallowed is often forced through the nostrils; if the cardia be obstructed, the patient frequently regurgitates a large quantity of food apparently swallowed. In cases of tumours, as scirrhus, aneurism, &c., the trachea is often compressed, and a croupy dyspnœa and cough are apt to be conjoined with dysphagia.

There is much difficulty of swallowing in the very last stages of typhous fever, and in the state of sinking in general; the attempt is not unusually attended with painful choking, coughing, and catching of the larynx.

Deglutition is impaired in some cases of paralysis.

Dysphagia is occasionally observed as a symptom in hysteria, and other nervous and spasmodic disorders.

The functions of the alimentary canal are generally much more deranged in fevers than in inflammations, except those of the mucous membranes. Of the former, anorexia is often the first, and constipation almost a constant symptom, and the alvine evacuations are dark and fetid; in a late stage of protracted fever, aphthæ, diarrhœa, melæna, or a tympanitic affection, not unfrequently supervene: in inflammations, the stomach and bowels are not essentially, and often not at all, affected, except, indeed, in the colliquative stage, when aphthæ and diarrhœa are not uncommon. A similar remark applies to the class of disorders as distinguished from diseases: in the former there is much, in the latter frequently very little, stomachal or intestinal disorder.

The stomach and bowels are apt to be much affected in diseases of the head: concussion frequently induces vomiting as its first symptom. Vomiting is often a precursory symptom of apoplexy. In cases of compression, the stomach and bowels are apt to be torpid, and are with difficulty acted upon by medicine.

Inflammation of the stomach is attended by irritability and frequent vomiting. In enteritis the bowels are apt to be obstinately costive,—and there is at length, in many cases, much tenderness and tympanitic affection; the latter symptom is also observed in dysentery.

Vomiting, hiccup, the ineffective operation of purgative medicine, distension, &c., occur in some cases of enteritis, strangulated hernia, intus-susceptio, and in the last stages of many diseases.

Hiccup, rumination, and vomiting, are frequent symptoms in the dyspepsiæ. Vomiting occurs in cholera, and in many cases of poisoning; and frequently as a symptom of gall-stones, and of renal calculus or inflammation.

In some chronic diseases of the bowels, the convolutions of the intestines are apt to be distended and raised in the form of a transient painful, spasmodic, and flatulent tumour; and the passing of the food, or the evacuation of the bowels, is attended with much pain.

The substances rejected by vomiting are principally food, mucus, bile, fæces, pus, and blood.

The morbid appearances observed in the alvine evacuations are chiefly diarrhœa, scybalæ, mucus, pus, and blood; the motions themselves may be scanty or copious, dark-coloured or light-coloured, and disordered and offensive in different degrees; the appearance of the mucus and of the blood is also various. It has already been observed that the alvine evacuation is generally much more offensive and disordered in fevers than in inflammations, and in the class of disorders than in that of organic diseases. In some protracted diseases, however, the alvine evacuations are very morbid, especially in diseases of the liver, and of the mesentery. In those cases of disease of the liver

attended with icterus, as in all other cases of jaundice, the motions are clay-coloured, and deprived of the yellow tinge imparted by the bile.

In some cases, both of disease of the liver and of the mesentery, but especially the latter, the appetite is great, the food passes off quickly, and the motions are copious, fetid, and light-coloured.

The motions are generally pale and fetid when the food passes through the alimentary canal rapidly, as in lientery.

The alvine evacuations are generally very offensive in all cases attended with rapid loss of flesh, but in none more than in those in which the powers of life are, at the same time, in a state of decline — as in the decay of old age, in cases of slow fevers, &c.

Mucous evacuations are the effect of irritation or inflammation of the mucous membrane of some part of the intestinal canal, especially the rectum and colon. They occur in dysentery, as the effect of corrosive poison, and in cases in which the rectum is irritated by impacted and scybalous fæces; and they are often mixed with blood: in the last case there are often severe attacks of pain in the seat of the sigmoid flexure of the colon, and copious discharges of blood—effects which are relieved by evacuating the rectum by enemata.

Sometimes an exudation takes place from the internal surface of the intestines, which resembles membrane or tænia, and is discharged per anum, exciting much needless alarm in the patient.

Discharges of blood occur from indigestion and intestinal irritation; hæmatemesis and melæna are often conjoined, from these causes, in the different forms of the dyspepsia.

That state of things which gives origin to purpura, frequently conjoins other hemorrhages, as well as the petechial rash and vibices, with the vomiting and dejection of blood. We have already mentioned the occurrence of melæna as a formidable symptom in fevers. Discharges of blood from hemorrhoids should be distinguished from the more serious case of melæna.

The rectum and sphincter ani are apt to be affected with tenesmus, obstruction, and paralysis.

Tenesmus accompanies some of the diseases of parts in the neighbourhood of the rectum, as calculus, schirrus of the prostate gland, diseases of the uterus, &c., as well as those of the rectum itself. It is almost unnecessary to state how painful a symptom it is in most cases of dysentery, of diseases of the mucous membrane of the colon and rectum, of impacted scybalæ, &c.

Obstruction in the rectum is the effect of disease of the part itself, generally stricture or scirrhus, of the pressure of the uterus in retroversio uteri, of organic tumours affecting adjacent parts, &c. In every case in which symptoms of this kind occur, an examination per rectum should be instituted. We speak of the introduction of the finger; that of the bougie requires great care not to mistake the obstruction offered by a fold of the intestine, or the promontory of the sacrum for disease.

A paralytic state of the rectum and involuntary evacuations occur in the last stages of apoplexy and other diseases of the brain, and in disease of the spine.

Involuntary motions are the frequent effect of the extreme debility observed in typhous fever and in the state of sinking in general.

10. **Of the functional affections of the Urinary Organs.**—The symptoms to be drawn from the morbid affections of the functions of the urinary organs, relate to the secretion, excretion, and condition of the urine, and to the substances which are apt to be mixed and expelled with this fluid.

The secretion of urine is either too copious, scanty, or suppressed. A too copious secretion of urine takes place in the disease termed diabetes, and a very rapid secretion of limpid urine is sometimes observed in cases of hysteria and other nervous disorders. The urine is apt to be unnaturally scanty in dropsies. The case of total suppression of urine is generally a very serious affection, leading to coma and a fatal termination. (See a Paper by Dr. Abercrombie, Ed. Med. Journ. vol. xvii. p. 210.)

The excretion of urine is apt to be morbidly affected by strangury, dysury, retention, and enuresis.

Strangury occurs from the application or administration of cantharides, in some cases of hysteria, dysentery, and calculus, and other morbid affections of the bladder and adjacent parts.

Retention of urine is more frequently a symptom of disease. It is observed in the late stages of typhous fever, and is of very unfavourable augury; it occurs in diseases of the brain and of the spine; it is observed as an effect of debility and of insensibility in general; in the state of sinking, in extreme old age, &c.; it is not unusual after delivery; it is sometimes induced by the action of cantharides; and it is a symptom in retroversio uteri, and in other cases in which the neck of the bladder is subjected to compression from the state of the viscera situated in the pelvis. In the cases attended by insensibility, we have observed a constant elevation of the knees as the effect of the retention of urine, and of the distended and tender state of the bladder.

Enuresis, or the involuntary flow of urine, is also a symptom observed in typhous fever, and in diseases of the brain and of the spinal marrow. It occurs in the former case from great debility and insensibility; in the latter from insensibility or paralysis. It is sometimes even a rather early symptom of chronic inflammation of the brain.

Enuresis is an effect in some diseases of the bladder, and it arises sometimes from injury sustained during delivery.

We have once or twice met with cases in which the urine was expelled by involuntary gushes, occasioned by sudden contraction of the bladder; they have appeared to be of a hysteric or nervous nature. They have occurred in pregnancy, exciting the fear of abortion.

The appearances of the urine and the nature of its deposits, are subject to great variety, and still afford scope for observation and experiment. We are still in want of a series of careful observations on this subject in the different kinds, stages, and circumstances of fevers and inflammations, and of disorders and diseases in general.

In some cases the urine is copious and limpid, and remains, on cooling, free from sediment: this is particularly observed in hysteric and nervous

affections. In other cases, the urine is so charged with matters in solution, that there is not only a sediment on cooling, but a pellicle on its surface from evaporation or exposure to the air; this has particularly occurred in some instances of derangement of the digestive functions.

More frequently there is simply a copious sediment on cooling. These sediments are of different periods. We shall merely briefly state, in this place, the points which mostly call for attention from the practitioner.

The first is to determine whether the urine be acid or alkaline: this is readily done by using a little paper tinged with the tincture of litmus, or so tinged and reddened by a weak acid; acidity turns the blue paper red, and alkali restores to the reddened paper its blue tint. If acidity prevail, we look for deposits of the urate or lithate of ammonia; which is pulverulent or amorphous; or of the uric or lithic acid, which is crystallized, constituting the red gravel. If the urine be alkaline, which is observed more rarely and later, we expect a white pulverulent sediment of the mixed phosphates; or white crystals of phosphate of magnesia and ammonia, or the white gravel.

Excess of urea is detected by the deposit of crystals on the addition of nitric acid; albumen, by exposure to an elevated temperature; mucus, pus, and blood, by the test before mentioned.

Besides the tendency to deposits on cooling, the urine is sometimes charged with albuminous matters coagulable by heat, especially in certain cases of dropsy and disease of the kidney. It is almost unnecessary to notice the bilious tinge of the urine in the different cases of icterus, and its saccharine impregnation in diabetes.

Discharges of mucus with the urine attend chronic inflammation of the bladder, disease of the prostate glands, calculus, &c. Pus and blood are sometimes observed as the effects of calculus and ulcers of the bladder or kidney. These discharges should be carefully considered.

Copious discharges of blood occur in some instances of intestinal irritation and of purpura.

We once had a patient who discharged a quantity of dark-coloured blood on any exposure to severe cold; the affection yielded to the genial influence of a warm bed.

11. **On the functional changes in the Uterine System.**—The morbid changes in the function of the uterine system relate principally to the suppression, the too copious flow, or the unnatural state of the discharges.

The retention or suppression of the catamenia occurs in the second stage of chlorosis: in general, but by no means always, the flow loses its colour and diminishes in quantity very gradually, as the effect of this disorder.

In many organic diseases—in phthisis pulmonalis, in mesenteric diseases, &c. and in cases attended by great debility and emaciation—the catamenia are very apt to become suppressed, and that at once, without the changes in their appearance just noticed.

Exposure to cold, fear, and other causes, are apt to induce suppression of the catamenia. Much purgative medicine and fever will sometimes induce the same effect; but fever sometimes, on the contrary, seems to occasion a flow of the catamenia before the proper period.

The catamenia are usually suppressed during lactation.

Menorrhagia is less frequent than suppression of the catamenia; we have known it induced by intestinal irritation; it is frequently an effect of fibrous tumour of the uterus.

The fluor albus is an effect of many states of disorder, of great weakness, of frequent miscarriages, &c. It is often a source of great debility too, and of the inefficiency of medicine to remove a series of nervous affections.

Morbid discharges from the vagina take place in cases of polypus, scirrhus, ulcers, and other diseases of the vagina or uterus: the character of the discharges conduces very much to the diagnosis; when protracted, they ought always to lead to a careful examination.

Discharges of blood frequently depend on the existence of polypus: such discharges may, however, be the result of menorrhagia; or, during pregnancy, of a partial detachment of the placenta.

12. **The physical conditions of the Abdomen.**—The physical conditions of the abdomen are ascertained by an external examination, and by examinations per vaginam and per rectum. The external examination consists, at first, in applying gentle pressure, to ascertain whether the abdomen, or any part of it, be the seat of an enlarged viscus, of a tumour, of effusion, of tympanitis, of pulsation, &c. The liver may be felt lower in the hypochondrium than usual, from hydrothorax; or it may be enlarged in itself. The latter case will be distinguished by tenderness and other symptoms of hepatic disease. The stomach, and especially the pylorus, when diseased, may descend below its natural situation, and be found in the umbilical, and even in the hypogastric region. The symptoms give the diagnosis. It is only necessary to add in this place, a list of the principal viscera and tumours which may present partial indurations on examination of the abdomen. The former are—1, the liver; 2, the spleen; 3, the stomach; 4, the intestines; 5, the mesentery; 6, the kidney; 7, the bladder; 8, the uterus; 9, its appendages; and these organs should be traced on every examination of the abdomen:—the latter are—1, abscess; 2, effusion of lymph; 3, aneurism; 4, intestinal calculi, indurated fæces, &c. These and other sources of tumour should also pass through the mind in every examination of the abdomen. In many cases it is important to place the patient in the prone position, and to examine the regions along the spine, by the hand and by the stethoscope.

The abdomen may be generally enlarged—1, by polysarcia; 2, by anasarca; 3, by ascites; 4, by dropsy of the ovarium; 5, by tympanitis, &c. The two former are readily distinguished by comparing the elasticity of the one with the opposite, characteristic of the other. Ascites is ascertained by the sense of fluctuation conveyed by percussion. Early in the disease, the prominent part of the abdomen is also sonorous; the sides are without sound. It is frequently necessary to press through ascites, in order to arrive at an enlarged viscus or a tumour. Dropsy of the ova-

rium, on the contrary, frequently presents a total absence of sound in its most prominent part, whilst the sides of the abdomen are sonorous. In tympanitis the whole of the abdomen is tumid, tense, and sonorous.

There can be no doubt that the stethoscope might be used with some advantage in ascites, tympanitis, diseases of the intestines, &c. as well as in aneurism.

The examination per vaginam is essential to the diagnosis of diseases of the uterus and its appendages, of pregnancy, &c. To ascertain the condition of the vagina and of the os uteri, a speculum, consisting of a cylinder of glass of a proper form, is highly useful. Examination per rectum frequently confirms the diagnosis made by that per vaginam, and determines that of diseases of this intestine itself. Concerning the application of the stethoscope to the diagnosis of pregnancy, see the article SIGNS OF PREGNANCY.

13. **The effects of Remedies.** — The effects of *bloodletting* are those which are most appropriately introduced in this place as diagnostic of diseases.

It is one of the most remarkable facts in physic, that if several patients of similar strength and constitution, but affected by dissimilar diseases, be respectively placed in the erect position and bled to deliquium, they will be found to have lost very various quantities of blood.

The rationale of this is to be found in connection with an equally interesting fact, that different diseases induce in the constitution different powers or susceptibilities in regard to the effects of loss of blood. Each disease appears, indeed, to possess its own peculiar and intrinsic virtue in this respect. This is determined by placing the patient perfectly erect, and bleeding to incipient syncope; the quantity of blood which flows is the measure of the protective influence of the disease in one class of cases, and of its influence in superinducing a susceptibility to the effects of loss of blood in the other. A scale of diseases might be formed representing these properties. It would begin with congestion of the head, or tendency to apoplexy; inflammation of the serous membranes, and of the parenchymatous substance of various organs, would follow; and, lastly, inflammation of the mucous membranes. This part of the scale would be divided from the next by the condition of the system in health. Below this would be arranged fever, the effects of intestinal irritation, some cases of delirium, reaction from loss of blood, and disorders of the same class, with hysteria, dyspepsia, chlorosis, and cholera morbus. Persons in health and of moderate strength will generally faint if bled in the erect posture, on taking fifteen ounces of blood. We have known seventy ounces taken in the sitting posture, in the tendency to apoplexy, without syncope; but the case is an extreme one. Patients with pleuritis or pneumonia frequently lose thirty-five ounces of blood without fainting. In bronchitis little more is borne to be lost than in health. A stout person in fever will frequently faint on losing ten, twelve, or fourteen ounces of blood. In intestinal irritation, with urgent symptoms even, the abstraction of nine or ten ounces of blood will generally induce deliquium. In delirium tremens, or puerperal delirium, the patient soon faints from loss of blood. The same thing is still more observed in those cases of violent reaction which arise from loss of blood itself. In dyspepsia, hysteria, and chlorosis, the susceptibility to syncope from loss of blood is very great; and we have known a patient of good strength, affected with cholera, faint on taking four ounces of blood, although she had shortly before borne to lose nearly twenty ounces without faintness, under the influence of inflamed mamma.

The practical application of these facts consists chiefly in its affording a rule for bloodletting in all cases in which this measure is required to be fully instituted; a guard against undue bloodletting, both in this and some other cases; and a source of diagnosis. The fact is here mentioned with reference to the latter subject only.

If much blood has flowed before syncope has occurred, we suspect inflammation; if little, we suspect that, however similar the symptoms, the case is, in fact, of a different nature—perhaps irritation, perhaps exhaustion. We have also found that, in every case in which early syncope occurs from bloodletting, the remote effects of loss of blood, as reaction or sinking, are also very liable to occur; and it is in these cases that sudden dissolution has followed the use of the lancet. There is, in every point of view, intolerance of loss of blood. The reverse of all this obtains in inflammation, which seems to be incompatible, to a certain degree, with the effects of loss of blood, which are, however, very apt to supervene as the inflammatory action subsides.

There is another point of view in which the effects of bloodletting may prove diagnostic; it is, when, instead of effectually removing the disease, it only relieves a symptom which speedily returns, perhaps with augmented violence. This effect is seen in cases of chlorosis, in which the pain of the head or the pain of the side has led to the repeated but mistaken use of the lancet. Another case is that in which one of the remote effects of loss of blood itself, as pain of the head or throbbing of the temples, has suggested the further use of bloodletting. The eyes of the practitioner are at length opened to the folly and imprudence of these measures by a state of debility not entirely free from alarm. (Researches on the effects of Loss of Blood.)

These observations might be extended to other remedies, and especially to mercury, digitalis, purgative medicines, &c.

We have thus sketched the principal sources of the diagnosis of diseases. In another work we have treated of the subject of diagnosis still more practically, by endeavouring to furnish the student with a view of the objects presenting themselves to his notice in the wards of hospitals or the chambers of the sick. But the application of what is contained in the present article is sufficiently obvious to make it unnecessary to add to the length to which it has already unavoidably extended. [More full information on the various points may be obtained by turning to the different articles in the body of the work that are specially referred to.]

MARSHALL HALL.

SYNCOPE, (from συν and κοπτειν,) *animi deliquium, leipothymia; fainting.*

Syncope may be defined to be a sudden suspension of the heart's action, generally transient, but occasionally continuing for some hours, and perhaps even days, accompanied by cessation of the functions of the organs of respiration, internal and external sensation, and voluntary motion.

Sauvages distinguishes *leipothymia* and *syncope* as separate genera, alleging that the former begins in the head, while the latter is first perceived at the præcordia. There can, however, be little doubt that Morgagni is correct in considering these two words to designate the same affection occurring in different degrees of intensity; the characters ascribed to the leipothymiæ being merely less strongly marked than those assigned to syncope.

Fainting sometimes takes place without any previous warning; often, however, it is preceded by a general feeling of indisposition with languor, and by some of the following symptoms,—anxiety, a sensation as of sinking referred to the epigastrium, palpitations, confusion of mind, giddiness, obscurity of vision, dilated pupils, ringing in the ears, quivering of the lips, paleness of the face, coldness of the extremities, partial sweats, flatulence, nausea.

The phenomena of syncope, as indicated in the definition above given, are evidently much the same with those of sudden death. It is only, however, in the more intense forms of the affection that consciousness is wholly lost; and though the pulsation of the arteries is in all cases imperceptible, a feeble action may be generally discovered in the heart itself. Morgagni states that there is sometimes relaxation of the sphincters, with involuntary discharge of the fæces and urine.

The ordinary duration of syncope is from a few seconds to a minute, but occasionally it extends to hours; and cases are on record in which it is said to have continued for several days. In the opinion of Senac, the existence of such cases is doubtful, and, at any rate, he conceives they must be very rare. If we admit their occasional occurrence, the present state of our knowledge of the laws of human physiology will hardly allow us to suppose that the functions of respiration and circulation are *wholly* suspended for such a period.

The sensations which precede complete syncope are generally described by the patient as more or less distressing, commonly suggesting a painful impression that life is about to be extinguished. This does not, however, seem to be uniformly the case; and Chamberet, (the author of the article *Syncope*, in the Dictionnaire des Sciences Médicales,) adduces his own experience and that of the celebrated Montaigne, to show that the state of fainting, previously to the total loss of sensibility, is sometimes attended with highly pleasurable sensations.

With regard to the *varieties* of this affection, it has already been stated that leipothymia appears to be merely a less intense and perfect form of syncope. Dr. Parry seems to stand almost alone in considering the angina pectoris merely as a case of syncope, referable to a peculiar cause, namely, disease of the coronary arteries. Faintness is undoubtedly a part of this severe affection; but it is obviously inadmissible, on any sound principles of nosological arrangement, to include a disease which presents such marked and peculiar features, under a designation applied to a class of cases wholly destitute of those features, merely because they have some points in common. More recent investigations have shown that Dr. Parry's view of the pathology of angina pectoris is incorrect, in referring that affection exclusively to disease of the coronary arteries. As, however, diseases of the heart are among the most common causes of syncope, it is highly probable that those of its nutrient vessels may sometimes induce fainting, either with or without the peculiar characters of angina.

Sauvages distinguishes two species of his genus Leipothymiæ:—1. leipothymia à pathemate; 2. leipothymia stomachica. Under syncope he enumerates no fewer than twenty-one species, all of which are denominated from supposed occasional causes: perhaps, indeed, there is no malady which is induced by a greater number and variety of such causes. The following enumeration comprehends most of those which have been mentioned by authors, arranged, as far as is practicable, according to the part of the system on which they seem primarily or chiefly to act.

1. **Causes which act more especially on the Circulating System.**—Organic and other diseases of the heart, pericardium, and large arteries, and malformation of those parts, are among the most frequent and formidable causes of repeated faintings; sometimes appearing immediately to induce them, at others, rather to give a predisposition. Syncope is not a constant attendant on any one form of cardiac disease, even when in its highest degree of development, though reason and experience show that it is most liable to occur when the obstruction to the regular action of the heart is greatest; and hence, as Senac observed, it is chiefly met with in the more advanced stages of disease, and is often the forerunner of death. We do not seem to possess any satisfactory data from which to infer in what particular forms of disease this symptom is most common; but it seems probable that the opinion of Senac and Morgagni is well-founded,—namely, that it is especially met with in cases of dilatation. The former author justly remarks that the coagulation of the blood in the cavities of the heart is not, as many have supposed, the cause of fainting and death, but rather their effect. He also mentions a physiological fact which, if true, is certainly curious,—that if the apex of the heart be touched by a probe, (as in the case of penetrating wounds of the chest,) instantaneous syncope is produced.

Loss of blood, whether by spontaneous hemorrhage or by artificial means, is a very familiar cause of syncope; and when the evacuation is excessive, of syncope in its most dangerous form. Thus, in cases of hemorrhage connected with parturition, fainting not unfrequently passes into death; and even when recovery ultimately takes place, its duration and repeated recurrence is often most appalling. Professor Burns cites from La Motte a case in which a woman fainted no less than twenty times in one night. Arterial hemorrhage

seems to have a greater tendency to produce syncope than an equal loss of blood by a vein, and abstraction of blood by leeches still more so. There can be little doubt that this last fact is to be referred to the laws of sympathy, which, however ill-understood, are not the less certain in their influence. Dr. Alison considers the peculiar tendency to syncope from even a small abstraction of blood at the commencement of continued fever, as a diagnostic mark of some value in distinguishing that class of febrile affections from those which are merely symptomatic of local inflammation. The fact itself is probably referable to the nature of the exciting cause of continued fever, which seems to act as poison on the body.

Other evacuations, as repeated vomiting, profuse diarrhœa, and sweating, protracted lactation, and copious purulent discharges, not unfrequently induce syncope; but in many of these cases it is probable that the faintness is not wholly caused by the amount of the evacuation, and its consequent influence upon the vascular system, but in part also by the effects of local irritation, through the medium of the nervous system.

Syncope is also an occasional result of two other kinds of evacuation which materially differ from the preceding, inasmuch as they do not immediately proceed from the vascular system: these are the evacuation of dropsical accumulations, and parturition. In each of these cases the most alarming fainting may occur if the body be not adequately supported by bandages, and sometimes even when this precaution is taken. The tendency to syncope from these causes has been generally explained by the removal of pressure from the blood-vessels; but, as in the case of other evacuations, we are disposed to attribute it in part to the nervous system. This conjecture will appear sufficiently reasonable when it is considered that many important viscera are suddenly deprived of a support, or freed from a compression, to which they had been previously accustomed.

A state of the system, the reverse of vascular depletion,—namely, plethora, has been enumerated among the occasional causes of syncope, and is apparently adequate to produce such an effect by embarrassing and even suspending the heart's action.

2. **Causes which act more especially on the Nervous System.**—Sensations of various kinds are familiarly known to produce syncope. Among them, impressions made upon the organs of the external senses furnish some curious instances of those individual susceptibilities which we refer to idiosyncrasy. Thus, the scent of the lily, or the smell of saffron, cheese, &c. will cause faintness in some persons; and the ladies of Rome are said to be so peculiarly liable to it from the smell of flowers, that they generally avoid having them in their apartments. (*Chamberet*, loc. cit. *Clark*, Influence of Climate.) Offensive objects of sight appear to be more generally influential in producing syncope than those of smell. The appearance of blood, of open wounds, or surgical operations, has this effect on a large proportion of persons not accustomed to such spectacles. The sight of a toad, a spider, or even of a cat, mouse, bat, or other creature disgusting to the individual, will sometimes cause faintness, not merely in weak and foolish persons, but even in those whose good sense strives against a repugnance sometimes wholly insurmountable. In a few instances, objects which are pleasing to mankind generally, as the colour red, have been known to induce syncope. Persons unaccustomed to watch bodies in a rotary or undulating motion are sometimes affected by faintness on looking at them for a short time. Impressions on the organs of hearing and touch more rarely cause syncope; though instances are recorded of its being induced by the contact of velvet, satin, and even of paper. The faintness which follows long fasting may be ascribed, in part at least, to the sensations of the stomach when deprived of its accustomed stimulus. The tendency of a great degree of heat to produce fainting especially in crowded apartments where the atmosphere is necessarily vitiated, and in the use of the hot-bath, is another example of the influence of sensations. Dr. Heberden has noted the familiar fact that a person who, after using exercise, stands with his back to a large fire, is peculiarly liable to faint. Violent pain, as in parturition, colic, cramps, &c. will often cause syncope, as also will the opposite sensation of pleasure, as in sexual intercourse. The effect of severe shocks given to the system, as by falls, blows, &c. seems nearly allied to that of pain.

Mental emotions, especially those of a depressing nature, as fear, terror, jealousy, &c. are well known to be capable of inducing syncope. The more exciting passions, as anger, love, joy, &c. are much less liable to produce this effect, and indeed sometimes directly counteract it. Dr. Parry remarks that "courage, confidence, and determination to accomplish certain ends, will sustain the action of the heart, and prevent that syncope which would otherwise arise from considerable hemorrhages."

Violent or protracted muscular efforts, as in running, riding, straining, &c. especially soon after taking considerable quantities of food or drink, and also motion in unusual directions, as gyration and retro-gestation, appear also to furnish instances of syncope induced chiefly through the medium of the nervous system. Under the same head we must of course include all those cases of syncope which consist in cerebral diseases or lesions, such as wounds and concussions of the brain, effusions of blood or serum, inflammation of the brain or its membranes, acute hydrocephalus, paralysis, epilepsy, &c. Heberden remarks that epileptic patients are peculiarly liable to faint on waking in the morning. Morgagni (Epist. xxv. art. 6,) relates a case in which there had been great liability to syncope; on examination, the only pathological change which could be detected were some spiculæ of bone on the falciform process of the dura mater,

3. **Causes which act principally on other Organs of the Body.**—In predisposed persons, almost every local affection is inadequate to produce syncope, but those of some organs are more so than those of others. Among the more common causes, we may enumerate many disorders of the stomach and bowels, as sickness, hunger, repletion, indigestion, particular kinds of food in certain idiosyncrasies, the operation of emetics and acrid poisons, gastric and enteric inflammation,

diarrhœa, worms, colic, constipation, and cholera. Affections of the genital organs, especially of the female, perhaps rank the next. Thus pregnant women are very liable to faintness; and it is said to be sometimes produced by fecundation. Some disorders of the pulmonary organs are not unfrequently attended by fainting, as pleurisy, phthisis, and asphyxia. Dr. Heberden says that it often occurs in hooping-cough. We have the authority of Senac for adding organic diseases of the liver and spleen to this enumeration; they must, however, be comparatively rare causes of syncope.

4. The last head comprehends such causes as are either more general or more obscure in their mode of operation. Such are miasmata or other unknown causes of epidemic diseases, as fever, plague, small-pox, Asiatic cholera, &c.; also digitalis, prussic acid, and other poisons of the narcotic class; the continued inhalation of impure air; repelled eruptions, as variola, rubeola, erythema, scabies, herpes, &c. (Syncope Exanthematica, *Sauvages;*) suppressed discharges, as leucorrhœa, carcinoma, suppurating ulcers, &c. (Syncope Metastatica, *Sauvages;*) and finally every circumstance which exhausts the vital powers of the system.

Of all the occasional causes mentioned in the preceding enumeration, there is probably not one which uniformly produces syncope in every person subjected to its influence. In no morbid affection do we meet with more striking differences of predisposition and liability. Some individuals, especially females, are subject to faint from causes which in no degree affect the great bulk of mankind; while others are found to be proof against those which experience shows to have ordinarily a powerful tendency to induce syncope. These remarkable differences depend on circumstances of moral or physical conformation respecting which our knowledge is very imperfect. Experience, however, enables us so far to generalize on the subject as to consider the female sex much more liable to syncope than the male, and to regard every circumstance which materially impairs the strength either of the body or mind, and still more of both, as giving a predisposition to this affection. Hence females of delicate frame, or who have been educated in habits of excessive indulgence, persons who have been exhausted by hemorrhage or protracted illness of any kind, debauchees, and those who are vapourish, hysterical, or melancholy, are found to be peculiarly subject to faintings. Heberden considers that the tendency to syncope is often greatly determined by the force of habit, a cause which is well known to have a powerful influence in the production of many other affections.

In enumerating the occasional causes, a considerable number of them, including mental emotions and passions, have been classed together, as being supposed to influence the heart chiefly through the medium of the nervous system. This view of the subject, though perhaps the one most generally adopted, has been strenuously opposed by Bichat, and others both before and since his time. That eminent physiologist (Recherches Physiologiques sur la Vie et la Mort, art. v. and xi.) taught that the brain has no immediate influence upon the heart, and that, when death takes place first in the former organ, its extension to the latter is effected through the intervention of the lungs. It was also his opinion that the passions and mental emotions are to be referred primarily to the heart and not to the cerebral system; and in analyzing the pathology of syncope, he contended that the suspension of the heart's action was in all cases the primary circumstance, — that of respiration, sensation, and voluntary motion, being only secondary. There can be little doubt that these views, though not without some portion of truth, are far too exclusive, and indeed the facts and arguments which he adduces in support of them cannot be considered as by any means decisive. Morgagni justly observes that it is one thing to admit that the heart can continue its movements for a time, after its connection with the nerves has been cut off, and another to deny that its actions cannot be deranged, weakened, and even interrupted by irritations of the nervous system. The former fact, he remarks, was well known to Sénac; but that judicious writer did not, therefore, pretend to deny the second.

With regard to what might be termed the **proximate cause** of this affection, we do not conceive that in the present state of our knowledge it would be useful or even practicable to push our inquiries beyond the fact that syncope consists in a suspension of the heart's action. To say that this arises from a "deficient excitement of the nerves of the heart," adds nothing to the knowledge of the chain of causation, though it may serve to veil our ignorance by a form of expression scarcely precise enough to admit of our determining whether the position it assumes be true or false.

Although the phenomena of fainting are hardly if at all distinguishable from those of death, yet even under its most formidable aspects as to protraction or repetition, it is a rare occurrence for the patient to die in syncope. On the contrary, it is often found to be a most important provision of nature for the preservation of life, by arresting hemorrhage, which would otherwise soon destroy it. So unfrequent, indeed, is it for death to begin at the heart, that this organ has been called the *ultimum moriens*. There are, however, many cases in which, after repeated attacks of syncope, the patient may at last sink under a severe one. Bichat instances intense and protracted pain, profuse suppuration, other kinds of evacuation, dropsies, some fevers, and gangrene. To these may be added, on unquestionable authority, including that of Morgagni, organic diseases of the heart.

Many effects or sequelæ of syncope have been noted by authors. Senac says that there sometimes remains for a while a sensation of great fatigue, or of weight in the cardiac region, also palpitation, great anxiety, and transient spasms, especially of the lips. Dr. Abercrombie also remarks that fainting not unfrequently passes into convulsions; and Dr. Armstrong has sometimes observed palsy of one side of the tongue follow recovery from syncope which was caused by great exhaustion. Heberden says it occasionally passes off with vomiting, discharge of fæces, or eructation: and that in some cases giddiness remains for a time. Epilepsy has also been noted as an occasional effect of fainting.

It has been already observed that in hemorrhages syncope is often found to be an important curative effort of nature. Its artificial production by venesection has been considered by some writers as materially conducing to the efficacy of that operation in fevers and some kinds of local inflammation. Experience seems, however, on the whole to show that the good effects of bloodletting are very much proportioned to the quantity drawn. If this be the case, the early occurrence of syncope must be rather hurtful than beneficial. Such was, in fact, the result of Dr. Welsh's elaborate investigation of the effects of bleeding in the epidemic fever which prevailed at Edinburgh in 1818, &c.

The examinations which have been made into the state of the heart and other organs in persons who have died during syncope furnish some facts which are deserving of notice. Morgagni (Epist. xxv. art. 13) and Senac cite a case from Gretzius, of a woman who died "of continual leipothymiæ," and in whom the cavities of the heart were found not to contain any blood, but to be universally distended with flatus. More recently the attention of the profession has been directed to cases of a description analogous to that of Gretzius, by a paper communicated by Mr. Chevalier, in the first volume of the Med. Chir. Trans. That gentleman relates three cases of sudden though not instantaneous death, two of which began like fainting, the third presenting symptoms of apoplexy. In neither of them was any thing morbid discovered in the internal organs, except extreme flaccidity of the heart, which was not at all contracted, and all its cavities were quite empty. He also cites a case from Morgagni, (Epist. xlviii. art. 44,) resembling the two first mentioned of his own, and proposes to call the affection **asphyxia idiopathica.**

With regard to the state of the lungs, Bichat says that he has ascertained, by a large number of observations, that they are always empty of blood, and that, if otherwise free from disease, they are found collapsed, and do not fill the thorax.

The **diagnosis** between syncope and some other diseases, as well as the difference between it and actual death, is a subject of considerable importance. Chamberet tells us that it is to be distinguished from death by the continuance of certain internal functions, as absorption, secretion, and nutrition, and by the capability of restoration in regard to those which are suspended. This is no doubt true, and yet it is obviously incapable of resolving the question whether the state in which a physician sees his patient be death or syncope. The fact appears to be that we know of no characters by which these two states may be certainly distinguished. Independently, however, of all curative consideration, the question acquires considerable importance from its relation to the subject of premature interment. In temperate climates, where burial is commonly deferred for many days after death, occurrences of this kind must be extremely rare, far more so than popular fears lead many to suppose. The danger is perhaps greater in tropical countries, where interment not unfrequently takes place on the very day of the patient's death. If the body has not been opened, the only infallible precaution against so horrible an accident is to wait for some evidence of commencing decomposition. We were some time since requested to look at the body of a person who had died suddenly, because, at the expiration of seven days, the relations could not satisfy themselves that there was any decisive proof that life was extinct. We could detect no certain mark on the surface exposed to view, but, on raising the eyelids, a conspicuous depression of the centre of the cornea at once resolved the question.

Although asphyxia and apoplexy have many features in common with syncope, and cases may even sometimes occur in which the diagnosis is difficult, yet in practice it is generally pretty obvious, too much so to be easily reconciled with Chamberet's statement, that these affections present the same phenomena, only in a different order of succession. With regard to apoplexy, Dr. Abercrombie well observes that it differs from syncope chiefly or entirely in the state of the general circulation, not in the effect produced on the sensorial functions; this certainly does not imply a perplexing diagnosis. We have also the authority of Senac for considering the distinction of both apoplexy and epilepsy from syncope as sufficiently obvious. The occasional supervention of epilepsy upon syncope has been already noticed, and we suspect that the two affections occasionally assume a very similar aspect. (See a case in Morgagni, epist. xxv. art. 6.) It is, however, in connection with hysteria that practical difficulties are most apt to arise; and in this cause of obscurity syncope partakes with a multitude of other affections, the characters of which are occasionally assumed by that anomalous malady. In regard to the question of diagnosis, it will not be out of place to advert to a class of cases noticed by Dr. Abercrombie. That valuable writer says that he has many times seen children, as, for example, after suffering from tedious and neglected diarrhœa, lie for a day or two in a kind of stupor resembling coma, but eventually recover under a nourishing diet with wine. He remarks that such cases seem to correspond with the "apoplexia ex inanitione" of the older writers, and to differ from syncope chiefly in coming on gradually, and continuing much longer than the ordinary duration of that affection.

We have already seen that it is comparatively rare for syncope itself, however severe or protracted, to pass into actual death. In this point of view the *prognosis* may therefore be considered as generally good. But if we regard syncope as a guide to our judgment of the ultimate event of the cases in which it occurs, the question of prognosis takes a very different form, and requires a very different answer. Viewed either as a symptom of various morbid states, or as a secondary and symptomatic affection, our anticipations of the future will be chiefly influenced by the nature of the circumstances under which it occurs. In organic and other diseases of the heart and large arteries, its repeated occurrence commonly denotes that the morbid affection is considerable and dangerous, and thus it is often the prelude to death. This class of cases was probably the principal foundation of the following aphorism of Hippocrates: — "Qui cerebrò et fortiter absque causâ manifestâ linquuntur animo, derepentè moriun-

tur." The imperfect state of the art of diagnosis in his time sufficiently accounts for his ignorance of a cause, the extensive influence of which was very little understood before the last century. In hemorrhage which is not of very immoderate extent, syncope is, as we have already seen, often a favourable circumstance, by contributing to its suppression: but the repeated and long-continued faintings which are induced by excessive loss of blood, as especially during or after labour, are too commonly the immediate precursors of death.

In considering the prognosis of syncope in a general manner, we may safely follow Senac, who observes that it is to be judged of from the violence, frequency, and duration of the affection, together with the nature of the cause on which it depends, or the circumstances under which it occurs. It has been alleged that faintness is on the whole more unfavourable when it appears at the commencement of acute diseases than when it attends their maturity or decline.

The **treatment** of syncope may be considered under two points of view, the first embracing the curative measures applicable to the affection itself; the second regarding its causes, or the circumstances with which it is connected when presented to us as a symptom or secondary affection. Both of these will sometimes require to be considered conjointly, but it is with the former that we are chiefly concerned in the present article.

Almost all the remedies ordinarily resorted to in order to recover persons from fainting may be comprehended under the general designation of stimulants. The most common are the following:—Fresh cool air, which acts both on the exposed surface of the body and on the respiratory organs; cold water sprinkled on the face, or taken into the stomach; a sudden blow or noise; ammonia and other stimulant errhines; warm embrocations applied to the epigastrium, as ammonia, camphor, &c.; stimulants taken into the stomach, as ether, ammonia, essential oils, ammoniated tincture of valerian, opium, brandy, wine, vinegar, common salt, &c. The recumbent posture is generally found to promote recovery, apparently by facilitating the restoration of the cerebral circulation.

Although the ordinary treatment of syncope, and that which experience has amply justified, is more or less stimulant, it seems generally admitted that remedies of this class cannot safely be used indiscriminately in all cases. The exception appears to be chiefly directed to the more formidable kinds of organic disease of the heart, and to cases of hemorrhage, in which it might be feared that suddenly to substitute a rapid and energetic circulation for a state of syncope would be hazardous. We much doubt, however, if the caution be of any great value, and still more whether it really influences medical practice in any notable degree. At any rate it must chiefly apply to the more permanent stimuli, as alcoholic preparations; for few practitioners would hesitate, in circumstances which require any interference at all, to employ such as are transient in their operation. In those cases in which syncope is regarded as a curative effort of nature, directed to the checking of hemorrhage, stimulants must of course be avoided in common with every other means for recovering the patient. Such is the theory; but the practice is a point far less easily determined. When we remember that syncope is sometimes in such cases the immediate precursor of death, we shall be ready to apply to the subject generally the opinion of Professor Burns in connection with parturition, that "no man of observation can suppose syncope to be safe in hemorrhage after delivery, or hesitate, by opium, and brandy or wine, to recall his patient to animation, or prevent a renewal of the fainting fits."

Not only has the indiscriminate use of stimulants been objected to, but even a remedy of a directly opposite nature, venesection, has been considered applicable to some cases. When, however, Senac and others recommend its employment in circumstances of plethora, congestion, and some organic diseases of the heart, it can hardly be supposed that they contemplate its use during the actual state of syncope, but rather as a preventive remedy, directed to the primary affection.

When fainting has been induced by surfeiting or indigestion, the administration of an emetic is obviously indicated as part of the treatment.

EDWARD ASH.

TABES MESENTERICA.—*Mesenteric disease. Syn.* Atrophia mesenterica; atrophia infantilis, *Hoffmann:* febris hectica infantum, *Sydenham:* scrofula mesenterica, *Sauvages:* parabysma mesentericum, *Good:* physconia mesenterica, *Baumes:* mesenteritis chronica; carreau of the French writers: darrsucht der kinder; gekröschwindsucht, of the Germans: mesenteric fever, hectic fever, and marasmus, of *Underwood:* tubercles of the mesentery; tuberculous disease of the abdomen, &c. &c.

The mesenteric disease may be briefly defined "a chronic enlargement of the mesenteric glands accompanied with gradually increasing emaciation, to which fever of the hectic kind is sooner or later added." The hard and prominent abdomen contrasting so remarkably with the extenuated limbs, gives so peculiar a physiognomy to this affection, that it rarely fails to excite the attention of even the most careless observers.

Of all the names which have been invented for this disorder, perhaps that given to it by Sauvages, *scrofula mesenterica*, is the best, as indicating at once the constitutional nature of the affection, and the organs in which, in such cases, the scrofulous diathesis particularly manifests its influence. The name *carreau*, by which it is commonly known in France, seems to refer to the hard and cushion-like prominence of the abdomen: that of *entero-mesenterite*, by which it has been designated by some recent pathologists, is objectionable, as it rests on the dubious theory of its constant origin in inflammation of the mucous membrane of the small intestines. This term has, moreover, been already appropriated by M. Petit to an acute affection of the mesenteric glands accompanying an inflammation of an exanthematous character, seated in the mucous membrane of the small intestines, and which, unlike the chronic or scrofulous affection, occurs more frequently in the later periods of childhood.

The terms tabes and atrophy, which originated when symptoms rather than pathological condi-

tions regulated nomenclature, were supposed by the older nosologists to indicate well-characterized diseases, but which are now looked upon merely as symptoms; and the terms might, perhaps, without any great disadvantage, be erased entirely from our nosological tables. But as changes in the denomination of disorders are attended with so many inconveniences, we have not ventured to substitute any other term for that of tabes mesenterica, which has been so long established, is so well understood, and is in such general use in this country.

Time of Life, Sex, &c.—Though no period of life is altogether exempt from the chronic or scrofulous enlargement of the mesenteric glands, it having been observed at every stage of existence from fœtal life up to the adult period, and even in old age, yet, indubitably, the period most subject to it is from the time of weaning up to the eighth or tenth year. Perhaps from the third to the sixth year more cases occur than during any other equal space of time. "Diseases of the lymphatic system," says Billard, "are not so common in the eight or ten first months after birth as at an after period. The mesenteric glands, which are so liable to chronic inflammation and tubercular disorganization in children above a year old, especially when suffering from chronic inflammation of the intestines, are rarely implicated in such inflammations when occurring in very young infants. The only alteration usually detected in them, in the latter cases, consists in a slight tumefaction, and on cutting into such glands they are found somewhat hard, and of a rosy or sometimes very red colour." Billard does not, however, assert that children at the breast are altogether exempt from mesenteric atrophy, but only that they are much more rarely the subjects of it. "The lymphatic glands of the neck, and those about the bronchi and root of the lungs, are in very young infants more frequently attacked than those of the mesentery, which last at birth are rather small, and become very liable to disease only in proportion as they become developed." (Traité des Maladies des Enfans nouveaux-nés, p. 633.) "Affections of the lymphatic glands," says Andral, "are most frequent at that period of life when these organs enjoy the most active nutrition, so that this particular case verifies the general law in conformity with which the diseases of every organ are in the direct ratio of its development of structure or action. Thus it is in childhood that theory would lead us to expect the most frequent disease in the lymphatic ganglia, and observation confirms this expectation." (Anat. Pathol. ii. p. 448.) According to Meckel, a very high authority in questions of pathological anatomy, of the whole lymphatic system the mesenteric glands are the part the most subject to tubercular degeneration, more so than even the bronchial glands, or those in the neck, groin, axilla, &c. "This degeneration of the lymphatic glands," he says, "is most frequent in children of from one to four years old, but continues to occur frequently at every period up to the tenth year: after this it grows rarer till about the fifteenth year, when it again becomes frequent, and the patients die with the same symptoms as children do. In general the tubercular degeneration, when it manifests itself at a later period than childhood, is much more dangerous and quickly fatal than at earlier periods." (Handbuch der Pathol. Anat. b. ii. p. ii. p. 379.) "Scrofula," says Dr. Thomson, "seldom attacks children under two years of age. I have seen it, however, occur earlier than this. Dr. Cullen used to mention a case in which the disease broke out in an infant only three months old; but this is an uncommon event. . . . . But though glandular scrofula occurs most frequently in children, it is by no means confined to that period of life, for you find the lymphatic absorbent glands affected in all periods; and accordingly I have even found the lacteal or mesenteric glands affected with scrofulous inflammation in persons of a very advanced age." (Lectures on Inflammation, p. 136.)

Underwood, in his account of mesenteric fever, which, though written in his usual rambling and indistinct manner, contains many valuable practical remarks, states that according to his experience the period most liable to mesenteric disease is that from the third or fourth up to the eighth or tenth year, adding that in decidedly scrofulous habits it may, however, occur much later. Pemberton tells us he had met with the disease at every period from the sixth month up to the twelfth year. Gardien thinks that he has seen the greatest number of cases about the seventeenth year.

[Tubercles were found in the mesenteric ganglions in one-fourth of those who died of phthisis, whose bodies were examined by M. Louis (*Researches on Phthisis*, Sydenham Society edition, p. 93, London, 1844). In 100 adults, who died of the same affection, according to another observer, M. Lombard, they were found ten times; whilst, in the bodies of 100 tuberculous children, they were found thirty-one times. At the Hôpital des Enfans malades, of Paris, in tuberculous subjects from two to fifteen years of age, tubercles were found in the mesentery in one half.

It is a common belief, that the disease is frequent in very young infants. This, according to MM. Rilliet and Barthez, (*Traité Clinique et Pratique des Maladies des Enfants*, iii. 422, Paris, 1843,) is a great error, which it is important to correct. Should it be shown that the disease rarely attacks infants under three years of age, abdominal tumours and general tumefaction of the abdomen of young subjects must necessarily be generally independent of mesenteric tuberculosis. The researches of those gentlemen have demonstrated,—that mesenteric disease is slighter the younger the child — that the tuberculization attains its maximum of development between the 5th and 10th year; and that both when severe and slight, it is very uncommon from 12 to 15 years of age.]

As to the relative frequency of the disease in males and females, authors are not agreed. Schmalz, in his learned work on Diagnosis, has stated that boys are more liable to it than girls; whilst, on the other hand, Guersent, whose ample opportunities of observation, diligence in availing himself of them, and good faith and accuracy in detailing the results of his experience, entitle his opinion to much weight, thinks that affections of the mesenteric glands are more frequent in girls than in boys. "The disease," says he, "is more

common from the first dentition up to the twelfth or fifteenth year than either previously or subsequently: but we must beware of supposing that even in children it is so common a disorder as some writers seem to think. Bayle says that in a hundred subjects there is not on an average above four in which dissection discovers tubercles of the mesentery. This observation refers to individuals of all ages. At the Hôpital des Enfans, where the patients received are never under one nor above sixteen years old, the proportion of mesenteric tubercles is much more considerable. It may be about seven or eight per cent. for the girls, who appear more generally liable to pulmonary and mesenteric affections than the boys; whilst, for the latter, the proportion may be about five or six per cent." This result he gives only as an approximation to the truth, adding, with his usual caution, "that an immense mass of observations would be necessary ere we could come to any very positive and finite conclusion on the subject, seeing that different years are characterized by a great variety in the proportionate mortality by tubercular affections." (Dictionnaire de Médecine, t. iv. p. 313.)

[MM. Rilliet and Barthez (*Op. cit.*) accord with Schmalz in the belief, that boys are more frequently affected than girls, and they state, that it is chiefly when "the disease is very considerable," that the predominance of boys over girls is marked. The following table is given by them.

Of 144 children who have presented mesenteric tubercles, there were,

From 1 to 2½ years.....	27	Boys..18 / Girls.. 9
From 3 to 5½ years.....	41	Boys..27 / Girls..14
From 6 to 10½ years.....	55	Boys..37 / Girls..18
From 11 to 15 years.....	21	Boys..11 / Girls..10

	Boys.	Girls.
Tubercles not numerous.....	49	27
Tubercles tolerably numerous.....	28	20
Tubercles very numerous	16	4
	93	51]

In private practice the frequency of the disease is much less than in hospitals or among the poor in their own abodes, as the children of the rich are infinitely less exposed to its exciting causes. The prejudicial influence of the impure air of a crowded hospital on infancy, and its tendency in particular to induce tubercular disease, is so great, that the propriety of establishing such institutions for the reception of very young children is extremely questionable.

Predisposition.—The individuals in whom we have most reason to apprehend the development of this affection are those of a scrofulous habit, as indicated by the peculiar and well-known physiognomy, the thick and projecting upper lip, frequently recurring, protracted and indolent inflammations of the conjunctiva and edges of the eyelids, a delicate transparent skin and clear complexion, or an earthy paleness and bloated appearance of the face, indolent enlargements of the cervical glands, elongation of the fingers, and a broadening of the terminal phalanges under the nail, &c. The probability of the disease arising is increased when there are, moreover, an unnatural prominence of the abdomen, weakness of the digestive organs, irregularity of the bowels, and ill-conditioned discharges, with a frequent tendency to irritation of the mucous membranes.

As Dr. Henning and some other late writers have thrown a doubt on the scrofulous nature of this disease, we shall here take a short review of some of the principal authorities on the subject. Portal, in a paper in the Mémoires de l'Académie des Sciences for the year 1781, entitled "Sur la Phthisie de Naissance," or hereditary phthisis, alludes to the frequent coincidence of enlargement of the mesenteric glands with phthisis or tubercles in the lungs, and details one such case in an adult. In three children of one family, who all died phthisical, all had the glands of the mesentery as well as those of the neck swollen and full of gypseous matter, the remains and evidence of previous tubercles. The number of similar cases recorded since has made this frequent coincidence of a tuberculated state of the lacteal glands with the same morbid condition of those of the chest and other parts of the body, quite notorious. Again, in the fifth volume of his Anatomie Médicale, the same writer says there is no part of the body where steatomatous congestions (that is depositions of scrofulous matter) are more frequent than in the mesentery; they occasionally exist even where there is no enlargement of the cervical glands. Gui-de-Chauliac has even gone so far as to say that the source of scrofula is in the mesentery, and Riolanus at one time adopted this notion: "Notabis mesenterium strumarum radicem ac fundamentum esse, nec foras erumpere unquam nisi mesenterium strumosum fuerit." But the latter writer subsequently modified this exaggerated opinion, and Morgagni helped to dispel this erroneous view, having frequently, like all later pathologists, found unequivocal marks of scrofulous action in other parts, while the mesentery was perfectly healthy. Meckel, as we have seen in a passage quoted above, considers that, of the whole lymphatic system, the glands of the mesentery are the part most subject to the formation of tubercular matter. Of the absolute identity of its nature in this situation with that of external scrofula, Bichat likewise entertained no kind of doubt. "Scrofula," says he, in his lectures on Pathological Anatomy, "may be subdivided according to the parts which it attacks, viz. the abdomen, chest, and neck, the affection of each of which for the most part occurs as an isolated malady." (Anat. Pathologique, dernier cours, d'après un manuscrit autographe, &c. P. A. Béclard.) He also notices as one of the proofs of the frequently scrofulous nature of the inflammation and enlargement of the mesenteric glands, the extreme slowness of their progress. His assertion, however, that this affection usually occurs in an isolated manner, or in only one of the situations above specified at a time, is at variance with our own experience as well as that of most writers on the subject, as we shall see hereafter. Sir Astley Cooper, in the remarks on scrofula in his lectures, lays it down that the mesenteric glands are, next to the cervical, the part most liable to the development of this truly constitu-

tional affection. (Surgical Lectures, Lancet, iv. 102.) It would not be easy to find a more exquisite example of universal scrofula, or a more satisfactory proof of the intimate connection, or rather identity, of the mesenteric disease with scrofula, of which it is indeed but one of the many local manifestations, than in a case given by Dr. Cheyne in his work on Hydrocephalus, p. 125, in which, along with scrofulous ophthalmia, swelling of the cervical glands, protrusion of one of the dorsal vertebræ, scrofulous enlargement of the instep, and tubercles in the liver, the mesenteric glands were found enlarged, and contained the peculiar caseous matter which is so characteristic of the disease. At page 150 and 152 of the same work, are to be found two other cases, which are scarcely less decisive as to the constitutional nature of the disease. "The absorbent glands of the mesentery," says Baillie, "are frequently found to be scrofulous, and this is more apt to take place in children than in persons of a more advanced age. When affected with this disease, the glands exhibit different appearances according to its progress: they are enlarged in their size, and are often somewhat softer to the touch than in a natural state. When cut into, they sometimes show very much the natural structure; but more frequently they are changed in part into a white soft curdly matter, and this is not uncommonly mixed with pus." (Morbid Anatomy, p. 209.) We have the authority of Andral likewise for the fact that the mesenteric glands are one of the parts of the body into which tubercular matter is the most frequently secreted; and what gives the more value to his opinion is his high character for impartiality of judgment and freedom from exclusive theories. Thus, while on the one hand he admits that congestion of these glands is often the mere consequence of an irritation seated in the intestinal mucous membrane, he insists, on the other hand, that their enlargement is, in at least an equal number of cases, only one of the many simultaneous effects of a common or constitutional cause, viz. a scrofulous habit; and hence he looks upon it as a practical absurdity to attempt in all cases to subdue the supposed *ganglionite* by the mere abstraction of blood, according to the favourite practice of the modern French school. Cullen, too, was well aware of the connection of mesenteric disease and scrofula. "Many instances," says he, "of emaciation seemingly depending on this cause, (viz. obstruction of the course of the chyle,) have been observed by physicians in persons of all ages, but especially in the young. It has also been remarked that such cases have most frequently occurred in scrofulous persons, in whom the mesenteric glands are commonly affected with tumours or obstruction, and in whom generally at the same time scrofula appears externally." In short, the number of distinguished writers who have advocated the strumous nature of mesenteric disease is so great, that one is almost tempted to think that the few who have put forward an opposite opinion were in some degree actuated by a love of singularity.

Symptoms.—The disease may be divided into two periods: 1st, that in which the tubercles exist in an indolent state, and have not yet produced any irritation in the glands in which they are imbedded, or in the surrounding cellular substance; 2d, that in which inflammation has taken place around them, and the process of softening and suppuration is going forward. In the first period they are for the most part productive of no obvious derangement in any part of the system, and are consequently accompanied by no symptoms by which their existence can be detected, except in the case, which is extremely rare, if indeed it ever occurs at the earlier periods of the disease of the glands being already so much enlarged as to be perceptible to the touch.

Morgagni has mentioned the case of a negro, cut off suddenly, in whom the mesenteric glands were found greatly enlarged and scrofulous, though he was almost up to the moment of his death in the enjoyment of excellent health; and Bayle records the case of a child which was burned to death while in perfect health, being fat and in good condition, though tubercles existed in the mesentery, and in some of them suppuration was actually commencing. There are probably few practitioners, who have enjoyed extensive opportunities for the prosecution of pathological anatomy, who cannot recall instances of young patients cut off rapidly by acute diseases, in whom enlargement of these glands, which had been altogether unsuspected during life, existed.

In the earlier periods of the disease there is much reason to think that even where symptoms do occur in connection with enlargement of these organs, many of them are referable with greater probability to coexistent disease in the gastro-intestinal mucous membrane; and this we beg the reader to keep in mind while perusing the following array of symptoms, which have been supposed by systematic writers to characterize mesenteric disease. If, however, the enumeration comprise a faithful account of those combined groups of symptoms which most frequently coexist in nature, or, in other words, if they correspond with the more usual complications which the disease presents, they will have as much, if not more, practical value than the selection of an individual group supposed to correspond to the simplest form of the affection; for this last is so extremely rare, that some of the most experienced observers, as we shall see, declare that they never happened to meet with it.

Amongst the most prominent symptoms, according to Pemberton, (Diseases of the Abdominal Viscera,) are lancinating pains deep-seated in the abdomen, but of short duration, resembling the pain of gripes rather than that of inflammation; these recur sometimes but three or four times in the day, and are at first scarcely at all increased by pressure, neither do they produce any inclination to pass fæces, nor are they relieved immediately upon such evacuations taking place: the state of the bowels is very variable, but generally in an extreme, either tending to constipation or to diarrhœa, the stools in the latter case being of unnatural appearance, and consisting chiefly of frothy mucus. Dr. Young, and most of the older authors, speak of a chalky appearance as well as of a want of consistency in the alvine evacuations, as if the chyle had been rejected by the lacteals, and left in the form of a milky fluid in

the intestines. To such an appearance the "alvi laxitas lienterica" of Sauvages' definition alludes. This whitish earthy-looking matter is, according to Sir Astley Cooper, of a calcareous nature. In such cases the functions of the liver are evidently much impaired, the natural tinge of the bile being altogether wanting in the stools. Worms not uncommonly are passed, and though probably merely an effect, are too often mistaken for the cause of the disease. The abdomen gradually enlarges and grows hard, whilst the rest of the body, and especially the extremities, become remarkably emaciated, the limbs resembling sticks covered with shrivelled parchment. The features are elongated, compressed, and so entirely altered in their expression, that the face of even a very young child comes to resemble the wrinkled visage of an ape or of a very old man. The cheeks are fallen in and of a marbly paleness, except during the accession of the fever; the veins are developed, and strongly contrasted with the white ground on which they run; the nose is lengthened; the eye glassy, sunk in the socket, and often surrounded by a livid circle. The lips are inclined to swell, and are occasionally of a deep red colour, and fissured or ulcerated at their commissures. The state of the tongue is variable; sometimes there is a white streak down each side; often it is perfectly natural. There is little thirst, at least in the earlier stages. The appetite is variable, but for the most part voracious, and the ingestion of food, however nutritious and in whatever quantity, seems to have little power in retarding the daily increasing marasmus. Conradi remarks that the appetite is not merely ravenous, but occasionally also perverted, there being a longing for acid food, cheese, and heavy meal-puddings, and a repugnance to flesh-meat soups, and other of the more nutritive, easily digestible, or appropriate foods. (Handbuch der Speciellen Pathologie und Therapie, b. ii. 206.) With regard to the circulatory system, the pulse is generally considerably above the natural standard at all times; and towards the evening, when the diurnal accession of fever takes place, it is still further accelerated, much restlessness coming on at the same period. During sleep, says Pemberton, profuse perspirations break out on the forehead and breast: at other times the skin, especially of the extremities, is for the most part dry, rough, and scaly; more rarely flaccid and moist. The secretion of the sebaceous glands is increased, and may often be expressed from those on the back and other parts in the form of minute white worms, for which by the vulgar this appearance has often been mistaken; (*crinones, commedones*, of the older writers.) In scrofulous patients generally, as well as those labouring under that modification of struma which we are at present considering, the follicular secretion is for the most part vitiated; hence the heavy nauseous smell of their perspiration, particularly perceivable after any violent exertion, in heated rooms, &c. The disturbance of the nervous system is manifested by fretfulness, dullness of the faculties, and aversion to all exercise of mind or body. There is rarely any delirium or sleeplessness. Death may take place either by exhaustion in a state of extreme marasmus, or, as not unfrequently happens, by the supervention of an active inflammation in some of the internal organs: thus some are cut off by acute peritonitis, others by pneumonia, hydrocephalus, &c. (*Darwall* on the Disorders incident to Children.)

A disease of which the progress is so slow as to be often nearly insensible, scarcely admits of any subdivision into stages which shall not be in a great degree arbitrary. Gardien has, however, divided it into three periods. The incipient stage is characterized by a general languor, dulness, and depression; the face becomes pale and shrivelled; there is flatulence, mucous vomiting, uneasiness after eating, and other unequivocal evidence of derangement of the digestive organs; the appetite is unsteady, sometimes being voracious, and at other times altogether deficient; the belly becomes large and tense, but is not yet painful on pressure; the tongue is loaded, the breath foul, and the perspiration of an acid odour. In the second stage the derangement of the digestive functions is still more marked, the stools are very fetid, and occasionally whitish; the indurated glands can now be felt, and enlargement of the cervical glands often coexist. In the third stage suppuration of the glands takes place; nutrition is at an end; the stools indicate an inflammatory state of the mucous membrane of the intestines, by which its secretions are variously modified; the skin is harsh, of an earthy hue, and glued as it were to the bones; the pulse becomes small and frequent, and slight rigours are felt, especially at mid-day and towards evening. In the third stage he holds the disease to be incurable, and believes that recovery even from the second is very rare. The division just detailed coincides very closely with that of Raimann, who speaks of a premonitory stage; of a stage of emaciation and hectic, and finally of that of colliquative sweats and diarrhœa. (Handbuch der Speciellen Medicinischem Pathologie und Therapie, b. ii. 227.) "There is an early stage of glandular obstruction in the mesentery," says Underwood, "and of the fever here alluded to (the mesenteric fever), that is often falsely attributed to worms, but will not yield to mere purgative medicines as that disorder usually does. It attacks children from the age of three or four years, the fever remitting and sometimes intermitting irregularly; is attended with loss of appetite, swelled belly, and pain in the bowels, the latter sometimes taking place more or less violently every day, or is generally more violent if the child be a day or two free from it." And again, farther on, he says, "Indigestion, costiveness, or purging, irregular appetite, flushed cheeks, or a total loss of colour, impaired strength and spirits, remitting fever, and a hard and tumid belly, with emaciated limbs, are amongst the more constant symptoms attending at one period or other of this disease." (On the Diseases of Children, p. 228–230.)

Portal's account of the symptoms is succinct and clear. In addition to the tumours being occasionally felt through the abdomen, there is often an excessive hunger, a hard and frequent pulse, heat of skin increasing towards the evening, and perspirations towards morning. Emaciation and diarrhœa occur towards the conclusion; the patient dies in a state of marasmus; or the cellular

membrane of the legs, and subsequently of the whole body, becomes infiltrated, effusion into the cavity of the abdomen eventually taking place, and bringing the existence of the wretched sufferer to a close. Guersent has little confidence in the majority of the signs generally considered characteristic of the disease, and thinks that until the enlarged glands can actually be felt, we must be contented to remain in doubt. A very slight analysis of the symptoms detailed above would indeed suffice to show that very many of them are by no means peculiar to the enlargement of the mesenteric glands.

As to the presence or absence of pain, its seat and degree, there is considerable inconsistency in the accounts of different authors. Thus Dr. Young says—"It is more immediately distinguished by acute pain in the back and loins; by fulness, and, as the disease advances, pain and tenderness of the abdomen:" whilst Portal, on the contrary, after mentioning that the tumours may be felt through the abdomen if they be large and the epiploon not very fat, proceeds to state that they are rarely attended with pain in the abdomen, or colic or derangement of the digestive functions. These differences are only explicable on the supposition that, whilst Portal is describing the disease in its simplest form, the English author is speaking of it as it more usually appears, viz. in complication with affections of the mucous membrane, &c. Pain in the back and loins is mentioned by Morgagni likewise as an occasional symptom of mesenteric disease; but as this affection is liable to pass into, or to become complicated with, scrofulous disease of the vertebræ, the origin of such pains has probably been sometimes erroneously referred to the mesentery, a mistake which we have ourselves known to be committed. According to Guersent the pain is of a dull kind, referred chiefly to the centre of the abdomen, and not increased by pressure unless it be pretty firm and directed towards the lumbar vertebræ. It frequently persists with little change for months or even years; but sometimes we may suspect its nature from observing that it becomes, like the sufferings from all other scrofulous affections, increased in spring and autumn. But from the kind or degree of the pain no very definite conclusions can be drawn, as that which occurs in chronic inflammation of the mucous membrane of the small intestines is very similar; and, moreover, the two affections very frequently coexist. Perhaps, where the mucous membrane is chiefly in fault, slight irregularities in diet will be more apt to aggravate the symptoms, and external pressure or distension by food will create more uneasiness; whilst, if the mesenteric glands are more particularly the seat of the morbid action, it is by the concussion imparted by running or leaping, or by hiccup, that most distress will be caused.

The tumefaction of the abdomen in the earlier stages depends in a great measure on flatulence, and occasionally on the frequent over-distension of the stomach with food; and it is only in the later periods that it can be attributed in any great degree to the increased volume of the glands themselves, or to peritoneal effusion. An habitually prominent abdomen is considered very generally by the vulgar as one of the strongest characteristics of the disease; but the value of this sign has, perhaps, been much overrated. Considerable projection of this part is the natural condition in young children, owing chiefly to the size of the liver and colon being, relatively to the other parts of the body, greater than at a later period of life, and likewise to greater flatulent distension being permitted by the less degree of tone possessed by the intestines at this tender age. Guersent declares explicitly that children in whom this part is even unnaturally large, have not, according to his experience, been more liable to the disease than others. Such a phenomenon has, in some cases, seemed to depend merely on increased gazeous secretion connected with weakness of the digestive organs, diarrhœa, &c.; and, on the other hand, he has frequently on dissection found the mesenteric glands diseased, though no such distension had existed during life. The mucous vomitings and other gastric symptoms attributed to tabes, as likewise the argillaceous and otherwise unnatural stools, are truly referable only to the complications,—namely, to the coexistence of irritation or inflammation of the mucous membrane. To the milkiness of the urine given in the Dictionnaire des Sciences Médicales as one of its symptoms, Guersent attributes just as little importance, as it occurs in many other infantile affections, and generally wherever the urine is diminished in quantity, or has been long enough retained in the bladder to become loaded with the earthy phosphates. In short, after a full review of the subject, the distinguished writer just named feels himself obliged to acknowledge that it is chiefly by negative symptoms, or the process of exclusion, as it is called, that we can come to have a well-grounded suspicion of the existence of the disease.

Amongst the rarer occurrences in the progress of the disease, is that mentioned by Sir Astley Cooper, where one of the suppurated glands contracts an adhesion with the parietes of the abdomen and discharges its contents externally. In such cases he has observed the opening to take place more particularly at the navel, and communicate at once with the cavity of the intestines and with the diseased glands; and although an artificial anus was thus induced, the case has terminated favourably. In this case poultices were applied until the inflammation was reduced and the matter all discharged, and adhesive straps subsequently employed, so as to approximate the edges of the opening and thus gradually obliterate it.

Schmalz alludes to the occasional appearance of pus in the stools, and attributes it to the evacuation of the suppurating glands into the intestinal canal. The same author has likewise made mention of ischuria renalis as an occasional occurrence in the course of the disease. "The diseased lymphatic glands may lead to morbid changes of the parts which surround them," says Andral, "either by compression or by the irritation and inflammation which they excite. Thus, in the abdomen, by their enlargement and pressure on the pylorus, they have simulated many of the symptoms of scirrhus pylori; if accumulated around the biliary ducts, they have impeded the flow of the bile and induced jaundice: the uterus have in like manner been compressed by them, as has also the vena

cava, and dropsy of the inferior extremities has been the result.

Complication. — Tabes mesenterica, as has been already said, is a disorder which rarely exists in a simple form. Much of the obscurity in which it is enveloped, and of the vagueness of the descriptions of it to be met with in medical authors, depending on the very frequent coexistence of other maladies, it is necessary to say a few words here of the diseases with which it is most commonly complicated. Of these, phthisis, or tubercles seated in the lungs, is indubitably the most frequent. Guersent has met with this complication in five-sixths at least of the cases of tabes occurring amongst children in hospital; and out of the four cases of the disease in which dissections were made by Baumes, pulmonary tubercles, crude or suppurating, were discovered in three. In the abdomen, the coexistence of inflammation of the serous or mucous membranes is very common. The peritoneum is often found in a state of acute or chronic disease, and minute tubercles very frequently exist in the cellular membrane beneath it, as likewise in the liver and neighbouring organs. Inflammation of the mucous membrane of the intestines, and especially of the lower part of the ileum, is so apt to occur as to have led to its being held by many, and more especially by the disciples of Broussais, as almost the sole and invariable cause of the enlargement of the glands. Worms are sometimes observed in the stools, and though probably merely a consequence of the weakened state of the digestive organs, are frequently mistaken for the cause of the illness; but the perseverance of the disease after their removal by appropriate medicines, shows how trivial a complication they constitute. Tabes mesenterica sometimes exists in combination with rachitis, and also with scrofulous disease of the vertebræ or spinal cord, (*Louis*, Mémoires Anatomico-Pathologiques, p. 417); and hydrocephalus, as we have already seen, not uncommonly sets in during its course.

The following case, given by Andral in the fourth volume of his Clinique Médicale, affords a good example of the various complications which dissection sometimes detects, and of the difficulty or impossibility of disentangling their symptoms during life. A tailor, of about twenty-five years of age, entered La Charité with all the symptoms of incipient phthisis, cough of four months' standing, emaciation, previous hemoptysis, &c. The cervical glands were enlarged, the abdomen swollen but not painful even on pressure, the stools natural, pulse frequent, no perspirations. About a month before his death, which occurred in six weeks after coming into the hospital, the abdomen began to swell more rapidly, and fluctuation was perceptible. Some time afterwards diarrhœa set in for the first time, accompanied with hectic and rapid sinking, and it occurred at intervals till death. On dissection, enormous lymphatic glands were discovered enveloping the trachea within the chest, and the bronchi. A few crude tubercles were found at the apex of the left lung, whilst the upper portion of the right lung was occupied by tubercular matter in a state of incipient ramollissement. The abdominal cavity contained a bloody effusion, the peritoneum was inflamed, and the concave surface of the liver and the spleen were covered with a thick false membrane, in which tubercles were likewise observed. The mesentery was transformed into an enormous tumour resulting from the agglomeration of tuberculated glands, many of which were individually as large as an orange. The mucous membrane of the stomach and small intestines being pale throughout, afforded an additional proof that a tubercular affection of the mesenteric glands may exist unpreceded by any obvious inflammation of that portion of the mucous membrane from which the lacteal vessels take their rise. The internal lining membrane of the large intestines presented some red patches, connected, no doubt, with the recent diarrhœa. The same excellent observer gives another case, occurring in a lad of nineteen, which ran a very similar course, terminated fatally in about three months, and presented analogous morbid appearances on dissection. Along with the enlargement of the mesenteric glands, there coexisted also phthisis, ascites, chronic peritonitis, and inflammation and ulceration of a scrofulous nature in the mucous membrane of the intestines. (Clinique Médicale, vol. iv. p. 616–621.)

Morbid Anatomy.—On dissection, the glands of the mesentery are found in various stages of disorganization, according to the duration of the disease. In the earlier stages they appear red, and are somewhat increased in size and density. Subsequently to this, tubercular matter is deposited either within their substance or on their surface; and this morbid production, at a still later period, comes not merely to occupy the place of the entire gland, (the true glandular structure becoming gradually absorbed and eventually disappearing,) but increasing in quantity, and being agglomerated and consolidated, it constitutes tumours of considerable magnitude, which have been compared to a heap of peeled chesnuts, to which, by their dull white colour and firm consistence as well as form, they often really bear considerable resemblance. In a number of cases, constituting perhaps the majority, the tubercular matter seems to be immediately deposited, without any previous inflammatory stage, the glands being pale and unaltered in density even in what appears to be the incipient stage of their degeneration. With regard to the deposition of tubercular matter, the following are the opinions of Meckel and Andral, which will be found in some degree to substantiate the statements just made. "The glands," says the former of these distinguished pathologists, "appear enlarged, but they are not always really so; their substance does not itself degenerate, but the tubercular matter is deposited in it: this process," he continues, "may commence in the centre of the glands, yet frequently it begins simultaneously in several spots." —"The lymphatic glands," says Andral, "are one of the parts of the body into which tubercular matter is most frequently secreted. It may exist either in a state of infiltration, or it may occupy isolated patches, or the whole of the gland. Such glands sometimes afford evidence of previous inflammatory action, being enlarged and red generally, whilst the tubercular matter occurs disseminated in points throughout the congested structure. But it must be acknowledged that in other instances there is not the smallest evidence that the tubercular deposition has been either preceded or ac-

companied by hyperemia of the part." Bocker, a German anatomist, has always found it possible to inject the diseased glands with mercury, their lymphatics being quite permeable; and hence he concludes that in the majority at least of the diseases of the lymphatic glands, the principal seat of the alteration is in their cellular structure alone. The tubercles, whilst in their indolent state, are of a dull white or yellowish-white colour and firm consistence; at a later period, when irritation has been excited around them, they pass into a state of ramollissement and suppuration, and contain that softened caseous matter, usually considered characteristic of scrofulous disease, mixed up with pus.

The tumours in the mesentery, says Portal, are of all sizes, from that of a pea to that of the head of an infant. (*Tulpius, Lieutaud, &c.*) In such gigantic specimens of the disease as the latter constitute, Portal supposes that the scrofulous matter does not occupy the glands alone, but that it is effused between the laminæ of the mesentery, as he has found also the mesocolon and mesorectum thus similarly obstructed and distended. In two or three cases he has met with erosion of the peritoneum, the puriform fluid which had been contained between the laminæ of the mesentery being effused into the cavity of the abdomen. Cowper, as quoted by Morgagni, speaks of a child extremely emaciated, in whom two of the mesenteric glands were found greatly enlarged and compressing the receptaculum chyli. In strong contrast with this is the case given by Fabricius of a woman who died in a state of great emaciation in consequence of the obliteration and disappearance of the mesenteric glands, "lente tabe extincta cujus viscera omnino nihil exhibuerunt nisi quod glandulæ mesenterii penitus evanuerunt," which, if we are to believe Ruysch, is no infrequent cause of atrophy in the aged, in whom these glands are usually found very much diminished in size. The mesenteric glands occasionally contain a dry calcareous matter, such as is sometimes found in other tuberculated organs, and it is conjectured to be here, as in the lungs, the result of a salutary conversion effected by the powers of nature.

[In 144 cases of mesenteric tubercles, the following characters are presented, (Rilliet et Barthez, *Traité Clinique et Pratique des Maladies des Enfants*, iii. 410, Paris, 1843:)

Yellow granulations	7
Miliary tubercles	57
Tubercular masses	84
Softened tubercles	13
Cretaceous tubercles	8
Tubercles not numerous	75
——— Somewhat numerous	48
——— Numerous	20]

The peritoneum frequently exhibits unequivocal evidence of inflammation in the existence of adhesions and effusions of fluid into its cavity. Minute tubercles are often observable, as stated in a preceding paragraph, beneath the peritoneum, on the surface of the liver, and in the substance of false membranes caused by previous inflammation. The intestines are frequently found distended with air, as the tympanitic state during life would lead us to expect; and the mucous membrane, and especially that of the ileum, is often inflamed, and the mucous follicles enlarged: ulcerations, moreover, very commonly exist, and occasionally present on their surface minute depositions of tubercular matter. The existence of inflammatory appearances in the mucous membrane in cases of enlargement of the mesenteric glands, is, however, by no means an universal occurrence; and as such ulcerations, on the other hand, frequently exist without any alteration in those glands, their invariable existence in the relation to each other of cause and effect, though it has found such strong advocates, cannot, we think, be admitted. In the parallel case of the enlargement of the cervical glands, we have sufficient evidence that the lymphatic ganglia are capable, as might have been anticipated, of becoming primarily diseased.

[Of the 144 cases of tabes mesenterica observed by MM. Rilliet & Barthez, (*Op. cit.* iii. p. 424,) in 42 the intestines had neither tubercles nor intestinal alterations; in 43, the tuberculization was almost equally intense in the intestines and mesentery; in 39, the intestinal tuberculization was more considerable than that of the mesentery; and in 20, the disease of the mesentery presented a marked predominance over that of the intestines. Again; of the 144 whose mesenteries were tuberculous, 65 had no intestinal phlegmasia; and in 34 of these the mesenteric tuberculization was so little advanced that it might be regarded as independent of inflammation of the intestine. This slight advancement of the tuberculization of the mesentery coincided with acute lesion of the small intestine 15 times, and 3 times with chronic inflammation; 26 times it coincided with acute lesion of the large intestine; 10 times, with chronic; and 12 times, the intestinal disease was seated both in the small and large intestines. Somewhat advanced tuberculization of the mesentery coincided with acute inflammation of the small intestine 5 times; with that of the large 17 times; with its chronic inflammation 5 times: 3 times both intestines were affected together. Very advanced tuberculization of the mesentery coincided 4 times with inflammation of the small intestine; 6 times with that of the large; with its chronic inflammation, once; and in one case both intestines were affected simultaneously.

In 12 cases, both intestines were perfectly sound, and presented neither tubercles nor inflammation; and 25 times the small intestine was entirely sound, the mesentery being tuberculous.]

To the very frequent, we had almost said invariable, coincidence of tubercles in the lungs or bronchial glands in fatal cases, we have already alluded. Sauvages speaks of hydrothorax as well as ascites being occasionally detected on dissection, the effusion of serum taking place, as he supposes, during the agony just before death. In other cases an effusion into the abdomen, giving rise to manifest fluctuation, has taken place at an earlier period, and yet, as in a case of Broussais, no water has been discovered on dissection, it having been to all appearance taken up by the absorbents immediately before the fatal termination.

Theory.—It was formerly supposed that the remarkable wasting of the body in this disease, notwithstanding the use of the most nutritious food, was attributable solely to the obstruction in

the mesenteric glands being carried to such a pitch that little or none of the nutritive matter elaborated in the stomach and small intestines could find its way into the thoracic duct.* To this theory of mechanical obstruction, the researches of Soemmerring, Boeker, and other modern physiologists, have been fatal, as they proved experimentally that these glands were rarely if ever altered by disease so universally and completely as to be impervious even to their anatomical injections. Moreover, it is an indisputable fact, that children, in whom these glands have been plainly felt through the walls of the abdomen, have continued to live for years in this state, and eventually died of some other totally different disease; and Cruikshank, long ago, when referring to the possibility of children and grown persons having ever died of such obstruction, which he was not prepared absolutely to deny, said, "but in such enlargement of the glands, if it ever takes place, we should meet with the stagnation of the chyle in the first set of lacteals; yet I never saw such stagnation in any case whatever."

A knowledge of these facts renders it necessary to look to some other source for an explanation of the phenomena; and as it would seem that so long as the glands continue in an indolent state no very evident symptoms are produced, and as it is only on certain changes tending to their softening and suppuration being set up, that they induce great emaciation and hectic fever, it becomes highly probable that these symptoms depend on sympathy with the irritation and inflammation which, like foreign bodies, the tubercles eventually excite. All that we know of tubercles in other parts of the body tends to confirm this view of the subject. The hectic symptoms were once, indeed, supposed to depend on the absorption of their purulent contents; but as abscesses, even on a much greater scale, in which absorption is constantly going on, do not necessarily give rise to any such symptoms, this supposition must be abandoned.

The frequency of the coexistence of disorder or disease in the gastro-intestinal mucous membrane must not be lost sight of in our attempts to explain the symptoms of tabes mesenterica, as in such a state of these organs it is natural to suppose that the chyle will be imperfectly elaborated and only partially absorbed, in consequence of which the circulating fluid must be materially altered in regard to its nutritive powers, and an appearance of general cachexy and an increase of the scrofulous diathesis will be the result. The morbid condition of the mesenteric glands themselves must likewise be supposed to render them in some degree incompetent to their functions, which consist, doubtless, in working up or modifying the chyle in its passage through them, in some manner hitherto imperfectly understood. "It has been disputed," says Dr. Thomson, in the work already cited, "whether scrofula be originally a disease of the solids or of the fluids. When it arises from an improper or indigestible food, it may certainly be alleged to have its origin in the fluids; and it may even be doubted whether it may not be directly produced in the glands of the mesentery by the irritation of an ill-assimilated and probably acrimonious chyle." Thus the opinion of Gui-de-Chauliac, alluded to in a former part of this article, though the result of an exaggerated generalization, was not, perhaps, altogether without some apparent foundation in truth.

Diagnosis.—The difficulty of accurately diagnosticating an affection of the mesentery is, for reasons already detailed, often extremely great. Fortunately, however, many of the diseases with which it coexists, or for which it might be mistaken, require a mode of treatment very similar with itself. The diseases with which it is most liable to be confounded are, chronic or scrofulous peritonitis, inflammation of the mucous membrane of the intestines, infantile remittent or irritation of the same membrane, worms, constipation and the consequent presence of scybala in the great intestines, tubercles of the bronchial glands, or in the lungs themselves. For the most probable means of distinguishing tabes mesenterica from some of these diseases, we must refer to former parts of this article, and more especially to the section on symptoms: we shall here add a few general remarks, in the hope of still further facilitating this object. A readiness in detecting the scrofulous habit will sometimes aid us materially in our investigation of a suspicious case. "All scrofulous diseases," says Nacquart, (Dict. des Sciences Médicales,) "are accompanied, even in their earlier stages, with a degree of puffiness of the features, and a sickly yellowish white, or waxy colour of the skin, which, as the emaciation proceeds, becomes in a manner transparent." From the exasperation of the symptoms in spring and autumn, and their amelioration in summer and winter, an additional insight into the nature of the case, when it runs a very long course, may sometimes, as already suggested, be acquired. Mesenteric scrofula, according to Sauvages, differs from the ordinary or external species, inasmuch as it attacks younger children, and is accompanied by a pallid countenance instead of a full and florid one. To the latter of these diagnostic marks, however, little value can at the present day be attributed, as glandular and all other varieties of scrofula are now known to occur as often in the sallow and pallid as in the high-coloured.

From chronic peritonitis, Pemberton thinks mesenteric disease may be distinguished by pressure, which gives so much less pain in the latter affection, as well as by the absence of superficial pricking pains, and by the peritoneum, as felt through the abdomen, not imparting to the hand that feeling of being strongly bound down, on which he dwells so much as a sign of peritonitis. The occurrence of a regular evening exacerbation and the expression of the countenance, he conceives, will also afford us useful assistance in the formation of our diagnosis; and to this the absence of vomiting may likewise contribute.

It is, says M. Roche, chiefly by negative signs that we can hope to succeed in diagnosticating tubercles of the mesentery in their earlier stages. The presence or absence of other tubercular affections, and an investigation of these exciting causes, may, however, assist us in our endeavours to de-

* "In tabes mesenterica," says Cullen, "the emaciation depends on an obstruction of the mesenteric glands, through which the chyle must necessarily pass to the thoracic duct." Thomson's edit. of Cullen, vol. ii. p. 562.

tect it. As to the general symptoms by which it is accompanied, it possesses most of them only in common with other diseases. Thus tumefaction of the abdomen, along with emaciation of the limbs, and derangement in the digestive functions, may be the result either of inflammation of the mucous membrane, or of tubercular affection of the mesenteric glands; but when the patient is scrofulous or phthisical, the skin blanched and habitually relaxed; when the diarrhœa, if any, consists of ill-digested food rather than of morbid intestinal secretions; where the ingestion of aliment is not followed by immediate inconvenience, and the nature of the diet does not sensibly influence the disease, animal food appearing to be as easily digested and with as little inconvenience as a farinaceous or milk diet; if there be no great thirst nor heat of skin, nor pain and tenderness on pressure in the abdomen, nor peculiar stools, indicating mucous irritation, it becomes highly probable that the disease with which we have to deal is incipient mesenteric disease rather than a gastro-intestinal affection. Inflammation of the mucous membrane of the small intestines, on the contrary, will be recognised by the greater degree of pain and tenderness of the abdomen, thirst, mucous or greenish stools, a hot and dry skin, and a look of exhaustion and depression: the symptoms are, moreover, all exasperated immediately after taking food, especially if it be of a stimulating nature. But these nice distinctions are often unfortunately little available in practice, as the two affections in question very commonly coexist, tubercular glands and inflammation and ulceration of the mucous membrane being collateral effects of the strumous diathesis of nearly equal frequency. Yet a knowledge of the exciting causes may even here be of considerable utility in serving to show us which of these affections in all probability predominates. If the illness has come on after the use of too stimulating food or medicines, our attention will be particularly directed to the mucous membrane; if, on the contrary, the child has been suckled by a debilitated nurse, or fed on insufficiently nutritive food, whilst at the same time it has been living in a damp, dark, and unhealthy habitation, we shall be led to suspect the predominance of a morbid condition of the mesenteric glands. The effects of treatment may likewise serve to throw some light on these doubtful cases, antiphlogistics being found to relieve the former much more than the latter affection. The infinitely greater frequency of the intestinal affection than of the mesenteric must never be lost sight of in the formation of the diagnosis. (Dict. de Méd. et Chir. Pratiques, t. iv. 621.)

"The inflammation of the mesentery and its glands," says Schmalz, "is for the most part difficult to recognise, partly because it lies so deep amongst the other viscera, partly because the inflammatory symptoms are very inconsiderable. It is seldom found to exist alone, being commonly complicated with inflammation of the bowels or peritoneum. We may suspect it when there is a deep-seated and firmly-fixed pain in the abdomen, which seems to come out at the back, and which is increased by firm pressure at the navel, by upright position, quick movement or shaking of the body, and bending of the back. It is usually accompanied by swelling and hardness of the belly. The pain and fever for the most part are very slight; sometimes the patient complains of a sense of compression or tension deep-seated within the abdomen. The symptoms characteristic of the inflammation of any other organ are absent. When a child suffering under indurated or scrofulous mesenteric glands commits any error of diet, or is exposed to cold, there often arises a fever with slight pains in the belly, constipation, nausea, vomiting, itching of the nose, increased flow of saliva, enlarged pupil, and other symptoms, which are often attributed, though very erroneously, to worm fever." (Versuch einer Mediz. Chirurg. Diagnostik.)

With regard to infantile remittent, or worm fever, as it is vulgarly called, we should never lose sight of the important fact that it is liable to pass into tabes mesenterica. It consists essentially in an irritation, and occasionally even inflammation of the mucous lining of the stomach and bowels. Being comparatively a much more manageable disease, the importance of its being early recognised and appropriately treated is obvious. For a somewhat extended account of this affection the reader is referred to the article Infantile Remittent Fever, in 2d vol. of this work. We shall here briefly recapitulate its leading symptoms, which are fretfulness, frequent drowsiness, fever, restlessness, especially at night; acceleration of pulse and respiration, hot and dry skin, tongue furred and moist at the commencement, but soon becoming sore and red at the edges and dry at the point; thirst and preference for cold drinks, and especially for cold water; irritable stomach, bowels constipated in some cases, and diarrhœa in others, consisting of dark white, mucous, bloody, or otherwise unnatural stools. The child cries frequently, especially if the abdomen, which is hotter than the rest of the body and tympanitic, be touched. The extremities are often cold, even when the face is flushed. "Sometimes," says Dr. Mackintosh, "the child appears to be recovering for a few weeks and then relapses, and during the remission it even gains flesh and strength, but the abdomen remains tumid, and in this condition the child may remain, getting better and worse till the mesenteric glands become enlarged or dropsical effusion takes place into the abdomen; the emaciation increases; there is no fever, except at night; the appetite is occasionally voracious, and, in fact, the little sufferer presents all the symptoms of the disease usually known by the name of tabes mesenterica." (Practice of Medicine.)

The symptoms of mesenteric disease, according to the late Dr. Baillie, correspond in a great degree with those of the common round worm of the intestines. "In both diseases there is a tumid belly and emaciated extremities. They are chiefly to be distinguished by worms not being discovered in the one disease notwithstanding the use of strong purgatives, while they pass off from the bowels in the other. The startings, the itchings of the nose, and the grinding of the teeth, may, perhaps, also form some ground of distinction — they occur very commonly in worms, but I believe very rarely where the glands of the mesentery are scrofulous. Some discrimination, likewise, be-

tween the two diseases may sometimes be derived from examining strictly into the nature of the constitution. If decided marks of scrofula show themselves in an external part of the body, they will lead a practitioner more satisfactorily to the opinion that the mesenteric glands are affected with the same disease." (Morbid Anatomy, p. 209.)

In the advanced stage of tabes mesenterica the glands can generally be distinctly felt, unless chronic peritonitis with effusion into the abdominal cavity exist, so as to conceal them from the touch. They may be distinguished from collections of hardened scybala, as Guersent remarks, by means of pressure, which causes a slight pain in the former and none in the latter case; besides, the glands will be felt nearer the centre of the abdomen, whilst the indurated fæces will more commonly be found in the course of the colon, and more especially in the left iliac fossa. Diarrhœa, also, almost always exists in the latter stages of tabes; and in all doubtful cases we should take the precaution of clearing out the bowels by enemata and purgatives before we finally announce our opinion. Vogel, in his admirable little work on the mode of examining the sick, recommends that the examination of all such cases should be made early in the morning while the patient is still fasting. We have heard of instances where, in extremely emaciated subjects, the prominent bodies of the lumbar vertebræ were mistaken for tumours within the abdomen: such an error, however, is likely to occur only to very ignorant or very careless observers.—See ABDOMEN, EXPLORATION OF THE.

The state of the respiration, the presence or absence of cough and expectoration, and, above all, the stethoscopic signs, will generally enable us to recognise during life that species of phthisis which depends on tubercles in the lungs themselves; but as to that arising from a similar affection of the bronchial glands, we may often be left in perfect ignorance till after the fatal termination. The absence of all the characteristic signs of disease within the abdomen and lungs may, however, sometimes enable us to suspect it. In a case of this kind recorded by Bichat, which from the general symptoms was mistaken for ordinary phthisis, it was remarked that pressure in the epigastrium induced a sense of suffocation, and that pressure on any part of the chest caused a general feeling of uneasiness through it, though there was no local pain. The child died in a state of frightful marasmus, and the bronchial glands were found greatly enlarged and converted into steatomatous matter.

To conclude the subject of diagnosis—where a child, more especially if of a scrofulous habit, is becoming gradually more and more emaciated, though the appetite may be good, or even in excess, in the absence of all evidence of disease in the other abdominal organs, as well as in those of the chest and head, a careful investigation into the state of the several functions having been made, our suspicions will naturally turn towards the mesenteric glands; and if any enlargement in these can be detected, suspicion will be converted into certainty.

Prognosis.—In all cases of this disease, even the simplest, the prognosis must be very guarded, as the event is dubious, and the tendency to go on, though often by slow and almost insensible advances, to a fatal termination is very great; and this is more especially the case when one or more of the complications already alluded to as of so frequent occurrence, exist. In the absence, however, of all evidence of disease within the chest, and of inflammation and ulceration of the mucous membrane of the intestines, of inflammation of the peritoneum, scrofulous disease of the vertebræ, &c. the case is not to be given up as hopeless, even though the enlargement of the mesenteric glands should have already made such progress as to be distinctly felt through the abdomen. We have daily opportunities of observing the possibility of reducing scrofulous inflammation and enlargement seated in the external lymphatic glands, under the joint influence of judicious treatment, appropriate diet and regimen, and the advantage of a well-chosen place of abode. From the similarity of the structure of the glands of the mesentery there is every reason to expect, even prior to experience, that their diseases also should be within the reach of art. The earlier the disease is detected, the greater, of course, is the prospect of success. In the first stage of the affection, before the mesenteric glands had become much enlarged, or the fever continual, whilst the appetite was good and the digestion unimpaired, and no diarrhœa had taken place, Underwood often succeeded in subduing the morbid action. When the enlargement of the glands is already very great, and many of them are implicated, and when hectic fever has set in, the hopes of relief become very slight. Where colliquative diarrhœa, night-sweats, extreme marasmus, effusion into the abdomen, and swelling of the limbs have come on, the case is near its fatal termination. In this, however, there is nothing peculiar to tabes. The supervention of colliquative diarrhœa in all scrofulous diseases, whether seated in the lungs, great joints, or other parts, renders their character all but desperate, inasmuch as it generally indicates the accession of extensive disease in the mucous membrane of the intestines. To whatever cause we may attribute this new complication, whether to sympathy with the previously suffering organ, or to the general excitement in the system kindling inflammation in the predisposed mucous membrane, or whether we consider it as a new and collateral development of the scrofulous tendency, (ulceration of the intestines being now well known to depend very frequently on this cause,) it is powerfully instrumental in accelerating the fatal catastrophe.

The older the child is at the period of attack, the better perhaps is the chance of recovery, as the functions of these parts are then no longer in that state of activity which the rapid building up of the body in extreme infancy imposes upon them. Such at least is the judgment which a combined consideration of the laws of physiology and of those which regulate disease would suggest; and the remark of Sauvages, that he has known children who had laboured for a considerable time under the disease, recover on approaching their tenth year, seems to confirm it. Pemberton likewise remarks that the younger the child the more

dangerous is the case: in all instances, however, his prognosis was extremely cautious; for in the majority of cases, the pain being very slight, there is too much reason to fear that the disease may have become far advanced long before its existence has been even suspected. Its progress is very insidious, often almost insensible; the fatal event taking place at various periods, from three or four months to as many years. To afford us any chance of effecting a cure, says the last-mentioned author, the treatment should commence early, and before much emaciation or severe fever exists. Amongst the indications of a favourable termination he enumerates improvement of the colour and expression of the countenance, diminution in the length and severity of the evening accession of fever, reduction of the size of the abdomen, and the gradual recovery of flesh. The spontaneous occurrence of a very slight diarrhœa or of a cutaneous eruption has been thought by Gardien and some other practitioners to exercise a favourable influence over the disease.

Etiology.—The causes of the disease have by some writers been divided into two kinds, namely, those which tend to produce or develop scrofula generally, and those which act more immediately on the abdominal organs; but as many of them act at once in both these ways, we shall not here attempt their separation. Cold and damp places of abode shut out from the free circulation of air and from the light of the sun, a cold, moist, and changeable climate, uncleanly habits, deficient exercise, inadequate clothing, food of difficult digestion or insufficiently nutritive, together with all debilitating diseases, are, when acting on a weakly habit of body, among its chief sources. From all this it is plain why the disease is especially met with among the children of the poorer classes living in the filthy, ill-ventilated and crowded lanes and alleys of great towns. It is well known that tubercular affections can be induced at pleasure in the domestic animals by improper feeding and want of fresh air. Mr. Youatt, in his Veterinary Lectures, gives a remarkable exemplification of the influence of the latter of these causes in cows kept crowded together in houses where there is no adequate access of fresh air. Those animals which are placed at the greatest distance from the door, window, or other apertures for ventilation, and which are consequently kept in the closest and most impure portion of the atmosphere, are much more liable to tubercular disease than even those which are subjected by their position to be immediately blown upon by the entering draught of cool air. The cows brought from the country into Paris, and kept there constantly shut up for the purpose of supplying the inhabitants with milk, are extremely apt to die of tubercular phthisis. Scrofula has been considered by some writers as a species of animal etiolation, and much stress has been laid upon the wants of a sufficiently frequent exposure to the solar light as a cause of its production.

It has been supposed that spoon-fed infants, and those who have had the misfortune to have a nurse debilitated by consumption or some other exhausting disease, incapacitating her to afford milk in sufficient quantity or of sufficiently nutritious quality, as well as those children which have been nourished almost entirely on farinaceous food to the exclusion of animal matter, are peculiarly liable to the disease. But those who have seen the swarms of healthy children brought up in some parts of these countries on a diet almost entirely vegetable, and especially on the potato, the nutritious qualities of which by no means entitle it to a high rank even in this class of alimentary substances, will not feel disposed to attribute any great degree of importance to this cause, at least when the individual is placed in other respects in favourable circumstances, and especially in regard to the enjoyment of a salubrious air and abundant exercise. Where, however, these are wanting, as in the crowded parts of a great city, the importance of a certain portion of animal food is unquestionable. A singular explanation has been given us by Portal as to the manner in which the overfeeding of children with farinaceous food leads to the enlargement of the glands of the mesentery, &c. He supposes that partly by its bulk and partly by the gas which is extricated from such food, the stomach and intestines are habitually over-distended, and thus compress the neighbouring parts, impede the circulation of blood in the vena portæ, and cause a general congestion of all the glands within the abdomen. Bordeu had a peculiar prejudice against the use of milk in the case of children disposed to scrofulous affections. But the premature and entire substitution of other forms of animal food, whether in the shape of soups, jellies, &c., for the bland and highly nutritive fluid which nature has prepared for this tender age, however specious in theory, cannot fail to be injurious if adopted as a general rule of practice.

Whatever tends to induce irritation in the mucous membrane of the intestines, as coarse, stimulating, and ill-digested food, or the abuse of purgative medicines, must have a similar effect on the orifices of the lacteals, and eventually on the glands through which they pass. Many analogous instances are to be met with in the animal economy where the prejudicial influence of irritants applied to a mucous membrane is transmitted to the glands in its neighbourhood; and there is some reason to suppose that even where the primary irritation is low in degree, if it be long kept up or frequently renewed, the secondary glandular congestion ensues with no less certainty than if the cause were more acute; and in a scrofulous constitution, long-continued glandular congestion and tubercular development are almost synonymous. On the influence of disorder of the digestive organs in the production of scrofula, Abernethy and his disciple Mr. Lloyd have dwelt much; and Dr. Mackintosh is persuaded that scrofulous affections generally, and above all that species of which we are now treating, depend on gastro-intestinal irritation or inflammation. "Judging," says he, "from the condition of the tongue, from the appetite, the increased thirst, the tumefaction of the abdomen, the degree of flatulency, the occasional pain in the belly, the irregularity of the bowels, and the appearance of the feculent matter, I persuaded myself, many years ago, that scrofulous affections were produced by disease in the digestive organs, and that that disease, whatever else it might be owing to, consisted principally

in extensive irritation of the mucous membrane; but I had little notion that there were also extensive ulcerations till I was repeatedly convinced by dissection that this was the case." But though we have ourselves likewise in very many instances found ulceration in the intestines of subjects who had been carried off by scrofulous disease, we do not think that it has been yet made out to be an universal occurrence, which, to constitute it the absolute cause of this affection, would be necessary; nor has it even been proved in those instances where it does occur, that it is always the first link in the chain of morbid actions. Moreover, these inflammations and ulcerations are very frequently, perhaps generally, preceded by the deposition of minute submucous tubercles, which seem to owe their origin to a general tubercular diathesis of which they are but one of the many local evidences. We possess drawings of such submucous tubercles about the size of the head of a small pin, the surrounding mucous membrane being in some instances still pale, and affording as yet no evidence of irritation or inflammation; whilst around others these effects have already been produced, and the process of ulceration is commencing. M. Andral, whilst he admits, as we have seen, that disease of the mucous membrane often precedes that of the mesenteric glands, strenuously asserts that the latter are capable of taking on scrofulous action without any such preliminary lesion of the intestines.

It is partly from the general debility of the system induced, and partly from the inflammatory state of the mucous membranes which they leave behind them, that the exanthemata, and especially measles and scarlatina, as well as painful and tedious dentition and hooping-cough, are so apt to be followed by enlargement of the mesenteric glands and other scrofulous affections. The sudden disappearance of porrigo, itch, sores behind the ears, and other cutaneous affections, have been supposed to lead to a similar result; and this has been thought to take place most probably through the medium of an exacerbation of that inflammation of the mucous membrane which is known so often to complicate diseases of the skin.

The premature administration of bark in intermittent fever has been accused by some of inducing obstruction of the mesenteric glands, whilst by others this has been considered the effect of the ague itself, or rather of the irritation of the mucous membrane which often accompanies it. Broussais, in his "History of the Chronic Phlegmasiæ," has given two cases of enlarged and tubercular mesenteric glands with chronic peritonitis, occurring as the sequelæ of ague. The subject of one of these, a soldier twenty-six years of age, immediately after the aguish paroxysms had been subdued, began to complain of a slight pain and swelling of the belly and imperfect digestion. Marasmus and feverishness at length ensued, and the case terminated fatally about the end of the third month. The bronchial glands were found diseased, as well as those of the mesentery, which were swollen, hard, and tubercular at their centre. The mesentery itself was considerably thickened, and peritoneal adhesions had taken place with deposition of tubercular matter in the effused lymph. The other case was very similar in its progress and termination. According to Broussais, the ague in both was merely symptomatic of a gastro-enterite, and the enlargement of the mesenteric glands, as well as the chronic inflammation of the peritoneum, were its collateral consequences. Enlargements of lymphatic glands, though so often a consequence of mucous inflammations, are, he thinks, never the result of serous inflammations. The evidence of inflammation of the mucous membrane in the cases cited is, unfortunately for his theory, any thing but convincing. In only one of these cases had any bark been given. (Histoire des Phlegmasies Chroniques, vol. iii. p. 354–368.)

Treatment.—The treatment of tabes mesenterica coincides in the greater part of its extent with that of general scrofula, and of this by far the most important portion consists in giving the patient the advantage of good country air, abundant exercise, warm clothing, and nourishing food adapted studiously to the powers of the stomach and to the state of the intestines. The medicines, properly so called, which have at one time or other been used in this disease, are reducible to purgatives and aperients; alteratives, including mercurials, antimony, guaiacum, sarsaparilla, &c.; tonics, comprising the liquor potassæ, carbonate of soda, iron, bark, bitters, &c.; deobstruents, such as the muriate of barytes, burnt sponge, iodine, and cicuta. In addition to this list, there have likewise been employed externally, leeches, tepid, sulphureous, and cold baths, electricity, stimulant and anodyne frictions or plaisters, or stronger counter-irritation, by means of tartar-emetic ointment, croton oil, &c.

"In the commencement of this disease," says Burns, "the steady and repeated use of mild purgatives with calomel, conjoined with some light bitter infusion, decoction of bark, tonic medicines, and gentle friction over the belly continued for a considerable length of time morning and evening, would appear to be of more service than any other plan of treatment. Copious evacuations in this disease are not required; it is sufficient that the bowels be brought into and kept in a regular state, which, in the incipient stage at least, sometimes requires pretty strong doses." (Principles of Midwifery, including the Diseases of Women and Children, p. 745.) He was in the habit of giving a dose of calomel every second or third night, occasionally combining it with rhubarb, in order to prevent it affecting the constitution, or interposing from time to time a dose of castor oil. Purgatives should, however, never be pushed the length of diminishing the strength, and are generally of very dubious propriety in the advanced stages of the disease. Many of the later French writers are very hostile to the employment of all medicines of this kind, as well as to tonics and to all substances which might in any degree irritate the mucous membrane. "The inflammation and enlargement of the lymphatic ganglia of the mesentery," says Reis, an ardent disciple of Broussais, "which so often occur after inflammation of the digestive passages, are merely sympathetic phenomena. Certain physicians, who will not give themselves the trouble to think what takes place in such cases, still persist obstinately in the practice of stimulating the mucous membrane of the intestines of patients labouring under mesenteric

disease. What good result can they look for from the employment of tonics, deobstruents, &c., applied without intermission to a mucous surface already in a state of inflammation?" To all this it may be replied, first, that it is not by any means certain that the mucous membrane is still inflamed, were we even to grant, for sake of argument, that such inflammation necessarily formed a preliminary stage to the disease of the mesenteric glands; and, secondly, even though the mucous membrane were still in an inflamed state, this inflammation being frequently of a scrofulous character, might itself perhaps be beneficially modified by the application of a gentle stimulus; such at least is often the case with external scrofulous inflammation, strumous ophthalmia, &c. Besides, the trivial ill effects of the momentary local excitement by tonics, &c., might be more than compensated by the improvement of the constitution at large; and the temporary irritation of the mucous membrane by a purgative might be much more than counterbalanced by the improvement of its secretions, the unloading of its vessels, as well as by a species of counter-irritation, which, by being spread over a *large extent of surface*, most of which is sound, can cause little risk, in prudent hands, of creating or exasperating local inflammation, whilst it tends at the same time to control the determination of blood to the congested glands, and to promote absorption. The bold, continued, and somewhat empirical employment of powerful purgatives by certain physicians of the new Italian school, even in cases of inflammatory diarrhœa, though a practice which we should feel little disposed to imitate, shows at least that the danger of their exhibition has been much exaggerated by the followers of Broussais.

As to the utility of tonics, such as bark and the various preparations of iron, there is still much difference of opinion in this country; few if any practitioners of the present day giving them credit for that specific power over scrofula which Fordyce, Fothergill, and other distinguished physicians of the last age, seem to have attributed to them; but as to the employment of mild aperients, nearly all the best English authorities are still in their favour. Dr. Pemberton recommends purging the patient twice a week with calomel at night and salts the next morning, a slight tonic and conium being used in the intermediate days. He admits, however, that we must be cautious in our mode of purging children, for, if carried to excess, it not only exhausts the general strength, but induces in particular such a weakness in the muscular fibres of the intestines that the abdomen soon becomes tympanitic. As a general rule, he lays it down that the more severe the evening accession of fever is, the greater is the necessity for purging, and the more caution is then required in the use of tonics; whilst on the other hand, as the fever diminishes in intensity, the more freely may the latter class of remedies be employed. Even after some impression had been made on the disease, he still continued to give half a grain of calomel every night for a week, and then intermitted its use for the same period, and so on alternately for two or three months.

The practice of Underwood consisted in giving a grain or half a grain of calomel twice or thrice a week, and small doses of the subcarbonate of soda on the intermediate days, or an infusion of burnt sponge and senna, if there was considerable costiveness; and subsequently a light bitter and a chalybeate. These remedies, he asserts, will almost always succeed in curing the disease if early employed, that is, "before the mesenteric glands become much enlarged or the fever continual, whilst the appetite continues, and the first digestion is little impaired, and no purging has taken place." If any additional purgative be requisite, or if there should be reasons for not employing calomel, he speaks highly of rhubarb and tartarized kali, or rhubarb with sal polychrest, which was so favourite a remedy with Fordyce, either of which medicines may be employed daily for many weeks with perfect safety; and after enumerating some other remedies, as diaphoretics, tonics, stimulant frictions, &c., he concludes, "but above all, purging is always the most essential to the cure of this dangerous disease;" and it is not to be omitted even though there should already exist frequent stool, as such spontaneous evacuations do not, he observes, reduce the swelling of the belly, whilst they but too often deter practitioners from the use of active or repeated purges. He was in the habit of giving, for a length of time afterwards, fractional doses of calomel with ipecacuanha and cicuta, and to these at a still later period of the disease a little calumba was added. Mr. Abernethy, whose chief aim in this as in most other diseases was to improve the general health through the medium of the digestive organs by well-regulated diet, sea-air, and alterative doses of mercury, very commonly gave half a grain of calomel with three grains of rhubarb, and a small quantity of ginger every second night; and Mr. Lloyd, in his treatment of scrofulous affections, acts upon the same principle, trusting chiefly to blue pill and laxatives followed up by the compound decoction of sarsaparilla and Plummer's pill long persisted in. Sir Astley Cooper, in addition to the use of highly nutritious food, in order to compensate, as he says, for the small quantity of chyle which passes through the mesenteric glands, uses tonics and alteratives together with a stimulant plaister applied all over the abdomen, or frequent frictions with the hand to excite the action of the absorbents. The internal medicine most frequently given by him is a tincture composed of one grain of the oxymuriate of mercury dissolved in two ounces of the tincture of bark, or of tincture of rhubarb if costiveness prevail, the dose of this solution being a tea-spoonful twice a day. It is given with a view merely to improving the secretions of the liver and intestines, and producing one stool daily. The hydrargyrum cum cretâ with rhubarb is likewise occasionally employed by him as an aperient, or a purgative of rhubarb and calomel is given about once a week, if necessary, in order to restore the secretions. These medicines, together with a tonic powder consisting of rhubarb and subcarbonate of iron, or of carbonate of soda, rhubarb, and calumba, are, along with flannel clothing, tepid or sea-bathing, and a dry warm atmosphere, his chief resources in scrofulous diseases. The dropsy which sometimes comes on in the course of tabes mesenterica is, according to Sir Astley, susceptible of relief from paracentesis; the

advanced period, however, of the disease at which this complication usually presents itself, will, we believe, deter most practitioners from having recourse to it. "In the mesenteric fever of infants," says Dr. A. T. Thomson, "we have found the following powder, aided by daily long-continued frictions of the abdomen with soap liniment, of great efficacy,—viz. ten grains of the sulphate of potass, with six of powdered calumba and three of rhubarb, given twice or thrice a day." Rhubarb is likewise a favourite medicine with Baumes in this disease; and Herz speaks of curing a case in the space of a month by the sole use of rhubarb and acetate of potass, eight grains of each being given night and morning to a child of three years old.

Portal was a decided advocate for the use of mercury in mesenteric disease. Its employment in scrofulous affections was likewise strongly urged by Bordeu, and it was administered in such cases long before his time by Baillou and other distinguished French practitioners. Mr. White made much use of calomel in diseases of this kind, and Mr. Farre brought mercurial frictions of the abdomen into temporary repute. Cullen, on the other hand, pointedly condemns the employment of mercury; and according to the best practitioners of our own days, it is only as an alterative or aperient that it should be exhibited. Where pushed so far as to affect the constitution and induce salivation, it may be productive of the worst effects in strumous habits; and even its use as an alterative and aperient, if repeated at short intervals and long-continued, in irritable states of the mucous membrane, is of very questionable propriety. To its employment as an occasional purgative when the tongue is furred, the stools deficient in bile, or the secretions of the mucous membrane of the intestines much vitiated, there can be no objection.

Where we have reason to apprehend irritation or inflammation of the mucous membrane, or chronic peritonitis, the application of leeches to the abdomen, along with fomentations, the hot bath, the mildest aperients, and a bland diet, are proper; and counter-irritation on the surface should be subsequently effected by means of stimulating liniments, or the ointment of tartrate of antimony, or daily frictions with a few drops of croton oil persevered in till an eruption appears. Such counter-irritation will tend likewise to exert a beneficial influence over the enlarged glands, and form a very material part of the treatment, even where the disease is supposed to exist in its simplest form. Leeches also may occasionally be employed with advantage even in the latter cases, provided that great emaciation and debility have not yet taken place; and more especially at that moment when irritation and inflammation begin to be set up in and around the enlarged glands; the difficulty of detecting this precise period will, in practice, we are aware, often be found very considerable, and the frequent repetition of local depletion, in a disease so eminently characterized by debility, can rarely if ever be admissible. To the principle itself, however, no fair objection can be made. Even if we hold the disease to be of a decidedly scrofulous nature, there is still no inconsistency in striving to subdue the local inflammation by topical bleeding, whilst we are at the same moment endeavouring to support the strength and improve the general tone of the system. Such is the practice to which Girtanner's theory of the disease, one of the best hitherto proposed, naturally leads; for according to him scrofula depends, not, as Bordeu would have it, on mere weakness of the lymphatic system, but also on an augmentation of its irritability. To reduce this irritability, those measures which tend gradually to strengthen the constitution are known to be the most effectual: such at least is the result of experience in regard to external scrofula where we have ocular demonstration of the efficacy of this plan of treatment. But until this desirable result has been obtained, and it requires some time, we should endeavour by topical antiphlogistics to reduce those local inflammations which are so easily called into existence in such habits, and which react so injuriously on the already debilitated constitution.

Cicuta still enjoys a kind of dubious reputation in this and other diseases of obstruction, as they used to be called. It may possibly sometimes be beneficial by diminishing local pain and moderating constitutional irritation. Perhaps, however, Dover's powder, in most cases where a narcotic is called for, and where the state of the bowels admits of its employment, will be preferable, as it tends not only to produce the effects just alluded to, but also at the same time to relax the skin, which is so generally, in the earlier stages at least, harsh and dry. The muriate of barytes, notwithstanding the high character which it for a time enjoyed in England, France, and Germany, has now fallen into pretty general disuse. Dr. Ferrier some years ago made trial of it in several cases, and published, in the first volume of his Medical Histories and Reflections, the results of his experience, which are very unfavourable to its supposed virtues in scrofulous diseases. In two instances only out of all those in which he employed it, did it appear to be in any degree serviceable, and even in these the good effects were not very remarkable. "I cannot help suspecting," he adds, "that the only benefit to be expected from it must arise from the action of the acid, either not completely saturated or not destroyed as a tonic, by this mineral. Several patients whom I now attend for scrofulous complaints, are taking the acid alone with apparent benefit, who had used the muriated barytes without experiencing the smallest alteration in their health." Dr. Thompson's evidence is much to the same effect. In the hands of Pinel, Hébréard, and some other French practitioners, in doses of one grain dissolved in two ounces of fluid, and repeated every second day, it seemed occasionally to resolve scrofulous indurations; but it not unfrequently produced very alarming effects, super-purgation, colic, pain in the chest, inflammation of the throat, &c. The danger of its use, especially where there is any phthisical tendency or inflammation of the mucous membrane of the stomach or intestines, is obvious.

The use of burnt sponge by Underwood and others has been already alluded to. It has, however, latterly, been little employed, as we now possess in iodine and its various pharmaceutical preparations the active principle of the sponge in a much more concentrated and yet more manageable form. These preparations may be used either

internally or externally, or both. In a case of Dr. Roots lately published, we have an example, as well of its energetic and beneficial agency, as of the great caution which its exhibition demands. (London Med. and Surg. Journal, March 2, 1833.) The patient, a boy six years old, of a strumous constitution, having enlarged cervical and inguinal glands, laboured under all the usual symptoms of tabes, viz. great emaciation, feverishness, dry, harsh, and shrivelled skin, abdomen enlarged, tense, and knotty, uneasy rather than painful on pressure, voracious appetite, furred tongue, &c. Half a drachm of the liquor potassæ hydriodatis of St. Thomas's Hospital was ordered to be taken thrice a day,* and half a drachm of the unguentum iodinii of the same hospital, containing a drachm of pure iodine to an ounce of lard, was rubbed into the abdomen night and morning. The warm bath was used daily to restore the cutaneous secretion, and bile being deficient in the stools, three grains of the hydrarg. cum cretâ were taken nightly, occasionally interposing a small dose of castor oil. Under the use of these measures, aided by a milk diet, and a small mutton-chop daily, the abdomen soon began to diminish in size. The dose of the liq. pot. hydriod. having now been increased to one drachm, induced, after being continued for a fortnight, mucous and bloody stools, and the abdomen became painful on pressure, especially in the left iliac region. The internal and external use of iodine, as well as of the mercurial preparation, was immediately suspended, and local depletion substituted. Two applications of leeches, together with counter-irritation by means of a few drops of croton-oil rubbed on the abdomen till an eruption of pustules appeared, and the use of mucilaginous drinks completely removed the dysenteric symptoms, and permitted a return to the external use of iodine. Of an ointment composed of one drachm of the ioduret of lead to one ounce of lard, half a drachm was rubbed into the enlarged inguinal and cervical glands night and morning; and this quantity was after some days increased to a drachm. Under this treatment the improvement was remarkably rapid, the belly becoming soft and natural in size, the stools regular and of healthy appearance, the limbs stout and firm, and the skin soft and pliant, while the external glands likewise were diminishing. Dr. Roots believing with M. Lugol, that the ioduret of lead is capable of exciting absorption more quickly than any of the other preparations of iodine, expresses great confidence in its efficacy in cases of enlarged mesenteric glands, provided the mucous membrane be neither ulcerated nor inflamed. Should irritation of the mucous membrane be induced by this substance, we must instantly substitute, as was so judiciously done in the above case, an antiphlogistic treatment, of which the most important part consists in local depletion, assisted by fomentation, warm bath, a demulcent diet composed chiefly of milk and mucilaginous fluids, an occasional opiate, and active counter-irritation. When we have reason to apprehend from the state of the external glands or otherwise, that those of the mesentery have passed into the inflammatory or suppurating stage, the use of iodine in any form is out of the question, as it would probably only accelerate the destructive process. Though the above and a few other cases which might be cited seem in favour of the employment of iodine in mesenteric disease, it has not yet been tried on a sufficiently extensive scale to enable us to decide positively on its value. De Carro of Vienna, so honourably known to the medical world for his zeal and activity in the investigation of the value of all new and promising remedies, speaks very favourably of its use in scrofulous affections. He has been chiefly in the habit of using Coindet's tincture of the hydriodate of potash, and has administered it in doses of from five to ten drops even to very young subjects, without ever having found it in any way injurious; and he thinks its advantages have been rather understated by Coindet,—a fault which cannot often be laid to the charge of those who introduce a new medicine into practice. Formay of Berlin has likewise used it with safety and benefit. Magendie and Guersent, on the other hand, have pronounced it useless in scrofula, and the latter in particular thinks it altogether inefficient in mesenteric disease as well as in enlargements of the external glands, even when very freely employed. Carminati accuses it of producing painful affections of the chest, stomach, and intestines, and in particular habits nervous symptoms, convulsions, &c. Amongst the ill effects sometimes induced by it, are acceleration of pulse, palpitations, dry cough, insomnia, emaciation, debility, trembling, headach, numbness of the arms, swelling of the legs, diminution of the breasts, &c. In very large doses it causes violent inflammation of the mucous membrane of the stomach and intestines. In mentioning these occasional ill consequences of the abuse of this medicine, we are far from wishing to discourage further trials of it in the disease under consideration, but think it right, in a practical work of this kind, to show the caution which its use demands, and the necessity of constant watchfulness during its employment.

Antimonials, though by the majority of practitioners not considered very powerful auxiliaries in the treatment of this affection, have yet their advocates. The incipient stage of mesenteric disease may, according to Dr. Hamilton, jun., be cured by them in conjunction with the nightly use of the warm-bath, light nourishing diet, and diligent frictions with an opiate liniment. "In some cases," says he, "even after the hectic symptoms had appeared for several weeks, this plan has succeeded."

Bitters and alkaline medicines, especially the liquor potassæ, have occasionally appeared to be of service in the earlier stages. The anti-scrofulous elixir of Peyrilhe, a medicine of this kind, enjoys some popularity in France in scrofulous diseases. According to the formula in Ratier's "Pharmacopée Française," it is a tincture composed of one ounce of gentian, and three drachms of carbonate of soda, to two pounds of alcohol,

* If the strength of this solution be correctly stated, viz. three and a half grains of the hydriodate to each half drachm of fluid, the dose is much larger than that usually given at the *commencement* of the exhibition of this medicine. The ordinary dose of the hydriodate is one grain gradually increased to three, dissolved either in an aqueous or a spirituous menstruum. Coindet's solution consists of thirty-six grains to one ounce of alcohol, of which from five to twenty drops and upwards may be given thrice a day.

digested together four days and then strained. In another formula which we have seen, a drachm and a half of the carbonate of potass is substituted for the soda, and brandy for alcohol. The dose for young children is about a tea-spoonful sufficiently diluted, given thrice a day, just before each meal. That so stimulant a medicine cannot be administered without considerable risk if much irritation of the mucous membrane exist, is obvious. Small doses of the sulphate of quinine in the early part of the disease sometimes exert a beneficial influence, apparently by improving the tone of the digestive organs. Chalybeates, especially mineral waters, are occasionally useful where there exists no indication of an inflammatory state of the glands or intestines, and cold sea-bathing may sometimes under the same restriction be advantageous; but if there be frequent pain and a distinct paroxysm of evening fever, if the tongue be much furred or very red at the point and edges, along with thirst and a quick pulse, the tepid bath must be substituted, and is, perhaps, in all stages save that of advanced convalescence, not only safer but more beneficial.

The diet is, as Pemberton has remarked, at least as important as medicine. That which he recommended consists of milk, dressed vegetables, gruel, and other farinaceous food, to which, if the child were above three years old, he added a small quantity of animal food every second day: of all kinds of fermented liquors he disapproved. Sir Astley Cooper, on the other hand, in addition to allowing animal food in small quantities frequently in the course of the day, together with rich broths, arrow-root, &c., approved of giving a little wine and water at dinner to stimulate the action of the stomach and of the absorbents. In the majority of cases, however, we should be inclined, with Pemberton, to exclude all vinous drinks through the apprehension of exciting that irritation the supervention of which we have so much reason to dread.

When the disease, in spite of every remedy, has run on to its last and fatal stage, it only remains for us to palliate the symptoms, to moderate the colliquative diarrhœa by the cautious use of opiates, Dover's powder, lime-water, anodyne injections, and blisters to the abdomen, and to support the strength as long as possible by a plentiful supply of bland unstimulating and nutritious sustenance, such as asses'-milk, rennet, whey, sago, salep, Iceland moss, &c. Jellies, soups, and other forms of animal food, and even a little wine and water may be added, if they are not found to increase the fever or exasperate the symptoms of gastro-intestinal irritation. For the various stages of this and of all other scrofulous disorders, no one absolute rule of diet can be laid down, as the kind and quantity of food proper for the patient must always depend on the actual state of the complaint, and particularly on the condition of the digestive organs. The most nutritive substances, if given in defiance of such considerations, can have no other effect than that of adding to the excitement already existing, and thus infallibly increasing the debility.

As to the prevention of the disease, most of the necessary information may be deduced from what has been said above of its causes. Good country air, a mild climate, proximity to the sea, abundant exercise and nourishing food, the use of flannel next the skin, and sea-bathing in summer and autumn, together with attention to the state of the stomach and bowels, and a judicious treatment of the exanthemata and other febrile disorders, are amongst the chief points demanding our attention. If a child is born of scrofulous parents, says Pemberton, it should be suckled by a healthy nurse for at least a year: after this the food should consist of milk and farinaceous substances: "by a perseverance in this diet for three years, I have found that the threatened scrofulous appearances have certainly been postponed, if not altogether prevented." Even a greater protraction of the period of lactation by means of a succession of good nurses, will, perhaps, in the case of very delicate children, be advisable. [See Scrofula.]

W. B. Joy.

TEMPERAMENT.—Temperament, or *crasis*, meaning mixture or tempering of elements, was in the old physiological notion a certain combination of four principal qualities, or, rather, of four corresponding entities, which were supposed to constitute, with some variety of proportion, the substance of living bodies. The four qualities are, in the abstract, hot, cold, dry, moist: in the concrete, fire, air, earth, water. "An animal or a plant," says Galen, "cannot be entirely hot—that is, consist wholly of fire; nor can it be wholly moist, as is the element of water: there must necessarily be a mixture or tempering of qualities, and the individual temperament is designated from that quality which superabounds." (De Temperamentis, lib. i. cap. i.) This, however, is not exactly the Hippocratic doctrine of temperaments, though coming near to it. Hippocrates supposed the bodies of all animals having blood to consist, the fluid parts of them at least, of four secondary or compound elements, which are, blood, phlegm or pituita, and the two kinds of bile, yellow bile and black bile or atrabilis. (De Naturâ Hominis.) These principles of living bodies are compounded of the simple elements or qualities of nature, thus: hot and moist produce blood; cold and moist, phlegm or pituita; hot and dry, yellow bile; and cold and dry, black bile. Bodies in which blood superabounds are of the sanguineous temperament; if phlegm is in excess, the phlegmatic temperament is developed; if bile, the choleric; if atrabilis, the melancholic or atrabilious temperament. Thus a speculation merely hypothetical gave origin to a fourfold division of constitutions, or, as they were termed, temperaments. It happened, likewise, that in the inhabitants of Greece, as of other countries under similar climates, there were four striking varieties of external appearance. There are two very different complexions, one fair and the other dark: when light flaxen hair and a fair skin are combined with a florid colour and other signs of a strong circulation and vigorous health, and, on the contrary, with a cold, pallid skin, and the indications of languor and weakness, we have two very different aspects displaying themselves in fair persons: and the dark complexion undergoes a similar variation when black hair and a swarthy skin are combined with a ruddy hue and the signs of strength and vigour, or, on

the other hand, with the appearances which betoken a low degree of physical energy.

Physicians at an early period imagined a connection between these four varieties of external characters and the four supposed conditions of excess or superabundance of particular elements in the temperament or constitution. They assumed that fair persons with flaxen hair and florid complexions have more blood than other men; that fair individuals with pallid skins and light hair have a superabundance of phlegm; and that dark-haired men abound respectively in yellow bile or black bile, according as they differ in a corresponding manner from each other. It is needless to conjecture the reasons which led the ancient physiologists to adopt this fanciful distribution.

The following are the descriptions generally given of the four temperaments thus constituted.

The **sanguine** or **sanguineous** temperament is distinguished by red or light brown hair, blue eyes, a fair florid complexion; the arteries and veins are large and superficial, and the pulse full and frequent; the skin soft, thin, and delicate; the body often large and tall, and inclined in the middle period of life to obesity.

The **phlegmatic** temperament is distinguished by light, sandy, or whitish hair; light grey eyes; a pallid, unhealthy whiteness of skin, which is almost bereft of hair; small blood-vessels; a weak slow pulse; cold surface; general defect of energy in the functions both of animal and physical life.

The **choleric** temperament is marked by black curling hair, dark eyes, a swarthy, and at the same time ruddy complexion, a thick rough, hairy skin, and a strong and full pulse.

The **melancholic** temperament is also noted for black hair and eyes and a dark complexion; but the hair is lank and straight, and the skin of a leaden and unhealthy hue; the pulse is slow. (*Gregory's* Conspectus Medicinæ Theoreticæ.—*Richerand's* Physiology.) It is observed, likewise, that persons of this temperament are tall, have long necks, narrow shoulders, flat breasts, long narrow heads laterally flattened, with expanded foreheads, well-proportioned countenances, small acute features, thin lips, and that they are slow and sedate in their manners and habits. (Sammlungen für die Heilkunde der Gemüthskrankheiten, von Dr. Max. Jacobi. Bd. 2. s. 200.)

To these varieties of bodily constitution and external aspect, certain peculiarities of mind, of temper or disposition, were supposed to be superadded. The connection of mental or psychical qualities with those of physical organization constitutes an essential part of the theory of temperaments; but we shall defer this consideration for the present, in order to enter upon it hereafter separately in a more suitable manner.

Many late physiologists have been inclined to doubt whether the external characters associated with the four temperaments are real and constant signs of diversity in bodily structure, and enable us to distinguish the principal varieties of constitution which exist. Divers attempts have been made accordingly, to define in a more satisfactory manner the peculiarities of organization and the resulting varieties of predisposition, which are chiefly interesting with regard to pathology. Hoffmann and Cullen have, indeed, retained the old division, supposing that the theory of the ancients, as to the peculiarities of constitution, was founded originally upon facts, though subsequently combined with an erroneous theory. But Haller opposed the doctrine of temperaments as connected with an erroneous and obsolete pathology; and Darwin endeavoured to establish a division of constitutions in reference to the vital actions of the system: these in his theory are of four kinds; the actions of irritation, sensation, volition, and association. The doctrines of the Zoonomia, however ingenious, were not calculated to take a firm hold on the opinions of correctly thinking persons, and the only attempt to improve upon the Hippocratic theory of temperaments which has been attended by any degree of success or general approbation is that of Dr. Gregory, who retained the four original divisions and added to them a fifth, which he designated as the nervous temperament.* The objection to this attempt, or, rather, the obstacle which stands in the way of its success, is the circumstance that only four strongly marked diversities of external character present themselves to observation: the nervous temperament is not so distinguished, and as this is an essential part of the original scheme for the distribution of temperaments, the improvement here proposed is lame and defective. If we dispense with this part of the system, we may multiply indefinitely the varieties of constitution or natural tendency, but this would be comparatively of little advantage without any distinguishing characters by which they may be recognised.

If we take, then, the classification of temperaments as it comes to us, since it does not appear to admit of much extension or improvement, we shall still find that the four varieties of external character really indicate more or less constantly, well-marked differences of constitution, and likewise of morbid predisposition. There is no doubt that persons having the complexion and other signs of the sanguine temperament, are more liable to certain classes of disorders than the phlegmatic or melancholic, while the latter have their own peculiar tendencies. The sanguine having a fully developed vascular structure, and therefore a vigorous circulation of blood, a warm skin and a high degree of organic sensibility, are more liable to sudden and powerful impressions from external agents than those of more languid vital functions. They are subject, in a greater degree, to severe inflammatory disorders, and disorders of this class are in them more acute: they bear, however, better than persons of more languid habit, evacuations of blood and the other measures which are found to be the proper remedies for these diseases. The greater fulness of blood-vessels, of those at least which are near the surface, the greater warmth of the skin, the florid complexion of the sanguine, afford reason to believe that the designation given to this temperament is

* For a fuller account of the modifications which the doctrine of temperaments has undergone, we must refer to Dr. Bostock's Elements of Physiology,—a work which ought to be in the hands of every person who devotes himself to the study of the animal economy. See vol. iii. p. 310. First edition. [See, also, M. Levy, *Traité d'Hygiène Publique et Privée*, p. 60. Paris, 1844.]

not wholly unfounded. We likewise find that sanguine persons are more subject to hemorrhages, to those at least which are termed active, as arising from excess in the force of circulation through the arteries. Individuals of the phlegmatic temperament are predisposed to disorders arising from, or connected with, a low degree of vital energy. Local congestions of blood existing independently of general excitement come under this category. Glandular and tubercular diseases take place in bodies weak in the structures connected with the vital functions, and are perhaps more frequent in the phlegmatic than in other temperaments. Inflammatory complaints, when they attack the phlegmatic, are less acute, and more disposed to terminate in chronic diseases than are those of the sanguine constitution, when at least the latter have been treated with appropriate remedies. The relations of the choleric to the melancholic temperament are similar to the relations which the phlegmatic bears to the sanguine; the former displays greater vigour, both in health and in disease, than the latter. The choleric and sanguine, when affected by disease of the nervous system, have complaints of greater violence and acuteness; mania or raving madness belongs particularly, according to the observations of M. Esquirol and many others, to these constitutions. The melancholic temperament is most prone to monomania, attended with depression and melancholy illusions. Hypochondriasis much more frequently affects the phlegmatic and melancholic, though we have occasionally observed it in persons who had some of the external characters of the sanguine temperament. The most severe cases of hypochondriasis, and those which approached most nearly to the character of melancholia, have certainly occurred in individuals of a dark leaden complexion, fixed and sullen aspect, and lank coal-black hair.

[Still, the slightest attention to the reputed characteristics of the temperaments will show the imperfection of their definition and demarcation, —so imperfect, indeed, that—as the writer has said elsewhere (*Human Physiology*, 5th edit. ii. 574, Philad. 1844), it is extremely rare for us to meet with an individual whom we could unhesitatingly refer to any one of them. They are, also, susceptible of important modifications by climate, education, &c., and may be so combined as to constitute innumerable shades. The man of the strongest sanguine characteristics may, by misfortune, assume all those that are looked upon as the indexes of the melancholic or atrabilious; and the activity and impetuosity of the bilious temperament may, by slothful indulgence, be converted into the lymphatic or phlegmatic. It is doubtful, also, whether any of the mental characteristics assigned to the temperaments be dependent upon them. The brain is the organ of the mental and moral manifestations; and although we may look upon the temperaments as capable of modifying its activity, they cannot probably affect the degree of perfection of the intellect,—its strength being altogether dependent upon cerebral conformation. It is even doubtful whether the temperaments can interfere with the activity of the cerebral functions. In disease of the hepatic, gastric or other viscera we certainly see a degree of mental depression and diminished power of the whole nervous system; but this is the effect of a morbid condition, and continues only so long as such morbid condition endures. Nor is it probable that any predominance of the nutritive functions could induce a permanent influence on the cerebral manifestations. Whatever might be the effect for a while, the nervous system would ultimately resume the ordinary action which befitted its primitive organization. Similar reasons to these induced M. Georget (*De la Physiologie du Systême Nerveuse, &c.* Paris, 1821,) to consider the whole doctrine of the temperaments as a superstition connected with the humoral pathology, and to believe that the brain alone, amongst the organs, has the power, by reason of its predominance or inferiority, to modify the whole economy. That a difference of organization exists in different individuals is obvious, —but that there is an arrangement of the nutritive organs or apparatuses, which impresses upon individuals all those mental and other modifications known under the name of temperaments, is sufficiently doubtful.]

Origin of Temperaments. Causes which give rise to these diversities. — It appears from what has been said that the four temperaments, considered as varieties of complexion and external character, reduce themselves to two principal ones. The phlegmatic temperament in this respect is nearly related to the sanguine; or rather, it is the light-haired or xanthous variety of the human species with a less full and perfect development of the structures essential to the vital functions, than what belongs to the sanguine temperament. The melancholic is a constitution bordering on disease, or at least marked by deficiency in the vigour of physical life, and bearing nearly the same relation to the choleric temperament as the phlegmatic bears to the sanguine. We shall at present make no attempt to determine the particular circumstances through the influence of which some bodies come to be endowed with a more perfectly developed vascular system than others. It is common to refer such phenomena to the infinite variety of nature, as a general fact, the observation of which throws, however, no light upon the productive causes. Another inquiry into which it may be more proper to enter after reducing the varieties of temperament, at least those of external character, to two, viz. the swarthy and the xanthous, will relate to the causes which give rise to these most remarkable diversities. On this subject we shall venture to offer a few remarks, as it has an extensive bearing on several parts of physiology, and particularly on the theory of external agencies on living bodies.

It has been conjectured that these and other analogous varieties of external character depend merely on original difference between distinct races of men. A great part of the population of Europe is supposed to descend from the mixture of two great tribes or nations, the Celtic and the German stock; and it has often been asserted that families of light complexion and red or flaxen hair inherit these peculiarities from Gothic, Danish, or Scandinavian, that is, from German ancestors; while those who are swarthy and dark-haired derive their complexion from forefathers who were of the Celtic race. However frequently this no-

tion has been maintained, it is in our opinion certainly erroneous; and this will be allowed if we can show that the facts from which it has been inferred have been assumed without adequate proof, and even in opposition to all the evidence of which such matters of inquiry are susceptible. The descendants of the Celtic people in the present age neither are, nor were their ancestors in former times, if we may credit historical testimony, a black-haired and swarthy race. If any person who travels through the middle parts of Wales or the western districts of Ireland, where a population of Celtic origin is to be found, if anywhere, unmixed or comparatively little intermixed with the offspring of a different stock, will make observation on the complexion of the inhabitants, we will venture to assert that he will not find more black-haired persons, in proportion to others, than in the central parts of England or the heart of Germany. This, at least, is the conclusion to which the writer of this article has been led after inquiries and observations continued or repeated during many years. Now, when we refer to ancient testimony, we cannot find one writer of antiquity who ascribes to the Celtæ as a general character a dark complexion or black hair. Tacitus, indeed, says that the Silures had curled hair and darkened countenances—*torti crines et colorati vultus*; but he mentions this very circumstance as a probable reason for supposing that that tribe was of Iberian rather than of Celtic origin, though on the whole he did not believe this to have been the case. This passage, instead of supporting the opinion that the Celtæ were a swarthy people, is in direct opposition to it. We have abundant testimony from other writers which leads us to adopt the very reverse of that opinion. Strabo declares in more than one passage, that the Gauls and Germans differed little from each other in form, stature, and complexion. He says that both nations were equally fair and yellow-haired or xanthous. (Strabon. Geog. lib. iv. item lib. vii.) Diodorus (Diodor. Bibl. lib. v. c. 28) ascribes to both the same characters; and Ammianus Marcellinus, whose authority on this point is, as M. Niebuhr has remarked, (*Niebuhr's* Roman History, vol. ii.), quite conclusive, since he resided many years in Gaul, has assured us that nearly all the Gauls were of high stature, fair complexion, and red hair.*

As this hypothesis will not bear the test of examination, we must look for some other way of accounting for the varieties of complexion and temperament.

The sanguine temperament, or the habit of body of which a fair florid complexion and light hair are the distinguishing features, appears to be a variety or deviation from the more ordinary characters of the human race, which rarely or sparingly displays itself in tropical or in hot countries, but springs up frequently in tribes migrating from these into cold or temperate regions, such a change constituting the origin or germ of a new stock, which is in many respects better adapted by its peculiarities of structure for the local conditions of its new abode. When this variety, which for the sake of distinction we term the xanthous variety, of our race, is to be found in hot climates, it is chiefly, as by many analogies in the animal and vegetable kingdoms we might be led to expect, in cool or temperate districts, where the warmth of the atmosphere is rendered moderate, or even cool, by mountainous elevations or by shady forests. Facts which establish the truth of these remarks may be found in every part of the world. The sanguine complexion is in no instance characteristic of a whole tribe, but may be observed to make its appearance occasionally in almost every nation or race of men. We may exemplify this remark in the Semitic race, of which the Hebrews, as well as the Arabs and the eastern Abyssins, may be reckoned as branches. The ancient Israelites appear, from various passages in the sacred Scriptures, to have been of the same complexion which is now prevalent in Palestine, marked with black hair, with a white or light brown skin. The modern inhabitants of that country are so described by travellers. (Dr. *Russel's* Hist. of Aleppo. *Volney's* Travels in Syria. *Browne's* Travels in Africa.) The Arabs of Yemen, of the interior of the Peninsula, and on the borders of the Persian Gulf, are, according to Niebuhr, De Pagès, Fraser, and other travellers of accurate observation, of a darker colour: they are said to be of a deep yellow or brown complexion, while "the tribes who inhabit the middle of the desert, have locks somewhat crisped, extremely fine, and approaching, as De Pagès declares, to the woolly hair of the negro." (*Fraser's* Journey to Khorasan. *Niebuhr's* Descript. de l'Arabie, p. 58. *De Pagès*, Voyage autour du Monde.) In many districts bordering on Egypt, the Arab tribes are described by Burckhardt as quite black: these people have straight hair, a circumstance which seems to forbid our imagining that they owe their dark complexion to intermixture with negroes. In Tigré the Abyssins, who speak a dialect cognate to the Arabic, are of an olive colour; and in Dixan, a part of Tigré, according to Mr. Salt, they are nearly black. (*Salt's* Narrative in Lord Valentia's Travels.) Springing up in the same race and within the same regions, we find the xanthous or sanguine complexion, but it is in elevated districts. "In the mountains of Ruddua near Yambo, in Yemen, the inhabitants," says Bruce, "are exceedingly fair." These are high craggy mountains, abounding in springs and verdant woody spots, where water freezes in the winter. "Some of the people," he adds, "have red hair and blue eyes, a thing scarcely ever to be seen but in the coldest mountains in the east. (*Bruce's* Travels to Abyssinia, vol. i. p. 246.) But the Jews, a branch of the same Semitic stock, have migrated from the land of their fathers; and it has often been observed that they have acquired great diversities in different countries. The Jews of Portugal are a strikingly different people from those of Poland. (Dr. Maximil. Jacobi's Sammlungen für die Heilkunde der Gemuths-krankheiten.) The Jews of Germany are in many places very fair; and in several towns in that country it is a fact well known that they are remarkable for strong, bushy, red beards. Here, then, we find the xanthous

* "Celsiores staturæ et candidi pænè Galli sunt omnes, et rutili, luminumque torvitate terribiles, avidi jurgiorum, et sublatius insolescentes."—*Ammian. Marcel.* lib. xv. 12.

variety springing out of a dark-haired race, in one instance, under a hot climate, but in tracts of considerable elevation; in the other, under a northern latitude.

Another widely spread race, whose immemorial abodes have been in climates nearly parallel to those inhabited by the Semitic nations, are the Libyan or Berberian tribes of northern Africa. To this stock belong the Berbers and Shellahs of Mount Atlas, whose language, the *Amazigh*, is allied to the *Showiah*, spoken by the Kabyles of the highlands behind Tunis, and to the dialect of the Tuarics dispersed through the Great Desert of Zahara. Of these tribes, who are proved by their idiom to be of cognate origin, the Tuarics are in many places of a dark brown colour, while the complexion of the Kabyles approaches to white, but with black hair. In the high mountains of Auress, however, according to Dr. Shaw and other travellers, tribes of the same Kabyles *are of fair and ruddy complexion, and their hair is of a deep or reddish yellow.* (Dr. Shaw's Travels in Africa. Hornemann's Travels, and Mr. Marsden's Appendices, &c.)

The natives of India furnish parallel observations. Some tribes in Malabar on the coast are nearly or quite as black as the natives of Guinea: the highlanders of Maharashtra are of a lighter colour: they are frequently of a tawny yellow, and Tippoo used to call them *bamboos*, from the hue of their skin. Farther northward than Guzerat, the Kattees, who are a tall and vigorous race of Hindoos, are of a much fairer colour, and have occasionally light hair and blue eyes. (Remarks on Kattiwar and its Inhabitants by Lt. J. M'Murdo. Bombay Trans. vol. i.)

Among the negro nations of intertropical Africa we should expect to find the xanthous variety of the human species making its appearance but rarely and under peculiar circumstances. What the peculiar external conditions are under which this variety springs up in the African races, we have unfortunately no accurate information, but that it does now and then display itself we know on good authority. White negroes are looked upon as great curiosities in Africa, and they are often collected by the black kings, and are kept as objects of wonder or ornament. Some of these white negroes are Albinos, having red eyes and white hair; but a great many of them, as we know from various travellers and naturalists who have minutely observed them, have blue or brown eyes, and red or yellow hair, and these doubtless belong to the xanthous variety: they have the external characteristics of the sanguine temperament. (*Pallas*, Novæ Species Quadrupedum. *Winterbottom's* Sierra Leone. *Buffon's* Supplement, tom. iv.)

Three other great divisions of mankind may be mentioned as displaying among them, under peculiar local circumstances, the same variety, though these nations have in general a swarthy or copper-coloured skin and straight black hair.

1. The people of the South Sea Islands allied to the Malays of Malacca and Sumatra, are in general of a dark tawny colour, with straight black hair; but in the Marquesas, Otaheite, Otaha, and several other islands, many individuals are of fair complexion, with auburn and sometimes even with red hair.

2. The native American race is generally considered as one of nearly uniform complexion under a variety of climes. That such a representation is a very erroneous one, the writer of this article has endeavoured to prove in another place, and the present occasion scarcely affords a fit opportunity for entering on a citation of numerous testimonies. It may here only be remarked that the scientific men and other travellers, who in late years have explored many regions in the interior of America, by order of the government of the United States, and who have in several instances published reports of their observations, which reflect high credit on the authors and on their nation, assure us that several tribes in the high countries toward the Stony mountains and the upper parts of the Missouri, have fair complexions, and light hair, and that the hair is in some individuals of a flaxen hue, with a tint of dusky yellow.*

We shall mention but one more instance of the origination of the xanthous variety or sanguineous temperament. It occurs in the races of northern Asia, who form a strongly marked and distinct group of nations, distinguished by a peculiar shape of the skull, which Blumenbach has termed Mongolian. To this class of nations belong the Mongoles and Kalmucs, the Mantschoos or Tunguses, the Chinese, and several of the Tartar tribes properly so termed. A Mongole, except in colour, is, according to Pallas,† more unlike an European than is an African negro. The complexions of adults are dark, and even the children are born with hair of a shining or glossy black. In this and many other respects they resemble the Indians, so termed, of America. Yet this is not invariable. Pallas saw one Calmuc girl, who had the perfect character of the race, but with flaxen hair; and we are assured by Mr. Barrow, that many of the Mantschoos, a nation closely resembling the Chinese and the Kalmucs, are extremely fair, of florid complexion, with light blue eyes, brown hair, and bushy beards.

The sanguine temperament seems, on the whole, to owe its origin or its frequent prevalence to a law of adaptation in the animal economy, which provides for changes in the constitution of organized beings of such kind as to fit particular races for external circumstances, and adapt the breed to the physical agencies under which it is destined to exist. That the constitution of body connected with the xanthous variety of our species is peculiarly adapted in many ways to temperate and comparatively cold climates, is obvious. A full, vigorous circulation of blood, increasing animal heat; a skin much less disposed to transpiration, and therefore to the cooling process, which is so salutary in hot climates, contributes to this end. The sanguine suffer much from heat in tropical countries; but they bear cold temperatures well. It is reported by Von Buch and other travellers, that the Finns in the north of Europe sustain much less inconvenience from

*Account of the Physical History of the Nations of the Missouri, chiefly from the Notes of Mr. Say, in James's History of the Expedition to the Rocky Mountains under Major Long.

† *Pallas*, Voyage en Sibérie; likewise an essay by the same writer, "über die Mongolischen Volkerschaften," of which a French translation is inserted in the xviith volume of Mémoires du Muséum d'Histoire Naturelle.

the cold season near the Arctic circle than Laplanders inhabiting the same district. (Von Buch's journey to the North Cape.) The former are generally a people of sanguine complexion, which is of rare occurrence among the latter.

There is no variety of constitution in the human species more evidently adapted by its peculiarities to the climates in which it exists than that of the negro, or we should rather say that of black tribes in general, for the remark includes many nations very remote from the people of Africa. If we look round the globe between the tropics, we shall find black and woolly-haired tribes in every part of it, at least among the older inhabitants of the hotter regions, and in those tracts in which the characters of the tropical clime do not occur in so intense a degree, we find races nearly of the same colour, with straight hair. If two lines are drawn across the African continent under the tropics, they will be found nearly to include between them the region in which the true characters of the negro are prevalent; to the southward of this space we discover Caffres and Hottentots, but not negroes; to the northward are tribes still more unlike the tropical African races. In the Isle of Madagascar the genuine Malecasses have black skins and crisped hair, though in their forms taller and more handsome than the negroes. Passing over the ocean eastward to the Indian continent, we discover the natives of Malabar nearly black, and the Cingalese in Ceylon of a hue almost equally intense, though neither of these races is at all woolly; but in the Andaman Isles in the Bay of Bengal we again find negroes nearly similar to those of Africa. Pursuing thence the same direction through the intertropical space to the further continent, we find, under the names of Samang and Bila, black races with woolly hair in the hilly tracts behind Malacca and Penang. Likewise in the interior of all the great tropical islands of the Indian Archipelago, wherever woody and inaccessible tracts defend the oldest races from the intrusion of Malayan and other colonists, the Papuas, black and with long frizzled hair, are still the sole inhabitants. Beyond the Indian ocean lies the continent of New Guinea, immediately under the equinoctial line. Here again, together with other productions of the equatorial clime, a black variety of the human race displays itself, woolly, like the negro tribes of Africa: they are the chief inhabitants of the extensive region above-mentioned, as well as of the great adjacent islands of New Britain and New Ireland. Still further to the eastward the insular groups of Louisiade, Solomon's Isles, Santa Cruz, and the New Hebrides, are occupied by tribes of a similar description. Here the woolly-haired people cease to be found: the natives of the more distant islands are of later origin or dispersed, as their still similar dialects prove, at a comparatively recent period. Passing over to the shores of the new world, we find no trace of woolly-haired races; but the people of California* and of Brazil, the hottest regions in America, are nearly as black as the Africans, and differ in a striking degree from the tribes inhabiting the north and south, as well as from the natives of the high plain of Anahuac.

We have made this survey in order to establish a fact which has often been denied,—namely, that the production of those physical peculiarities which belong to the negro, and of which a black skin and woolly hair are the most conspicuous traits, is in some way connected with the local circumstances of a tropical climate. This fact affords a presumption that the temperament [?] or constitution of races thus distinguished is peculiarly fitted for the regions which they inhabit, and other observations seem to prove this to be the case in a greater degree than we can fully explain. Europeans and their descendants bear with extreme difficulty an abode in Africa as well as in most other countries between the tropics. The coast of Zanguebar has been visited by navigators from the earliest times, and trading colonies have been established there and on various parts of the African shores; yet between the tropics these colonies have never maintained themselves, and now among the Portuguese at Goa an exile to Mozambique is considered as almost equivalent to a capital punishment. Even in the West Indies Europeans are supposed to be incapable of labour, and this opinion gave origin to the introduction of negroes. On the other hand negroes and black people in general seem to be under a corresponding disability to thrive and multiply in Europe. In cold climates they are always unhealthy, and are particularly subject to scrofulous and tubercular diseases. It is not so easy to determine what are the peculiarities of structure on which these differences depend. "The skin of the negro," as Dr. Winterbottom observes, "is always cool and remarkable for its velvet-like softness." Linnæus terms it, "*cutis nolosericea*." The head of the negro in his native region is covered with a thick dense mass of oily wool, which protects him from sustaining injury under the vertical solar rays. "The negroes," says Major Long, "so far from suffering any inconvenience, are found to labour with most alacrity and ease to themselves in the very hottest part of the day. The chilliness of the morning air in Jamaica seems to cast a damp upon their spirits, and renders them for a time feeble and torpid: one sees them creeping slowly out of their huts, bundled up with a thick clothing, shivering, and uneasy; but as the day advances, they grow more and more active and alert. The openness of their pores gives a free transpiration to bad humours, and they would enjoy robust health under the hardest toils if they were less prone to debauch. They love warmth in the night, and never sleep without a fire in their huts." (*Long's* History of Jamaica.) Mr. Jefferson has given a similar account of the negroes of Virginia. He says, "they secrete less by the kidneys, and more by the glands of the skin, which gives them a very strong and disagreeable odour. This greater degree of transpiration renders them more tolerant of heat, and less of cold than the whites. They seem to require less sleep. A black, after hard labour through the day, will be induced by the slightest amusements to sit up till midnight, knowing that he must be out by the first dawn of

* La Pérouse says, "the colour of these Indians (Californians), which is the same as that of the negroes, and a variety of objects, presented the appearance of a plantation in St. Domingo."

the morning. Their griefs are transient. Those numberless afflictions which render it doubtful whether heaven has given life to us in mercy or in wrath, are less felt and sooner forgotten by them. In general their existence appears to participate more of sensation than of reflection." (*Jefferson's* Notes on Virginia, p. 233.) This philosophical and republican owner of slaves endeavours to prove the negro to be of a species inferior to the white race. In the opinion that the negro is inferior in natural capacity, this writer is contradicted by the most intelligent and unprejudiced observers.

The xanthous or fair variety of complexion, and the black and woolly-haired mark the strongest diversities of temperament to be found in the human species, with respect to the adaptation for particular local circumstances. The red-skinned races seem to hold an intermediate place between these two extremes. To this class belong most of the native American nations, for among the latter there are, as we have seen, contrary to the assertions of many, both blacks and whites. To the class of red races belong also many tribes in the interior of Africa, whose native regions are chiefly elevated countries near the tropic of Cancer. The most remarkable nations of this stock in Africa are the Foulahs, the Red Poules, of Mollien and Golberry, who issued, about half a century ago, from their ancient abodes near the sources of the Rio-Grande, and spread themselves over the interior countries of Africa, where they have nearly conquered some of the most powerful of the negro states. To the same division of mankind, we must refer the Barabras on the Upper Nile, and some of the native tribes of Abyssinia; likewise the old Bedjas, according to Macrizi, the ancestors of the Ababde and the Bisharein, red tribes to the eastward of the Tacazzé, as well as the old Egyptians. The physical constitution belonging to these tribes of men is in many respects different from the temperament of whites, as well as from that of blacks. They have less sensibility and irritability: the physical functions are not so actively performed: the pulse is slow. Dr. Rush states that out of eight Indians whose pulses he examined, the arteries had not in one more than sixty-four strokes in a minute. The secretions are scanty, but the muscular system is endowed with great strength and fortitude. These nations are patient of fatigue, and capable of enduring want of food and other privations. Females have the catamenia but sparingly, and they cease at an early period. All writers inform us that their labours are remarkably quick and easy. This is the case among all the American tribes with whose physical history we have been made acquainted. Ælian informs us that the ancient Egyptians were remarkable for the same peculiarity. The reader will find information with respect to the physical characters and constitution of the American nations in the work of Dr. Rush, already cited; in the Physiological Memoir of M. Rollin, surgeon of the expedition of La Pérouse; Keating's narrative of a journey to the source of St. Peter's River; the Report of Edwin James, botanist to the expedition from Pittsburgh to the Rocky Mountains; in Don Felix de Azara's work on Paraguay; and in those of Baron A. Von Humboldt on various parts of South America.

Of Temperaments in relation to qualities of Mind.—We have surveyed the most remarkable varieties of constitution or temperament in several points of view, with regard especially to their origin and the external conditions under which they take their rise. But there is another subject connected with the doctrine of temperaments to which we have only adverted. This is the relation between the physical characteristics of particular constitutions and the qualities of mind supposed to be associated with them. Although we shall not venture to occupy so much space as might be requisite for entering at large into all the inquiries connected with this subject, we must not conclude an essay on temperaments without touching upon some of the most important questions involved in it.

The relation of mental peculiarities to corporeal structure has been observed by medical authors of every age, and it has been stated and explained in different ways. Hippocrates said that "the soul is the same in all men, but that the body is different in different individuals. The soul," he adds, "is ever like to itself, and undergoes change neither in greater nor less by nature, nor by necessity: the body is subject to continual alterations." "The affections of the mind depend upon the body: there are many states of the latter which sharpen, and many which obtund it." (*Hippocrates*, lib. i. de diætâ, § 21.) And Democritus, in a letter said to have been addressed by him to Hippocrates, asserted that "the intelligence of the mind depends greatly on the body, the diseases of which obscure the mental faculties, and draw the latter into consent." In the writings of Galen there is a treatise expressly composed to prove that the characters of men depend upon their temperaments. But it is in the works of modern writers that we find this doctrine most fully developed, and made a foundation for a division of human characters. According to Hoffmann, the choleric temperament by peculiarity of organization disposes men to precipitate and impetuous conduct, to anger, audacity, impatience, temerity, quarrels, sedition and the like. On the other hand the slow progress of blood through the vessels of the meninges, which is the result of its crassitude in melancholics, renders such persons timid, slow in business, anxious, suspicious, with difficulty of forming or uttering opinions. The sanguine by a happier temperament are rendered cheerful and free from care. A too abundant serosity causes the phlegmatic to be lazy, somnolent, and torpid. Certain temperaments qualify men for particular situations in life. Melancholic men, says Hoffmann, should be the king's ministers and counsellors; choleric persons should be appointed generals, foreign ambassadors, orators, conductors of all business requiring energy and despatch. Sanguine men are fit for courtiers, but individuals who have the misfortune to be of the phlegmatic temperament, being quite incompetent to any elevated condition, must be made common soldiers or labourers, and condemned to the lowest employments. (*Hoffmann*, de temperamento fundamento morborum, § 10.) The same writer applies the doctrine of

temperaments to nations, and explains by it their peculiarities. It is wonderful how ready a belief was given to notions so ill-founded, and to what an extent they were carried. The very learned Abbate Hervas finds a sufficient reason in the difference of temperaments for the conquests which northern nations have so often made in southern countries.* The English, however, says this sensible but occasionally quaint writer, though belonging to the stock of colder climes, have become—"*dal troppo bevere liquori gagliardi*"—in temperament unlike the other inhabitants of the north.

It is extremely improbable that an opinion should have held its ground for so many ages among men of observation, especially on a subject requiring no abstruse research, without some foundation at least in fact. The doctrine of temperaments is true to a certain extent, and has ever been confirmed by an appeal to experience. In order to be convinced of this, let any person compare individuals who display the characters of the sanguine temperament in a high degree, with others who have strongly-marked signs of the melancholic. There is no doubt that among the first will be found many in proportion who have a lively and cheerful temper, great sensibility, excitable if not strong passions; and among the latter, persons who are, if not sullen and dejected, (for such qualities are morbid extremes,) yet calm and disposed to seriousness and reflection rather than to mirth and gaiety, at the same time tenacious of impressions once excited in their minds, and capable of fixed and steady attention. These characteristic differences may be referred to greater or less degrees of sensibility, or to a more or less excitable condition of the nervous system, depending, perhaps, in the first place, on the circulation of blood, the apparatus for which is, as we learn from the greater vigour with which the function is performed, more fully developed in the sanguine than in the melancholic. No facts are more familiar in physiology than the intimate connection between organic sensibility and a free circulation, or than the increase or diminution of feeling which results from warmth and increased vascular action, and from coldness and torpor and the retirement of blood from the surface of the body and the organs of sense. States of the mind are so connected with affections of the body, that it is impossible for any person who considers these and the many other analogous facts which present themselves, to doubt that with each temperament particular mental qualities must be associated, although it is manifest that many writers have indulged their fancy on this subject, and have gone into more full and minute details than experience will establish.

The somewhat vague speculations of which we have given a specimen, on the connection of mental qualities with varieties of temperament, have given way to theories of a more precise and definite character. The observations of medical and physiological writers were strongly directed by the publication of Sömmering's works on the brain and nerves, and by his treatise on the seat of the soul, to inquiries which have been pursued with much zeal, respecting the brain and the relations which mental phenomena bear to its functions and organization. The opinion that this organ is the immediate instrument of reason and perception has become generally prevalent, and all the phenomena of intellect have been supposed to depend entirely on conditions of the brain and nervous system. By later physiologists, to whose opinions we shall advert in the sequel, the moral and active powers have been referred to the same organization. Thus the whole mind is represented as depending, at least instrumentally, on movements in organized parts, and therefore deriving not only some of its predispositions, as the old doctrine of temperaments represents it to do, but all its particular states and modifications from circumstances connected with the body. By this view of the relations between the mind and the brain, the influence of temperament on constitutional peculiarity of organization is greatly extended, the theory of these varieties becomes still more important than it formerly appeared, including as it does the whole modifications of which mind is susceptible, the conditions of structure on which these are dependent, and the external characters by which both are indicated in the form and outward appearance of the individual. We shall trace in a rapid sketch the history of these speculations.

Sömmering, in his celebrated treatise on the organ of the soul, takes it for granted that the object of his research is to be found within the cranium, and directs all his endeavours to discover the exact portion of the encephalon which may seem to present the highest claims to be the seat of animation. It is well known that he traced several of the nerves of sense to the parietes of the ventricles, and concluded at last that the serous fluid contained in those cavities is the intermediate vinculum between the soul and body, the instrument by which the former receives impressions from the appulses of gross material particles. (*Sömmering* über das Organ der Seele. Königsberg, 1796. Compare C. A. Rudolphi Comm. de ventriculis cerebri. Gryph. 1796.)

Reil, so justly celebrated for the accuracy of his researches into the anatomy of the brain and nervous system, lays it down as undoubted that the brain and nerves are exclusively the organ of the soul, the centre of every man's personal existence—"*den leib unseres ichs.*"

P. F. Von Walther, in his "*physiologie der menschen*," maintains that the soul uses the brain as the organ of all its manifestations, is connected with it as is the "idea with the workmanship in the performance of an artist." "The cerebellum," he adds, "is the organ of animal instincts, among which the sexual is the principal. The lobes of the cerebrum which lie over the tentorium approach to the same general character: they contain the organs of the affections." "The more tenderness and affection a man is endowed with,

* The work of Hervas, in nineteen quarto volumes, contains an epitome of human knowledge. It is entitled, "Idea del universo, che contiene la Storia della vita del uomo, elementi cosmogranci, viaggio, estatico al mondo planetario, e Storia della Terra." (Cesena, 1780.) Natural philosophy, physiology, anatomy, and other physical sciences, history, politics, statistics, are treated of in turn with a prodigious extent of information. The last volumes of the work consist of treatises on philology, and contain much original information on the history of languages not elsewhere to be found.

the more developed are the posterior lobes of the greater brain."

Magendie in his physiology maintains that the brain is the organ of the understanding; that the manifestations of the intellect must be looked upon as the results of the organization of the brain. In like manner he concludes that the passions are connected with actions carried on in the brain and nervous system: "a great assemblage of facts and investigations prove that the brain is the organ of thought."

The contents of Gall's voluminous works are summed up in his last publication "Sur les Fonctions du Cerveau." He there concludes that "the instincts, the inclinations, the sentiments, the intellectual faculties, the distinctive characters of humanity, owe their existence and their modification solely to the brain." "Sans cerveau, point de perception, point de sensation, point d'idée, point de jouissance, point de souffrance, point de moi."

Rudolphi observes that the brain is the "seelen-organ," the "soul's organ," "*sensorium commune*, *πρῶτον αἰσθητήριον*." (*Rudolphi*, Grundriss der Physiologie, bd. 2. abth. 1. p. 29.) "The seat of the soul," he says, "cannot become an object of philosophical research; but this we know, that the soul acts only through the medium of the brain, as its organ, on our bodies, as on the higher animals through the medium of the nervous system."

Similar conclusions have been adopted by Neumann, Carus, and Hartmann, whose remarks have been cited to that purport by Jacobi. (Sammlungen für die Heilkunde der Gemüthskrankheiten; zweiter band. Elberfeld.) The most distinguished writers in this country and in France have agreed with those of Germany as to the general inference that the manifestations of intellect depend upon the instrumental operations of the brain for their existence in a sound state, and are liable to be affected by morbid changes in those operations; such affections constituting the so termed diseases of the mind. The principal difference of opinion that now exists with reference to this subject turns upon the question whether we have proof that the organs of intellect and of physical phenomena in general are many in number, according to the doctrine of Gall; or ought rather, in the defect of such evidence, still to regard the brain as performing its office with one energy and undivided action; the continuity of structure rendering this the most probable opinion, unless anything can be proved to the contrary. The celebrated system of Gall has eclipsed all other attempts to theorise on the functions of the brain, and the question which is now agitated with respect to that organ is whether its *modus operandi* has been discovered or not; it being taken for granted that there is no other speculation on this subject which can come into any competition with that of the renowned author of phrenology.

So much has been said of late years with reference to this dispute, that we would gladly have abstained, if the subject had not fallen inevitably in our way, from all allusion to a controversy in which it is difficult if not impossible to bring forward anything new. The arguments which have been thought to bear upon it have been long since urged and repeated in various forms, until most persons are tired of the subject, and seem scarcely to expect any new evidence on the one side, and much less anything novel in the objections of those who oppose the statements and reasonings of the phrenologists. In fact nearly all that has been said of late by English writers on this side of the question was advanced many years since in the most forcible manner by the author of a critique in the Edinburgh Review. Similar objections are still frequently repeated, though most persons have become, or might have become, aware of their inconclusiveness. It must, for example, be evident to those who reflect upon the subject, that the arguments against phrenology founded on the difficulty of applying measurements to particular portions of the brain, is no objection at all against the truth of the doctrine itself, or the principle on which it is founded. With equal justice might the obstacles arising from the imperfection of instruments, or from states of the atmosphere which interfere with the observations of astronomers, be urged as invalidating the most noble of human sciences. Not less ill-judged have been the attempts of those who have argued against the speculations of the phrenologists on the ground of their dangerous tendency, and the alleged fact that they lead to fatalism and destroy moral responsibility. The pernicious results to be deduced from any new and specious doctrine are not reasons for shutting our eyes against the evidence on which it rests, but ought rather to render us more anxious to sift the matter to the bottom. If the thing be true, let this be known: "*fiat justitia; ruat cœlum.*" The real merits of the case will sooner or later be made apparent, and the sooner the better. It is vain to tell the phrenologist that his doctrine is at variance with the moral sentiments of mankind. His appeal is not to sentiments, but to lines and measurements. If it be a fact that thieves and homicides labour under what may be termed a morbid growth of cerebral substance above or behind their ears, the use of the halter and the gibbet should at once be laid aside for more scientific operations. Phrenology, however, does not go further than does Philosophical Necessity, that favourite doctrine of some theological professors, in destroying moral culpability, and proving that actions, by men termed crimes, are mere misfortunes, and the proper objects of pity and commiseration. There is, however, this difference between the two schemes which support such an inference, that whereas philosophical necessity can never be proved or refuted, but can only be re-asserted without producing the assent of mankind, phrenology certainly admits of proof or disproof, and would obtain it if the measurements of a sufficient number of heads, and those belonging to persons of marked qualities of mind, could be accurately and indisputably known. Another immense privilege is, in the meantime, in the hands of the phrenologist. He has the whole *terra incognita* of the brain at his disposal. Whenever a new fact presents itself in the intellectual or moral constitution of man, whenever it is judged expedient to add one to the list of knowing faculties or active principles, he finds space enough where to locate the new claimant, and furnish it with a domicile and suitable neighbourhood. Nor can any one reasonably object to his

mode of sharing out his domain, or plead with effect that such or such a piece of medullary matter is too small to be competent to a wish or a volition. But lest we should be thought decided partisans of cranioscopy, it behoves us to pay some regard to the arguments of those who, on more rational grounds than some of our countrymen, have hesitated in admitting the conclusions of Dr. Gall. We shall advert to the opinions expressed at different times on this subject by various writers on the continent, partly French, but chiefly in the country of the author. Among the latter this subject has not been given up, as it has been in a great measure among ourselves, southward of the Tweed at least, to dilettanti: it has been carefully examined by men of science, and if we could collect the general opinion of Germany, it might perhaps be regarded as conclusive of the ultimate fate of phrenology.

To the well-known report presented to and adopted by the National Institute of France,* we shall only advert in order to express our wonder that no attempt has ever been made to counteract its effect by procuring some decision of equal weight and authority in opposition to it. It will be recollected that this report had reference solely to the anatomical researches of the phrenologists, and to the new facts discovered or asserted by them respecting the structure of the brain;—that the individuals deputed by the Institute dissected the brain repeatedly in conjunction with Gall and Spurzheim, who readily communicated their observations and method of proceeding;—that the same persons afterwards examined by themselves the structures respecting which doubt existed in their minds, "endeavouring for a time to adopt the new manner of viewing the subject, and to give a clear and precise abstract of it," which was submitted to the phrenologists that they might be satisfied whether their ideas had been comprehended. After such an investigation the unfavourable tenor of the report drawn up by such a committee on the validity of the anatomical facts asserted, could not fail to be a stumbling-block in the career of the new science. Attempts have been made from time to time by the advocates of phrenology to lessen this unfavourable influence by imputing unfaithfulness to the members of the committee. They were desirous, it has been said, of gaining favour with Napoleon by giving an unfair report on a discovery made by foreigners. But this suspicion cannot be entertained by any person who knows that the individuals deputed to this task were Cuvier, Tenon, Portal, Sabatier, and Pinel: it is impossible that men so distinguished by high reputation as men of science and unblemished moral integrity, could commit so foul an act of treason against the majesty of truth. The anatomical discoveries of the phrenologists have never since the period of this report undergone a similar investigation: they are upheld, indeed, by declared partisans, but they have never been admitted by any number of competent judges like the committee above referred to, not self-constituted, but selected on the ground of eminent qualifications for the task confided to them.

The members of the French Institute already mentioned confined their objections to Gall's system, or rather their denial of his statements, to the principal facts which he asserted or discovered in the anatomy of the brain. Since the publication of that report, the new doctrine has been considered in all its bearings by some of the most distinguished anatomists and physiologists of Germany: Ackermann, Carus, Hartmann, Rudolphi, Nasse, and Jacobi, are thought by many to have refuted the most important of the positions on which it rests; and the arguments brought forward by these writers are allowed to be worthy of consideration even by those who do not hold them to be conclusive.

It must be observed, before we can enter into the general reasonings on this subject which some of the authors above-mentioned have advanced, that the most important difference between Gall's theory and that of other physiologists, in respect to the functions of the brain, does not refer to the point of view in which the intellectual faculties are considered by him as lodged in particular organs rather than exercised by the whole cerebral structure. His views of animated nature are much more extensive: they comprehend not only the powers of sense and cognition heretofore referred to the brain, but regard as necessarily belonging to the function of cerebral structures all those which in the aggregate are termed psychical phenomena, including the whole properties of animal life, of feeling and instinct, of action, whether resulting from external impressions, or arising from internal impulses towards particular ends. This is a much wider view of the province of brain and of nervous structures in general, than former writers have taken. Sensation, memory, imagination, have been referred perhaps by most to nerves and brain in man, and the properties resembling these faculties in the lower animals have been supposed to reside in corresponding structures. Muscular action has likewise been attributed to nervous energy, in the first instance at least, by one class of physiologists. But with Gall originated the attempt to discover in the brain the local seats of all those properties which constitute the principles of action, the whole psychical nature of all tribes of animated beings; to trace the social, domestic, personal characters of man within his cranium, and to find corresponding parts with which the phenomena of animal life peculiar to each lower tribe, all their wonderful instincts and specific habits, are equally connected. Gall has assumed as an universal fact, that every active and conscious principle in man and in lower tribes of the creation originally resides in a given part of the bodily structure; that the manifestation of every psychical characteristic is the immediate result of a peculiar organization in some part of the brain or the medullary cord; that the very existence of such properties is necessarily dependent on corresponding cerebral organs. The main principle of the whole theory, to which we are continually in express terms or by implication referred, is the assumed fact that these properties and structures are everywhere coextensive with each other. Now if the proof of the dependence of such properties

* Report on a Memoir of Drs. Gall and Spurzheim, relative to the Anatomy of the Brain, presented to and adopted by the Class of Mathematical and Physical Sciences of the National Institute.

upon corresponding cerebral structures is the universality of the connection or the coextensive existence of the structures and functions, we may expect that this relation will be shown to prevail through all departments of animated nature. Those who maintain this arrangement to be so fundamentally interwoven with the very constitution of living beings, are bound to show that the observation is limited to no particular department; but that, wherever certain psychical endowments are undoubtedly displayed in animals of whatever tribe, corresponding organs really exist in the cerebral or nervous structure belonging to that tribe. Should it, on the other hand, appear that similar manifestations of animal life, of instinct, appetency, feeling or tendency to action, exist in any two tribes for example, and that, in one, organs are discovered to which they may be thought referable, while corresponding organs are totally wanting in the other, the very foundation of the doctrine will be shaken; the universality of the law on which chiefly our admission of its claims is demanded, will be broken; the coextensive relation of properties and structures can no longer be asserted; and we shall require some distinct proof arising out of every particular example, before we can be expected to admit the asserted relation in single instances.

It has been observed by Jacobi, that although we should allow for a moment that the Gallian doctrine is applicable to the higher classes of the animal kingdom; or rather, if we for a time abstract ourselves from the consideration whether it is so applicable; on directing our inquiry to the insect tribes, and to all the orders of animals which are below them in the scale of organized beings, we find that the fundamental principle of the system fails entirely in its application to these great departments of nature. "The attempt to display any correspondence or analogy between one or more of the knots or ganglia situated at the upper part of the œsophagus in insects, and the cerebral organs in mammifers and birds, can scarcely be spoken of as seriously undertaken or as worthy of regard; and when we find that Gall has tacitly assumed such a correspondence in the structure of these parts, without proposing to bring forward any proof of its existence by the usual and only method of anatomical demonstration, we are struck at once by the extreme inconsistency of this proceeding, and should feel astonished at the boldness displayed in thus erecting hypothesis upon hypothesis, if we were not accustomed to such deviations from correct reasoning in the writings of the phrenologist." It is a fact that among insects, if we take collectively the different tribes, manifestations of all the psychical qualities observed in mammifers and birds, regarding here also as a whole the properties divided between particular departments, may be recognised in the most strict analogy. Attention, memory, the faculty of combining means to obtain ends, cunning, the desire of revenge, the care of offspring, and all other psychical qualities which have been traced in the former classes of animals, are likewise to be discovered in the latter, as typical or characteristic phenomena, sometimes in one, sometimes in another combination, or in different groups, sometimes more strongly, at others more feebly expressed. Now if this be proved, and if we really find in those animal tribes which are considered as the lower orders, as for example in insects, the same phenomena of animal life, which in mammalia, in birds, fishes, and amphibia, are comprehended under the term psychical powers, whatever relation these last may in reality bear to those properties in human nature with which they are generally compared, it hence results that the conditions of organization on which such faculties depend in insects, and by analogy in tribes placed still lower in the scale, are different from those which are assumed in the higher classes of animals to be essentially connected with the development of similar phenomena.

"Nor can it be maintained on any solid ground that phenomena so analogous depend on different causes, as metaphysicians formerly asserted when contemplating the psychical qualities of animals in general, and comparing them with the intellectual and moral attributes of the human species. We are not allowed to assume that the lower tribes are under the guidance of mere mechanical impulses while their activity displays effects parallel to the manifestations of animal life in the higher orders. For what essential difference can we point out in the principle of action, when we observe the young bee in its first flight from the maternal hive hasten straightways to the nearest meadow or sunny bank, and return home laden with wax and honey, and when the colt of the river-horse, foaled upon the land, after his mother has been killed rushes from the spot and betakes himself to the water which he has never seen; or when the young goat in the first hours of his life hides himself in the clefts of rocks, which nature already points out to him as his dwelling-place? Does psychical life display itself under a more limited or doubtful character in the flights of grasshoppers and dragon-flies, than in the marches of lemmings, so closely bound by the impulse which directs the course of their wanderings that they even attempt to gnaw through rocks which lie in their way rather than go round them, and they follow each other troop by troop, to their certain destruction, into the deepest rivers or widest lakes? Does not the earth-worm secure himself against the pursuit of the mole, provided with a well-formed brain, by making his way along the surface of the soil, where the latter cannot further trace him, with as much cunning as the fox and the beaver display in acts which are typical or characteristic of their kinds? I will ask again what difference is there between the skill with which the ichneumon or the ant-eater procure for themselves the same food, between that of the diving-spider or the corpse beetle, and the acts displayed by so many birds and mammifers impelled to similar pursuits? Are not like phenomena repeated in the economy of the ant and the bee, and in that of the beaver or of the Alpine marmot? And if we must refer to manifestations of a higher and freer sphere of agency, in what tribe of sucking animals does such a power display itself more wonderfully than in the wars of conquest carried on by different races of termites, in which the subdued become vassals to the victo-

rious tribe, and serve their lords in laying up for them their stores, and watching and protecting their young?

"In what relation to organic structure shall we consider these phenomena, as well as the manifestations of analogous powers, which display themselves in tribes generally ranked in a still lower station in the scale of organized beings, and in which the existence of nerves has never been demonstrated? Have we not also a right to ask how birds and reptiles nearly if not wholly destitute of many cerebral parts, the importance of which in mammalia can never be sufficiently extolled, yet collectively displaying not less than insects similar psychical phenomena to those of mammifers, come to be possessed of such faculties without the organs supposed to be necessarily connected with their manifestation?"

Without attempting to draw from these observations a more extensive inference than the data entitles us fairly to deduce, we may be allowed to conclude that, if they do not disprove, at least they throw a strong shade of doubt on the assumed universal relation of psychical qualities, and corresponding organic structures. It cannot, indeed, be demonstrated that the instincts of the ant or of the bee are not organically dependent on some infinitesimal parts of the ganglia discovered in those animals, but there is no degree of probability in such a supposition, nor are we led to it by a single well-established fact or analogy.

It may be thought by those who are accustomed to entertain the opinions of the phrenologists, or have imbibed what may perhaps be termed their prejudices, that every phenomenon of animal life must have its local commencement; that the origination of instinct or internal impulse to action, whether in insects or in the higher animals, cannot be conceived but as taking place in some appropriate organ;—that if such organs are not to be found in the nervous system, of insects for example, they must be sought elsewhere. In this, we must observe that a *physiological principle* is assumed on mere conjecture, on no ground whatever of fact, since nothing is known as to the nature of instinctive impulses which entitles us to conclude that they have a local seat in particular organs. A spontaneous tendency or aptitude to such acts as are needful or favourable to individual preservation, is well known to be an universal property of organized beings. Even plants, although they cannot be said to have instincts, yet display movements typical of particular species or tribes, and though without consciousness, directed towards certain destined ends. Can such tendencies be thought with probability to reside in any particular part of an organized being? Again, to what part of the conscious organized being or animal are we to refer the universal instincts, such as the desire of pleasure and the shrinking from pain? Are they not properties of the whole being rather than of any particular texture?—and where is the proof of their excitement by the agency of any appropriate organ? The instincts are of two kinds; one more immediately connected with states of the body—namely, the animal appetites; the other having some outward object and direction, as the instincts to build nests and to provide for young. As the former are connected with states of the body, their activity depends upon certain physical conditions which are temporary states of the natural and animal functions, and these may be more or less limited to certain structures. Hunger and thirst, for instance, are felt under particular circumstances of the whole system, but more especially of the digestive organs: there is no proof of the additional intermediate agency of any cerebral or other corporeal organ endowed with the office of exciting a desire of food or drink. The sexual appetite seems to obey similar laws as to circumstances of its excitement; and no farther reason can here be assigned than in the former case for conjecturing the existence of an intermediate organ of instinct. In this point of view the appetites or bodily instincts have a relation to particular structures, or rather to particular states. Less connected with any local organization appear to be the instincts properly so termed, and contradistinguished from the bodily appetites; as, for example, the instinct of self-preservation, or the impulse to shun the danger of individual destruction, the disposition to avoid pain, and seek pleasure or gratification. The attempt to localize all these universal principles of animated nature is a work of supererogation; the opinion that such laws of animal life are brought into operation by a particular organism like the mechanical movements of a watch, is at present altogether a gratuitous assumption. We cannot venture to determine any thing on such a subject, but there is, unless we greatly mistake the matter, more of probability in the supposition that the instincts or active tendencies proper to every tribe, typical of it, and varying with the diversities of organic structure, — that is, with the diversities of the whole organization of bodies, — are principles of action impressed on the entire being, and not inherent essentially or mainly and initially seated in any particular organ. The brain, except as the seat of the common sensorium, is perhaps unconnected with the origination of these impulses; though in the conscious and voluntary actions which ensue, the brain, the nervous and muscular systems come into operation more or less as subservient instruments.

If the advocates of phrenology should give up the universality of connection which they assume between psychical manifestations and particular organs, and allow that nothing of this kind can be proved, or even by analogy inferred, to have place in those which are termed the lower orders of animals, they may still maintain their position on a more confined scale,—namely, in respect to vertebrated animals. Here, however, these physiologists lose all the advantage to be derived from general analogy; they represent one department of nature as in opposition to another, even in respect to fundamental laws of its constitution. Negative reasoning is extremely difficult in such a case, yet Jacobi has suggested some considerations which in this point of view are not unimportant. He has observed that within the limits of particular species, referring now to the higher animals, psychical phenomena vary with all the varieties of organization, and even with the temporary condition of bodies, and this under circumstances which, in some cases at least, as we shall

show, preclude the possibility of assuming previous or simultaneous variations in cerebral structures. The animal qualities of the horse, for example, according to general experience, assume a variety of modifications, and these varieties in every instance correspond with peculiarities of structure: in connection with changes in the form of the skeleton, in the muscular system, in the texture of the skin, proportional differences manifest themselves in the vigour, spirit, courage, speed, and whole disposition of the animal. In dogs likewise the most striking varieties are found in the instincts of particular races, and every where in coincidence with the diversities of organization, in the organs of sense, in the form of the body, and the capabilities of action thence arising. Domestication produces changes in the bodily structure of other tribes, and it gives rise at the same time to corresponding changes in the dispositions. The elephants of Ceylon are distinguished from those of the neighbouring continent as well by superior beauty in the colour and figure of their bodies, by greater strength and swiftness, and particularly by their remarkably tractable temper, their courage, patience, freedom from violence, and susceptibility of instruction. The buffalo, the goat, and many other animals which are more or less domesticated, exhibit great alterations both in the form of their limbs, and in their instincts and dispositions. It seems to have been ascertained by an extensive series of observations, that wherever any changes have been induced in the psychical qualities of animals, wherever those dispositions which are typical of the race or species have deviated from their usual and natural character, a corresponding degradation, or at least a proportional change, may be found to have taken place in the structure of the body, in the form of the limbs and the bony fabric, in the organs of sense, the texture of skin, hair, or feathers, and in the whole organization. As these changes bear an uniform relation to each other, we have all the proof that can be expected of their intimate connection and mutual dependence. The numerous observations of Lavater, on the correspondence of external peculiarities of form with the qualities of mind, might serve as a groundwork for more comprehensive inquiries. Of Lavater's works, it is to be regretted that those parts only which refer to the face and skull have excited general attention. The same attention directed to other parts of the corporeal structure points out a relation every where certain and demonstrable between the form, measure of development, and natural aptitudes of particular parts as well as of the whole bodily fabric, and the psychical qualities which are connected with, and are therefore indicated by, such organic variations.

Now, unless it can be shown by the phrenologists that all such corporeal modifications are dependent on previous changes in the cerebral structures, (and the supposition is so improbable that we think it will scarcely be assumed,) we shall find in the correspondences above described a proof that psychical phenomena vary according to relations which are not dependent on the brain or nervous system.

Changes in the habitual state of the disposition and feelings, and in the temporary condition of the senses, and of the instincts and tendencies to action, induced by manifest causes affecting the physical or organic functions, lead us perhaps still more clearly to the same result. The states of the digestive organs influence the temper in a very sensible manner. Hunger or long fasting exasperates the ferocity of beasts of prey: the effect of a full meal is well known to modify the disposition in a reverse way: the inclinations are changed by the influence of wine and stimulants; cowards become valiant, and the timid and reserved loquacious. Nothing is better known than the influence which the sexual system exerts in the animal economy, on the psychical manifestations. How decided an alteration in the disposition is produced by emasculation! Two animals can scarcely be found more different from each other than an ox and a bull. At the period of life when the sexual system becomes developed, a new character seems to be formed: the inclinations undergo a marked change, not only in respect to habitudes immediately associated with the functions of that system, but in others more remotely or in no perceptible manner connected with it. When this natural development is impeded or retarded by disease, morbid symptoms are consequent not only in the state of the body, but in that of the mind also. An artificial change induced in the human species by design, gives rise to effects not less striking in the whole character than the corresponding results above adverted to in the inferior tribes. Here, indeed, the phrenologist brings in his doctrine as to the function of the cerebellum; but without reverting to the general views of the animal economy which render it improbable that the instincts are called forth by any such system of organism as this doctrine implies, we may remark that the particular arguments on which it rests have been proved by Rudolphi to be inconclusive and even nugatory. The cerebellum, as this writer has observed, is found to lessen rapidly in its proportional development as we descend in the scale of animated beings, without any corresponding diminution, and perhaps even with increase in the propensity which Gall connects with it. How remarkably powerful is this instinct in birds, and yet how small is the cerebellum in these compared with its size in mammifers, and even in the latter when we consider the magnitude which the same organ attains in the human species. We observe those tribes of animals in which the cerebellum nearly or entirely ceases to be found, obey, nevertheless, the impulsion of instinct as blindly or devotedly as other kinds which have the organ remarkably developed. When we consider the great amplitude which the cerebellum attains in man in comparison with its size in lower animals, we cannot fail to imagine some relation between this circumstance and the transcendent superiority of the human intellect compared with the psychical powers of brutes. Other observations lead us to a similar conclusion. Cretins, in whom the cerebellum is defective, display more or less of idiotism or defect of intellect, but no corresponding deficiency in the sexual instinct, which on the contrary often exists in such unhappy beings in the greatest intensity, and impels them to furious excesses. Again, injuries of the posterior part of

the head are observed to be followed by stupor and loss of memory, indicating the function of the cerebellum to be connected with the exercise of the mental faculties rather than of animal propensity. The assertion made by Gall that the cerebellum undergoes a change in the rutting season is entirely without proof, for the swelling of the neck which has been observed at that period has no connection with the state of the brain, and is a phenomenon of quite a different kind. On the whole, it would perhaps be scarcely too much to say that not only positive evidence is wanting to support the doctrine of Gall respecting the cerebellum, but that, whatever evidence on the negative side of the question the nature of the subject is likely to suggest, has actually been adduced. The only structures in animal bodies, the development of which is manifestly associated with the phenomena of instinct, so strangely referred to the cerebellum, are those immediately connected with the process of reproduction. With the temporary as well as the more permanent conditions of these particular structures, the animal instinct is connected as immediately as in the appetite for food with the state of the digestive organs. We have here one instance among many which indicate that nature has associated appetites and tendencies to action with conditions of structure, in such wise that the aggregate of these phenomena coincide with the whole attributes of organization, and that the modifications of the former keep pace with changes in the latter, and this on a system more comprehensive and less subject to exceptions than that suggested by the theory of the phrenologist.

The preceding survey of psychical phenomena in various classes and tribes of animals furnishes many general facts which are perhaps scarcely reconcilable with the phrenological theory: they seem, in the first place, to show that the relations which in it are assumed as prevailing through all nature are at any rate subject to vast and numerous exceptions, and as the main proof of this doctrine is the alleged universality of such relations, or the coextensive endowment of psychical phenomena with certain peculiarities of structure, the exceptions appear fatal to the system in its general bearing. In a more limited view, confined to the sphere of vertebrated animals, it has been shown that variations in these phenomena take place without any evidence of corresponding changes in the structure of cerebral organs, but in strict correspondence with changes in the general organization of the body, both in tribes and in individuals, and even with changes in the temporary state of individuals. This last consideration may be thought to invalidate if it does not overthrow the more limited argument advanced in support of phrenology.

Still the advocate of this doctrine will probably rest on his alleged experience of uniform coincidences *in the human species* between qualities of mind and the amplitude of cerebral parts, and within this sphere the phenomena would establish his inference if they were decidedly in its favour. If proportional amplitude in a given region of the brain were always coincident with a given quality of mind, the constant connection would prove a relation between the two phenomena. The phrenologist need not go beyond the human species in order to establish his doctrines on the basis of experience, but then this experience must be uniform and unquestionable. It is not enough to have a few chosen coincidences brought forward by zealous partisans who go about in search of such facts in favour of this doctrine, and pass by or really cannot perceive the evidence that ought to be placed in the opposite scale. The application of the main principle of the system ought to hold throughout. This, however, is not pretended by the phrenologists, who, aware of numerous and striking exceptions, elude their evidence by asserting that when a certain portion of the cranium and brain is greatly developed, while the faculty there lodged has never been remarkably distinguished, it nevertheless existed by nature, though the innate talent, through the want of cultivation, has failed to be displayed: the predominant organic power bestowed by nature was never discovered by the owner, though according to the fundamental principle of the doctrine, the natural preponderance of talent and propensity is alone sufficient to determine the habitudes of the individual and communicates of itself a strong impulse to particular pursuits. When, again, a strongly marked propensity or decided talent has been manifested without the corresponding amplitude of structure, it is in like manner pleaded that by sedulous exercise and cultivation a natural deficiency has been overcome. But should it even be admitted that some few exceptions to general observations may thus be accounted for and allowed not to overthrow the whole system, this concession can no longer be claimed if the exceptions are numerous. If, for example, we should examine a hundred monomaniacs, in all of whom certain feelings and propensities have been developed even to morbid excess, and it should be discovered by a person competent to form a judgment on the subject, that no evidence displays itself in the cranioscopy of so many individuals tending to support the doctrine, we should hold that it ought in all fairness to be abandoned. Some hundreds and even thousands of such persons have passed a part of their lives under the inspection of M. Esquirol, who possesses most extensive resources for elucidating almost every subject connected with the history of mental diseases, and has neglected no inquiry which could further the attainment of that object. The result of his observation will be allowed to be of some weight on the decision of this question, in which the appeal is principally to facts of the precise description of those with which he has been chiefly conversant. At his establishment at Ivry he has a large assemblage of crania and casts from the heads of lunatics, collected by him during the long course of his attendance at the Salpêtrière and at the Royal Hospital at Charenton, which is under his superintendence. While inspecting this collection, the writer of the present article was assured by M. Esquirol that the testimony of his experience is entirely adverse to the doctrine of the phrenologists: it has convinced him that there is no foundation whatever in facts for the system of correspondences which they lay down between certain measurements of the heads and the existence of particular mental endowments. This observation by M. Esquirol was made in the presence

of M. Mitivié, physician to the Salpêtrière, and received his assent and confirmation. There are few if any individuals in Europe whose sphere of observation has been so extensive as that of M. Esquirol, but testimonies to the same result may be collected from unbiassed witnesses whose evidence taken collectively may have nearly equal weight. Among these there are men unscientific though capable of correct and unprejudiced observation, as well as anatomists and physiologists. In the number of the latter is Rudolphi, who declares that he has examined many hundreds of brains without finding any thing that appeared to him favourable to the phrenological theory. (Grundriss der Physiologie, b. ii. abt. I. § 37.) In opposition to evidence apparently so strong and bearing against this doctrine in various ways, it might be thought difficult for the phrenologist to defend his ground; but he avails himself of the double method of elusion above described;—his position, like the cave of Philoctetes, affords him an escape on either side, and in one direction or another he contrives to baffle all the address of his opponents.

An inquiry may here present itself strictly in connection with the subject under consideration, and this is the last point of view in which we shall contemplate it: whether there are any conditions in the size, form, and structure of the brain, and in the measurement and external shape of the skull, which are connected with and tend to strength or weakness of understanding, or any other mental peculiarities of individuals: shall we go so far as to deny this connection so much insisted upon altogether, or how far it may be admitted on sure and certain grounds? As the brain is the organ of the mind, in several at least of the intellectual processes, it can hardly be doubted that with a perfect structure of this organ, a relative state of the intellectual faculties will be associated. But by what external signs is perfection or imperfection of structure denoted? If we were at liberty, with an ingenious French writer,* to assume that in every instance the amplitude of particular organs indicates a relative energy in their functions, there would be no longer any room for hesitation on the subject; large heads would denote at once great intellect; but neither is this general principle established, nor will facts support its application. We might, indeed, assume that a very contracted volume of brain, indicating that some circumstances affecting the original growth and organization of the body have prevented that organ from attaining its usual and natural development, would be found connected with a proportional weakness or even a total failure in its function; and this opinion is confirmed by facts, a congenital idiotism being generally combined with a very small and contracted brain and head. It does not hence follow that a brain unusually large either in its general development or in particular parts, must indicate more than ordinary power of understanding. It would rather seem probable that the state of interior organization from which the highest degree of energy in its appropriate action may be supposed to result, would be found in a brain, the volume of which, both generally and in its parts, has the medium degree of development, or is neither greater nor less than the average dimension. As far as our experience and observation reach, it bears out this presumption: the individuals whom we have known possessed of the greatest intellectual powers have been those in the form and size of whose heads, compact and of moderate volume, nothing remarkable presented itself. We are inclined to suspect that deviations from this middle form and size partake more or less of the nature of imperfection and disease. Hydrocephalic or rachitic, or other morbid predispositions, are perhaps the most frequent occasions of those unusual developments from which great and noble qualities are so frequently auspicated by the sanguine votaries of phrenology. [The whole of this subject belongs, however, rather to Physiology than to Practical Medicine.]

J. C. Prichard.

* Physiologie des Tempéramens ou Constitutions, nouvelle doctrine applicable à la Médecine Pratique, à l'Hygiène, &c. par M. Thomas. Paris, 1826.

[TETANICS.—Between the therapeutical agents described under the head of Narcotics, (q. v.) and those that may be classed under this head, a well-marked difference exists; for, whilst the former are anodyne and hypnotic in appropriate doses,—the latter leaving the encephalon untouched,—may affect most prominently the nerves of voluntary motion, giving rise to tetanic convulsions, especially in parts which are affected with paralysis; and only in excessive doses may induce the ordinary signs of acro-narcotic poisoning. It is in consequence of this effect upon the nerves that are distributed to the muscles, or to the portions of the nervous centres with which they are connected, that this class of agents has been termed, by recent writers, *tetanics;* a term which has been adopted by the writer, (*General Therapeutics and Mat. Med.* i. 384: Philad. 1843,) to avoid the confusion that might arise were he to attempt to suggest another, and perhaps one that would not be more expressive.

Dr. Pereira (*Elements of Mat. Med. and Therap.*, Amer. edit. i. 177: Philad. 1843,) has called them *convulsives*, and has defined them, "agents which augment the irritability of the muscular fibre, and in large doses occasion convulsions;" but their action seems manifestly to be exerted upon the nerves, and through them on the muscular irritability. The fact, indeed, that they induce involuntary muscular contractions of the voluntary muscles, from slight twitchings to the rigidity of tetanus, according to the quantity given, is sufficient to demonstrate, that the phenomena resulting from their administration are purely nervous.

Tetanics are chiefly given in paralysis, and especially in the local forms; none of them being well adapted for cases in which the cause of the paralysis is encephalic.

The main agents belonging to this class are nux vomica, and its alkaloids strychnia and brucia, which are classed by D. A. T. Thomson, under Excitants, and have been considered there. (See Excitants.) Arnica and toxicodendron belong to the same class, but they are not much used.

Robley Dunglison.]

TETANUS, from τιταινω, root τανω, *tendo*, is the name given to a disease of which the essential character is a rigid contraction of certain muscles; which contraction is sometimes called a *tonic* spasm, and is the opposite of that species which alternates with relaxation, and is termed *clonic* or convulsive. Although tetanus has been employed from the earliest times as a generic term, inclusive of several subdivisions, it will be seen presently that it is itself the peculiar designation of one of those varieties. Three principles of distinction may be noticed in the arrangements of the different specimens of the disorder, hitherto adopted. The most common is derived from observing the different parts of the body or sets of muscles affected in certain cases; whence the ancient names of emprosthotonos, opisthotonos, pleurosthotonos, tetanus, and trismus. Another, and one of more importance in a practical point of view, is based upon the origin of the disorder, and regards it as idiopathic or symptomatic: a division known also to the ancients: not that they used these very terms, but that a marked distinction was drawn by them between cases which arose from common causes, and those which were the effects of wounds. The third principle of arrangement is derived from the degree and duration of the symptoms, and is most insisted upon in the present day. By virtue of this principle, tetanus is distinguished as acute and chronic. We think it would be convenient to add to these a subacute variety, to include those cases which are of mild character, but which do not continue long enough to be designated chronic.* The grounds on which these several divisions are established will be spoken of in their proper places.

Description.—We shall commence our account of the symptoms of this disease, by a general survey of those phenomena which accompany its progress under all its forms, reserving the distinctive characters of the latter for separate consideration. It will be seen, however, that the most general description must necessarily include trismus, which is a part of each of the other species.

The accession of the disease is sometimes so abrupt as to give no warning of its approach; but in general there are certain precursory symptoms, which, however, can rarely be called *premonitory*, since they are common to many other disorders; such are uneasiness or restlessness, watchfulness, languor, depression, headach, dryness of skin, loss of appetite, and constipation. A more characteristic affection than any of these, and which was first noticed, we believe, by Richerand, is an unusual and persevering extension of the limbs during sleep, the tendency in health being, as every one knows, to a state of semiflexion. The disease may be said to have commenced when the patient feels a stiffness about the back of the neck, sometimes extending to the occiput, and a dryness and soreness in the throat. These symptoms, though common to many disorders, excite immediate alarm in the minds of surgeons, when the individual who experiences them is under treatment for local injuries. A violent pain under the sternum is a very frequent concomitant. The next occurrence in the order of time is the closure of the jaws, which in some instances takes place with a sudden snapping contraction: in others it is preceded by a feeling of pain, stiffness, and weakness in the temporal and masseter muscles, and the parts approach by degrees, being at last so closely fixed that it is impossible to separate them. Even wedges and levers are of little avail, says Aretæus, (De Causis et Signis Acutorum Morborum, lib. i. cap. 6); and, as he further remarks, if we succeed in separating the teeth we gain nothing by so doing, for on attempting to pour liquids into the mouth, the patient is found unable to swallow them, in consequence of the spasm which has by this time beset the muscles of the pharynx; or if he does accomplish deglutition, the effort is often so convulsive and agonising, that he entertains the greatest dread of repeating it, to such a degree, indeed, that, like the sufferer in hydrophobia, he is sometimes distressed at the very sight of water. The teeth are not always in complete contact, so that a viscid ill-conditioned saliva may exude through the intervening space. Thus far we are in possession of the principal symptoms of trismus,† or locked-jaw, which differs only from the other forms of the disease by the circumstance that in the latter the spasm occupies a greater number of muscles. This species is scarcely less formidable than the others with regard to its fatality, but it is probably attended with less pain than when the body is more extensively affected. As the disorder proceeds, a violent stabbing pain, occurring in paroxysms, is felt in the region of the diaphragm, and the trunk and extremities become variously distorted. The face is suffused with a dark red flush, and miserably disfigured by the perverted action of its muscles, which draw up the nose, wrinkle the forehead, and drag the angles of the mouth towards the cheek-bones in such a manner as to present one of the most frightful exhibitions of the risus Sardonicus. The spasms about the muscles of the thorax gradually increase to such a degree, that respiration is performed with the utmost difficulty and anguish; we know of no form of dyspnœa more distressing to the beholder. This occurrence, however, eventually plays a very important part in the extinction of the sufferings by death. Although the contraction of the muscles rarely ceases so completely as to form an intermission,‡ there are occasional remissions. These, as it regards the mouth and jaws, only aggravate the horrors of the case; for it often happens during a brief separation of the parts, that the tongue is convulsively protruded, and not retracted in time to escape the re-closure of the teeth,—an accident which is generally attended with profuse hæmorrhage. Sometimes the teeth are shattered by the violence of the spasm. The eyes are for the most part rigidly fixed, and suffused with tears. To conclude this brief account of the muscular derangements, it may be remarked that the sphincters are variously affected; thus,

* Mr. Guthrie has the merit of having been the first to draw the attention of the profession to the mild species as contra-distinguished from the acute.

† From τριζω, "to gnash or grind the teeth." Originally this term implied a convulsive rather than a tonic spasm.

‡ In two of Dr. Parry's cases there were marked intervals.

the urine is sometimes discharged with great and sudden impetus during the vehement contractions of the abdominal parietes, at other times it is retained. The anus is in general most obstinately closed, though cases have occurred in which the contents of the rectum have been expelled involuntarily.

The mind, in the midst of all these sufferings, is perfectly clear, and occasionally even cheerful. Mr. Abernethy used to state in his lectures, that he had often known patients express themselves as feeling better to the very last. We have never happened to notice this fact, but can testify to the absence of the excessive sensibility and terror, which are present in hydrophobic patients. There is neither headach nor vertigo, and the senses are unimpaired. It is almost needless to mention that articulation is very feeble and indistinct, and frequently attended with such distressing aggravations of the spasms, that the sufferer, although fully possessed of his consciousness, remains silent.

The circulation is only secondarily affected by the violence of the muscular contractions. Such is particularly the opinion of Sir James M'Grigor, (Med. Chir. Trans. vol. vi.) Dr. Hennen, (Military Surgery, p. 250,) and many other accurate observers. There is generally, however, a progressive alteration of the pulse during the course of this as of almost all other maladies. At the beginning it is pretty hard and full, but towards the close it becomes more frequent and feeble, and often is irregular and intermittent. The heat of the skin also appears to depend on the violence of the paroxysms; it has been found by Dr. Prévost of Geneva as high as 110° Fahrenheit. [It would appear, indeed, from experiments on the lower animals and pathological cases in man, that lesions of the upper part of the spinal marrow give occasion, at times, to an extraordinary development of heat. In the case of a man at St. George's Hospital, London, labouring under lesion of the cervical vertebræ, the temperature was marked by Sir Benjamin Brodie at 111°. (*Lond. Med. Gaz.*, June, 1836.)] The perspiration is generally profuse over the whole body, but sometimes is confined to the face and chest; it continues during the whole course of the disease, and has a peculiar pungent odour. The urine presents nothing remarkable as to quantity or quality; some describe it as always high-coloured, (*Rochoux*, Dict. de Méd. tom. xx.; *Fournier-Persay*. Dict. des Sc. Méd. tom. lv.) while others have observed it to be quite as often unchanged. Torpor of the intestines, to a degree that resists the most powerful purgatives, is allowed by all who have witnessed the disease, to be a more invariable accompaniment than any other. Such dejections as are obtained are excessively offensive and unnatural.

At the end of twenty-four or thirty hours, (*Larrey*, Mém. de Chir. Militaire, t. i. p. 209,) in acute cases, the disease has so far advanced that the patient is unable to swallow. In the progress of the attack we often notice an apparent emaciation, the forms of the muscles become distinctly visible through the skin, and their rigidity increases. Towards the close, a spumous fluid, mixed up of mucus, blood, and saliva, escapes from between the teeth, the face is more and more distorted, a cold clammy exudation bedews the skin, the spasms are aggravated by the slightest exertion, whether for change of position, or to take food or medicine, the remissions are fewer, the dyspnœa increases, the pulse becomes thready or imperceptible, and death takes place on the second day, or may be delayed to the tenth. (*Rochoux*, op. cit.) The most common period is within the fourth.* Hippocrates states in one place, (Aphor. vi. sect. 5,) "that if the patient survives this day, he is pretty sure to recover," an observation confirmed by the moderns; but in another place he tells us that the third, fifth, seventh, or fourteenth, may be the fatal day. (De Morbis, lib. iii.) Professor Robison, of Edinburgh, relates the case of a negro, who happened to scratch his hand with a piece of broken plate, and died of tetanus in a quarter of an hour.

[The average duration has been considered by M. Andral (*Cours de Pathologie interne*,) to be four or five days. Of 58 cases, that terminated successfully, 8, according to Mr. Curling, (*A Treatise on Tetanus*, Bell's Select Lib. edit. Philad. 1837,) recovered in a week; 3 in ten days; 4 in a fortnight; 4 in three weeks; 15 in a month; 4 in five weeks; 8 in six weeks; 3 in eight weeks; 3 in two months; and 2 in three months.]

It is the general opinion that death takes place in the way of asphyxia. We have no doubt that the obstruction of the respiratory movements accelerates the termination, but are inclined to think that the heart, enfeebled by the long-continued agony, and perhaps involved in the prevalent affection of the muscular parts (according to the opinions of Parry and Howship,) has at least an equal share in the production of the fatal result. There seems but little ground for Baron Larrey's notion, that the compression of the abdominal viscera, and the engorgement of the vessels of the brain, are importantly concerned in the catastrophe. But in whatever manner death is brought about, it is an event happy to the tortured patient, and gladly hailed by his friends. "Far less calamitous is it," says Aretæus, "than the previous sufferings, in the estimation of the bystander, even if he be the victim's own son or father!"

The most common variety of this disease is *opisthotonos*. All writers concur in this statement with the exception of Larrey, who seems to have more frequently met with emprosthotonos. The distinctive character of the former, as the name imports, is that the neck or the whole body is bent backwards. The posterior muscles of the neck are so rigidly contracted, that the head is dragged down upon the nucha and the larynx thrown forwards. In some cases there is no other incurvation, but more commonly the spastic action extends to the muscles of the spine, the effect of which is to draw the trunk into the form of an arch, the weight of the body being supported by the occiput, or rather by the vertex, and the sacrum. The inferior extremities are extended, and sometimes the muscles between the posterior parts of the pelvis and the thighs are so violently affected

* Fournier-Pescay (whose treatise on Tetanus received the prize of the Parisian Society of Medecine) states that he had only five cases of general tetanus that terminated so late as the seventh day.

as to throw the pelvis upwards, and thus to produce a much wider arch. This action of the abductors is greatly assisted by the biceps semitendinosus and other flexors of the leg, which, by reason of the vigorous antagonism of the extensors, have their fixed points on the tibia, and their moveable ones on the pelvis.* So great is the stretch on the abdominal parietes, that they feel as hard as a board, and, according to Aretæus, are sonorous when percussed. The latter observation we have not verified by our own experience, but think it highly probable, inasmuch as the constriction of the sphincter ani must prevent the escape of air from the intestinal canal, notwithstanding its compression by the contracted parietes, and, consequently, the latter must afford a clearer sound when struck. The arms, in this form of the disease, are usually in a state of extension and drawn backwards, but occasionally they are bent, and lie upon the breast. (See one of Larrey's cases, op. cit. i. 242.) The fingers not unfrequently escape any spastic affection. During the remissions that occur in opisthotonos, we observe that the muscles on the anterior part of the body are not unaffected, but they are not incapable of resisting their antagonists. The suddenness with which the recurvation takes place has been sometimes so great as to project the unhappy patient from his bed. In a case related by Fournier-Pescay the spasms occasioned a dislocation of the second cervical vertebra.

Emprosthotonos is a variety which has never occurred under our own observation; nor are we singular in this respect. Dr. Hennen, notwithstanding his many opportunities of observing the disease, never witnessed this form of it. The most striking descriptions of it that we have met with are those of Baron Larrey among the moderns, and of Aretæus among the ancients. The muscles on the anterior part of the body are said to be so contracted as to bend the head upon the breast, to curve the spine anteriorly, and to draw the thighs towards the belly. In very severe cases the head is brought into contact with the knees, so that the body presents the shape of a ball rather than of a bow, according to the remark of Aretæus. The condition of the legs is differently reported by these two observers; Larrey, in his general sketch of the symptoms, does not mention the extremities, but in one of his cases he states that "les jambes étaient roides, et fortement fléchies sur les cuisses." (Op. cit. p. 266.) Aretæus declares in one place that the legs are extended, and in another, that they are drawn forwards with such violence, that the knee-joint appears as if driven into the ham.† The arms are generally flexed, and the hands clasped together.

Pleurosthotonos is still more rare than the variety just described. It consists in a lateral incurvation of the neck and body. It is generally met with in the chronic form, but we once observed it in an acute case that but for this complication would have been simple trismus.

The last variety to be mentioned is that to which, in strict verbal correctness, the word *tetanus* should be confined. It is tetanus proper, consisting as it does in complete extension of the whole body. The frame is so rigidly set, that it is impossible to move one part without changing the position of the whole. Many writers treat of this variety as evidencing a balance between the flexors and extensors. This appears to be a correct observation so far as the head and the spine are concerned, because these parts are capable of motion in two directions. But when applied to the extremities the remark is incorrect, since the extension of these parts must be the result of the predominance of the extensors over the flexors. If there were a balance between the two sets, the position of the limbs must be intermediate to extension and the extremest degree of flexion; a position frequent enough in sleep and recumbence, when neither set is in action. Now, extension of the spine is a condition intermediate to that which the column would assume, if either of the sets of muscles on the anterior or posterior surface had the predominance; for, properly speaking, both kinds are muscles of flexion, though the posterior are said to be extensors, inasmuch as they keep the trunk erect by counteracting the tendency of gravitation to incline it forwards; consequently, a rigid extension of the trunk may be correctly said to result from the equilibrium of the anterior and posterior forces, erroneously called flexors and extensors; but the same explanation is inapplicable to the limbs, because in them extension is produced by the extreme of one of the antagonist forces. From this remark we exclude the feet and hands, which are in the same predicament as the head and the spine, that is to say, are not subject, as is commonly described, to flexion and extension, but to flexion in two directions.

Before proceeding to the next subject of consideration, we may observe that the inferior animals are liable to all the above varieties. Dr. Mason Good speaks of parrots as being frequently affected with trismus. Horses are very commonly treated by veterinary surgeons for opisthotonos and tetanus. Dr. Parry appends to his treatise some cases related by Mr. Sewell, of Bath. In the *Revue Médicale* for May, 1834, there are some cases with the post-mortem appearances, reported by M. Gelée, Professor of Veterinary Surgery at Toulouse. Lambs are also subject to the disease. "I have often seen lambs," says Dr. Parry, "whose ears, for the purpose of marking them, have been bored with a red-hot iron too near the root, so rigid all over with tetanus, alternating with convulsions, that their bodies would project in a right line with their hind legs when one held them out horizontally by the hind feet." (Cases of Tetanus and Rabies Contagiosa, p. 12.)

Causes. — Of the events which immediately precede that morbid state of the system which presents the phenomena above detailed, none are more common than mechanical injuries, and the application of cold, with or without humidity. With regard to the former, there is an entire concurrence of opinion among practitioners, that their efficiency as causes bears very little relation with their nature or degree. Every description of wound, no matter how inflicted, or in what part, or in what stage, may be the occasion of tetanic

* The contraction of the femoral muscles was, in a case related by Desportes, so violent as to fracture the thigh-bones. See his "Histoire des Maladies de St. Domingo," ii. 171.

† Ὡς δοκεῖν ἐς ἰγνύην κατὰ γόνυ τὸ ἄρθρον ἐξῶσθαι. Op cit. lib. i. c. 6.

symptoms, which form the species denominated traumatic. Morgagni tells of a young lady of Verona, who was attacked with the disease in consequence of a bite on the finger from a tame sparrow. (Epist. Anat. Med. liv. art. 45.) Dr. Reid knew a case in which tetanus supervened on the mere stroke of a whip-lash under the eye, though the skin was not broken. Larrey mentions, that a small fish-bone sticking in the pharynx was the occasion in one instance, and in another a slight solution of continuity in the external ear from a musket-shot. Andral alludes to a case that occurred at La Charité, in which the application of a seton to the thorax was the cause of fatal tetanus. (Clinique Médicale, t. iv. p. 445.) An instance is mentioned by Mr. Morgan in which the stroke of a cane across the back of the neck, and another in which a blow on the hand from the same instrument, produced the disease; in both the termination was fatal. (Lecture on Tetanus, delivered in Guy's Hospital, 1833.)

A reviewer of Dr. Reid's work on tetanus in the Edinburgh Medical and Surgical Journal, (vol. xv.) states that the extraction of a tooth was once followed by this disease. According to Sir James M'Grigor, "it occurs in every description and in every stage of wounds, from the slightest to the most formidable, from the healthy and the sloughing, from the incised and lacerated, from the most simple and most complicated." (Med. Ch. Trans. vi. p. 453.) Dr. Hennen observed, in like manner, that the wound, so far from presenting any unnatural appearance, would often pursue its course unaltered by the tetanic seizure; in one case he mentions that the cicatrization was completed on the same day that life terminated. Larry, however, lays considerable stress on the condition of the wound, which he says was generally either dry, or covered with a thin serous exudation. One case that occurred after amputation he attributed to too early cicatrization, and the consequent "reflux des matières purulentes qui suintaient encore de la plaie." (Op. cit.) Dr. Rush speaks of an absence of inflammation in wounds that cause tetanus. (Med. Inquiries, vol. i.) Fournier-Pescay in like manner describes them as pale, livid, and affording either an ichorous secretion or none at all. (Dict. des Sc. Méd. t. lv.) The instances already recited prove that the situations as well as the characters of the wounds are very various. When the predisposition is very strong, and collateral circumstances are favourable, the locality of the wound is almost a matter of indifference. But it would certainly appear that some wounds are more frequently followed by tetanic symptoms than are others. Hennen oftener observed these occurrences after wounds of the elbow and knee; many practitioners connect them with the extremities rather than with the trunk; and not a few speak of a greater liability to such symptoms from injuries of the thumb and great toe. (Mr. Morgan's Lecture.) Mr. Samuel Cooper states that the only surgical operations which he has known to be succeeded by this disorder, are those of amputation and castration. (Surg. Dict. art. *Tetanus.*) It was an ancient opinion, and is still by no means extinct, that injuries of tendons and ligaments, more frequently than of any other tissues, lead to tetanus,—a notion which we think may have arisen from the confusion which prevailed in the early periods of anatomy respecting nerves and fibrous membranes. Few, however, would now be disposed to assert the existence of a necessary connection between the disease and fibrous tissue. Were it necessary to disprove such a view, the facts adduced by Parry would have considerable weight in the refutation. This physician knew a case in which a long thorn was driven entirely through the tendo Achillis, and remained five days, producing no soreness in the part, but a pain in the ham; on suppuration being established, the thorn was extracted, and the patient felt no further inconvenience. "In the various experiments made by Haller, in order to investigate the sensibility and irritability of these parts, no bad consequence whatever ensued." (*Parry*, op. cit. p. 14.) Blows on the neck have been noticed both by ancients (*Hippocrates* and *Aretæus*, loc. cit.) and moderns* as frequent causes of tetanus; and it is evident that such injuries act directly on the cerebro-spinal centre. For a more ample account of the tendency of certain wounds to induce the disease under consideration, we must refer to writers on surgery. But we may remark, before quitting the subject, that although the presence of the disease is not fully announced till the appearance of soreness and stiffness about the neck and throat, it is not uncommon for the muscles in the neighbourhood of a wound to be spasmodically affected before any others become involved; sometimes indeed the patient escapes without any other sign of spastic disturbance.

Next in frequency to wounds, as an exciting cause, is exposure to cold and damp. There are indeed but very few cases of true idiopathic tetanus referable to any other marked exciting cause. Aretæus asserts the influence of a low temperature, and states that the disease is in consequence more common in winter than in any other season, and least frequent in summer, except as the effect of wounds or of a particular epidemic constitution. In tropical climates, exposure to the chilly night air and dew is well known to be highly dangerous. The negroes in the West Indies are frequently affected with this complaint. But it is by no means confined to warm climates. Dr. Gregory, of Edinburgh, used to mention in his lectures a striking instance of idiopathic tetanus that occurred in Edinburgh. An account is given by Bonetus (Sepulch. lib. i. sect. 13,) of a young soldier, who contracted the disease by sleeping in the open air a whole night in a fit of intoxication. Fournier-Pescay also reports the case of a soldier at Breda, who went into a cold bath, when greatly heated, and on coming out was seized with fatal tetanus; and also of a woman who died in a similar manner, after falling into a river when in a state of perspiration, and during the flow of the catamenia. He frequently observed, during the campaigns in Spain, that the soldiers, if they went to sleep upon the ground, after fatiguing marches under a burning sun, were particularly liable to tetanus. The cold and moist breezes from the sea have often produced the disease in hot countries. Many of the French soldiers were seized with it when

* Frank relates a case of "horrible tetanus" induced by a blow upon the spine. See Abercrombie on Dis. of the Brain and Spinal Cord, p. 395.

marching along the coast, on their way from Acre to Jaffa. A sudden change from the heated atmosphere of a ball-room to the external air, was sufficient to produce a very violent attack in a gentleman known to the author last cited.

But although wounds, and cold, and humidity are capable of producing the disease independently of each other, their combined action is infinitely more formidable. Many instances on record prove that the first of these would not have been followed by tetanus but for the intervention of the others, and that individuals have been placed under the most unfavourable circumstances with regard to cold, and yet have escaped the disease till the occurrence of an injury. Hennen lays less stress on the agency of cold than on that of air in motion; for all the cases which fell under his own observation had been exposed to a stream of air, either hot or cold. We think that the analogy of neuralgia strongly favours this view.

The irritation of worms has been regarded by some authors as the cause of tetanic affections. Laurent, of Strasburg, (Mémoire Clinique sur le Tétanos chez les blessés, 1797,) went so far as to assert that even in wounded subjects the real cause was the presence of worms in some part of the alimentary canal. Dr. O'Beirne (Dub. Hosp. Rep. vol. iii.) is disposed to award them a very considerable agency in this disease. There can be no doubt whatever that worms have been frequently discovered in the intestines of tetanic patients; but we imagine that every attentive practitioner must have observed these animals too often and in too great a variety of morbid circumstances, to be very ready to invest them with any specific efficiency in so rare a malady as that which we are considering. It is highly probable that the same state of the system which favoured the generation of worms, may have facilitated the operation of the proximate cause of tetanus. The following instance of alleged verminous action was communicated by Chaussier to Fournier-Pescay. A young man, after labouring under severe pain in the bowels and constipation, was attacked with tetanus, which yielded however to the free use of purgatives, under the operation of which an enormous worm was expelled. This animal was considered to have been the cause of the disease, notwithstanding the patient had received a sword-scratch on the ribs some days before. (Dict. des Sc. Méd. t. lv. p. 11.)

Terror has been considered the immediate antecedent in some cases, and sympathy in others. This we have on the authority of Dr. Hennen, whose observations were far too accurate to be called in question. Dr. Willan mentions a case in which there had been no local injury or other accident, and in which the only circumstance that could be fixed upon as the cause of the attack, was mental anguish; it should be added that the constitution of this individual had been previously weakened by other causes. (Reports on the Dis. of London, p. 289.) The Greek author, to whom we have so often referred, intimates that women are very subject to the disease after abortion. We are not aware of any modern observations in support of this opinion. We remember, however, attending a young woman, who was seized with locked-jaw soon after delivery of a still-born and immature fœtus; but the affection readily gave way to a turpentine injection, and we looked upon it as a mere sympathetic accident. The sudden suppression of perspiration has been known to bring on an attack. Such was the case with a woman, who, while labouring under a gastric fever, exposed herself at an open casement to the north wind. (*Fournier-Pescay.*) Heurteloup (Précis sur le tétanos des adultes) relates a case in which the attack was apparently brought on by an accumulation of cherry-stones in the intestines. Other exciting causes may be found in the works of various authors; such are suppression of the lochia, alcoholic intoxication, acute diseases, as variola, typhus, and gastric inflammation. Of the last of these an example will be given in another place. Fournier-Pescay adduces some curious cases communicated to him by M. Duval, in which the disease assumed the form of anomalous ague; in one of them it was remarked that both sides of the body were never affected in the same paroxysm, but regularly alternated in successive fits.

Various causes may be traced in the body itself prior to the occurrence of the immediate and efficient agent. The state of the system peculiar to certain ages has been commonly enumerated as one of them; but we doubt whether any thing very definite upon this subject can be gathered from the cases on record, if we except the liability of young infants; in consideration of which nosologists have established a variety known by the name of **trismus nascentium.** Instances of this variety have been met with principally in tropical climates, and particularly in the West Indies. Dr. Cullen, however, speaks of its having been witnessed in the Highlands, (First lines, § 1281); and Fournier-Pescay and Dagille bear testimony to its occasional occurrence in France. It happens for the most part within the first two weeks after birth, and is supposed to depend on irritation of the primæ viæ by meconium, worms, unnatural secretions, &c. or on a morbid condition of the umbilical fossa. According to one practitioner, (*Dr. Cadwallader Evans*, cited by Dr. Rush, Med. Inq. vol. i.), cases of the disease became very rare under the prophylactic use of purgatives, while another (*Dr. Colles*, Dub. Hosp. Rep. vol. i.) states that attention to the umbilicus produced almost certain immunity.

[At the Havana, according to Don Ramon de la Sagra, (*Historia Economica-politica y estadistica de la Isla de Cuba, Habana*, 1833), it destroys a large proportion of infants during the first fortnight. It has been suspected, that want of cleanliness and ventilation have as much to do with this as the changes of temperature that occur there so suddenly and so frequently, and in support of this view, M. Andral (*Cours de Pathologie Interne*) remarks that at Wilna, in Russia, where the climate is so different, the same affection is found among the Jewish infants, who are remarkable for the same want of cleanliness, and for being crowded together into a small space. It is common, too, in the Western Isles of Scotland and is singularly frequent in the Vestmann isles on the southern coast of Iceland. On these desolate rocks, the population of which does not exceed 160 souls, it was found, that in a period of 25 years, 186 infants perished of the disease under

the age of 21; and of these, 161 died between the fourth and tenth days after birth; 75 on the eighth day. The condition of life of these poor people is singularly destitute—fish, and the eggs of sea-fowl being their sole aliment; yet it is said not to be so different from that of the Icelanders of the main land as to explain the frequency of this fatal disorder amongst them; and hence it has been suggested by Dr. H. Holland (*Medical Notes and Reflections*, Bell's Select Library edit. p. 21, Philad. 1839) that some constitutional and hereditary causes are concerned. It is more than probable, that the influence of locality is excited in the causation, but how the organism is modified by these causes we know not. It has been supposed by some (as by Colles, Basch, and Levy) that the trismus of the new-born is owing to inflammation of the umbilical arteries.]

With regard to sex, the ancients considered females to be more frequently affected with tetanus than males, but less severely. We may take it for granted that in this remark they included certain irregular spasmodic affections incident to nervous and hysterical women. Males have been by far the most frequent victims in recent times; but this fact is perhaps more naturally explained by their being oftener subjected to such exciting causes as cold, vicissitudes, injuries, &c. than by their peculiar constitution.

The predisposing influence of warm climates and seasons has been matter of very general remark. One of the most striking illustrations of this influence is given by Dr. Rush. After mentioning the frequency with which wounds were succeeded by tetanus if the weather had been previously very warm, he relates, on the authority of some French surgeons, that at the siege of New York in 1781, some troops which had arrived just before from the West Indies, were the only persons that suffered from the disease in question, and that not a single case occurred among the soldiers who had passed the previous winter in Rhode Island. This acute physician attributed the effects of the warm atmosphere to its relaxing tendency, and points out its analogy in this respect with other predisposing causes, particularly laborious exertion. He also explains the particular liability of wounds received in battle to tetanic consequences, by the fatigue which soldiers generally undergo before engagements.

Humid situations also produce a very decided predisposition to this disease. We are informed by Larrey that great numbers of the wounded soldiers in the hospitals at Cairo perished of tetanus, which he attributed to the circumstance that those receptacles were erected upon ground subject to the periodical inundation of the Nile.

Bad or insufficient nutriment, close and ill-ventilated habitations, inattention to cleanliness, neglect of the bowels, &c., have been considered as predisposing causes; views which derive no little probability from the diminished frequency of the disease in our naval department in the West Indies, since the improvements which have taken place in their hygiene. The experience of Drs. Dickson and M'Arthur (Med. Chir. Trans. vol. vii.) was a very striking contrast to that of Dr. Lind. The latter states that five out of six cases of amputation used to die of tetanus; while Dr. Dickson reports that during seven years he met with only six cases of the disease occurring after amputation; and Dr. M'Arthur, who had the care of the naval hospital in Barbadoes, had witnessed only two cases in that institution during a space of six years, notwithstanding there was no lack of wounds, either from war or from surgery. Dr. Dickson concludes a very interesting paper with the following remarks:—"I trust I am, therefore, justified in inferring that to the improvements in the medical and surgical treatment of wounds, in cleanliness and ventilation, avoiding at the same time exposure to currents of cold air or sudden changes of temperature; in fine, to superior comforts, diet, and accommodation, but particularly to the greater attention paid to the state of the bowels, may be attributed the great infrequency of tetanus of late in the West Indies, when compared with former wars." (Med. Chir. Trans. vii. p. 465.)

Whether the comparative infrequency was entirely due to these causes, might perhaps admit of some question, as there is reason for believing that there are latent causes of tetanus, the removal of which might, consequently, have escaped observation; such causes, for instance, as are concerned in the limitation of the disease to particular districts, towns, streets, and even hospitals, notwithstanding they may be apparently in the same circumstances as other situations. (See Hennen's Military Surgery, p. 252.)

Prognosis.—This is mainly to be determined by the nature of the exciting causes, and by the type of the seizure. With respect to the former, it is sufficient to remark that the greater mortality of the *traumatic* species, so well known to the earliest observers in our art, (Επι τρωματι σπασμος επιγενομένος, θανασιμον. *Hipp.* Aph. 2. sect. v.) is matter of equal experience in modern times. Dr. O'Beirne witnessed two hundred cases in the peninsula, not one of which recovered. (Dub. Hosp. Rep. vol. iii.) That the idiopathic disease is a far milder and more tractable affection "is a fact well known," says an able writer in the Edinburgh Journal, (Vol. xv. p. 292,) "to every planter in the West Indies, who never considers his negroes as safe when the disease supervenes on a wound, but is frequently successful in alleviating the idiopathic species." The type of the disease as acute or chronic is a no less important guide as to the probable termination. Hennen confesses that he never saw a case of "acute symptomatic tetanus" recover. In the acute species Dr. Dickson found all curative measures followed by "unqualified disappointment." Mr. Morgan's testimony is still stronger; he says, "I have never yet seen or heard of an instance of recovery from acute tetanus." (Op. cit.) Many other authorities might be quoted to the same purport. The chronic species has acquired the additional character of mild, but the period at which the disease becomes chronic has not been sufficiently specified. "The disease which comes on suddenly," says Cullen, (First Lines, s. 1266,) "and advances quickly to a violent degree, is always more dangerous than that which is slower in its progress." If the patient survives the fourth day, there are good hopes of his recovery; not but that death may occur at a much later period. A patient of Prof. Cooper's lingered five weeks, and then died; but instances

of a fatal termination after the lapse of a single week are extremely rare. The complaint may continue for many months in a chronic form, and then gradually wear away. It will be seen that a great proportion of the remedies which have got the credit of utility in tetanus, have been indebted to their application to this form of it. A prognostic observation made by that distinguished physician, Dr. Parry, respecting the state of the pulse, has been often quoted. "If, in an adult, the pulse by the fourth or fifth day does not reach 100, or perhaps 110 beats in a minute, I believe the patient almost always recovers. If, on the other hand, the pulse on the first day is 120 or more in a minute, few instances will, I apprehend, be found in which he will not die." (Op. cit. p. 18.)

To us it appears that this remark does not by any means deserve the degree of notice that has been taken of it; for in the first place the author bases it upon an opinion altogether hypothetical respecting the affection of the heart in this disease; secondly, those who have had the most frequent opportunities of observing the disease, consider the circulation, as we have already stated, to be only secondarily affected by the spastic commotions of the system; and, lastly, if the observation be correct, it teaches us little or nothing additional, for if the patient lives till the fourth or fifth day to have his pulse examined, be it slow or frequent, there are good reasons for a favourable prognosis. Perhaps any considerable frequency of the pulse at the very commencement, may be justly esteemed a sign of severity, and likewise any remarkable smallness or irregularity; but in such a case there would be other symptoms far less equivocal. Baron Larrey formed an opinion that perspirations in certain parts were critical, those, namely, about the chest and abdomen, while those beginning on the head and extremities were symptomatic only. We are not acquainted with any other authority confirmatory of this opinion.

Diagnosis.—The features of this disease are so striking and peculiar, that they cannot be very readily confounded with those of any other. If the muscular affection be not sufficiently characteristic, there are, the peculiar pain at the lower part of the sternum, the state of the tongue, and the absence of delirium or coma. In consequence of the difficult deglutition produced by the spasms in the pharynx, and the occasional dread of fluids, taken in connection with the aggravation of the disease by trivial excitement, a superficial observer might possibly imagine that he was witnessing a case of hydrophobia. The differences are very decided, but we shall not stop to detail them, as they have already been set forth in a very ample and lucid manner by Dr. Bardsley, in the article on Hydrophobia, in this work. It is necessary to be aware that hysteria, which imitates so many formidable diseases, does not allow tetanus to escape her mimicry. Sometimes the representation is so faithful, that we have not the slightest doubt that many reputed examples of successful treatment of tetanus have been merely conquests over hysterical spasms. Dr. Whytt, in his work on Nervous Diseases, alludes to these occurrences; and there is a well-marked case of the kind in Mr. Tate's Treatise on Hysteria. But it is needless to refer to authorities, since no practitioner of even ordinary experience can have failed to observe spasmodic affections in irritable females, closely bordering upon what we have just alluded to. There is sometimes a locked-jaw from mere local inflammatory causes, which might perhaps be mistaken for a tetanic trismus. We have frequently witnessed it in inflammatory swellings of the face and fauces, in the tumefaction attendant on mercurial ptyalism, and in rheumatic affections of the temporal and masseter muscles. In one instance of the latter kind, which fell under our notice, the jaws had been fixed at an interval of barely one quarter of an inch for the space of three months. The history of such cases, and a variety of concomitant circumstances, will render their discrimination easy.

The diagnosis of spontaneous from artificial tetanus, or that produced by certain poisonous substances, is somewhat more difficult. The effects of nux vomica, the upas tienté, and other plants belonging to the genus strychnos, and of their active principle strychnia, are precisely similar to tetanus, both as it regards the peculiar nature of the spasms, and the absence of any mental disturbance. The discrimination, however, of such cases is highly important in many points of view, and must be sought in a careful examination of the previous history, of the progress of the case, and of a variety of collateral circumstances. In a temperate climate a sudden accession of tetanic symptoms of great severity, and running their course rapidly, in a person who has received no local injury, nor been exposed to cold and damp, would create a strong suspicion of poisoning. Supposing their character were somewhat milder, and their progress more tardy, the presence of certain signs of irritation in the alimentary canal would materially assist our diagnosis, since we know that the substances alluded to not only act on the nervous system, but are also decided irritants,—that, in short, they belong to the class of narcotico-acrids.

Accession.—The period of accession differs in the idiopathic and traumatic species, being in the former considerably earlier. When arising from exposure to the cold and damp of the night, the disease usually makes its appearance on the following morning. After injuries its appearance is generally, though not always, later. This difference is perhaps more apparent than real, for in the latter case, although we date from the infliction of the wound, which is the obvious cause, it would be more correct, were it possible, to reckon from that change, or from the commencement of that state of the wound which is really the cause of the distant irritation, and then in all probability there would not be observed the same protracted interval between the occurrence of the cause and of the effect. But this refinement, we confess, is of little practical importance, the great object being to ascertain how soon an individual who has suffered an injury may be pronounced secure from an invasion of tetanus. The most common period for the first appearance of the symptoms is during the second week. Sir James M'Grigor states twenty-two days to be the longest period. (Med. Chir. Trans. vi. 453.) Sir B. Brodie (See a Clini-

cal Lecture in Med. Gaz. vol. ii. p. 344,) mentioned on one occasion that the seventeenth day was the latest at which he had known invasion take place. Sir Gilbert Blane, in his work on Diseases of Seamen, gives a range of four weeks. Fournier-Pescay declares that he has known it occur at a period longer than a month, and, on the other hand, that in some very rare instances only a few hours have elapsed. We have already alluded to a case in which the disease not only took place, but was fatal in a quarter of an hour after the injury.

[In 128 observed cases, according to Mr. Curling, (*op. cit.*) the disease appeared from the 4th to the 14th day, in 81.]

Morbid Anatomy. — Though little if any thing of value is to be gathered from the researches which have hitherto been prosecuted in this department, it would be highly improper to pass them altogether without notice.

In the dissection of a case related by Bonetus, there was found nothing preternatural in the organs of the thorax and abdomen, but the ventricles of the brain were filled "materiâ quâdam viscidâ ac glutinosâ, colore luteo, vitello ovorum perquam simili sed fœtidâ admodum." He adds, "Hæc incumbens principio nervorum tam sæva symptomata in subjectis partibus excitârat. Venæ intercurrentes utramque cerebri meningem, admodum turgidæ erant bilioso sanguine." (Anat. Pract. lib. i. s. 13.) Morgagni relates the appearances in three cases of tetanus. In one there was some venous congestion in the thorax, neck, and head, with more vascularity than natural of the medullary matter of the brain. (Epist. Anat. Med. liv. art. 44.) In another there was a somewhat larger quantity of serum than usual in the ventricles of the brain; the cerebrum was firm in tissue, but the cerebellum rather soft. (Epist. liv. art. 49.) The third presented no morbid appearances, excepting a very little serum in the left lateral ventricle. (Epist. x. art. 2.)

In recent times particular attention has been directed to the appearance of the spinal cord. Dr. Reid, in his work on Tetanus, describes what he considered to be an inflammatory condition of the membranes, with or without the effusion of serum. Similar appearances had previously been mentioned by Burserius, who observed them in the case of a man who died of the disease after exposure to cold in a state of intoxication. Fournier-Pescay, who, while serving in the army, never neglected an opportunity of dissecting the bodies of those who died of tetanus, states that fluid blood was often found effused between the dura and pia mater, that the vessels of the latter membrane were gorged with blood, and that the cerebral substance was depressed. He makes no remark on the state of the spinal cord. (Dict des Sc. Méd. tom. lv. p. 6.) Rochoux cites Trnka and other authorities in testimony of similar facts. (Dict. de Méd. tom. xx. p. 338.) The periodicals of the last twenty years furnish several cases in which morbid appearances were said to be found in the spinal cord or its envelopes.* But since anatomists have learned to place less reliance upon mere redness and turgescence as indications of inflammation during life, the profession have become less and less satisfied as to the constant presence of morbid changes in the spines of tetanic patients.

Of the cases communicated to Hennen, many presented the cord and its membranes in a perfectly natural condition, and he had reason to suspect that the apparent lesions of these parts were often due to the rude use of the chisel and saw. The unskilful mode in which we have often known the operation of exposing the contents of the vertebral column performed, leads us to consider this author's conjecture a very probable one. Sir B. Brodie could never satisfy himself that these parts were diseased. (Loc. cit.) Dr. Elliotson considers the appearances described to be rather incidental than essential, (Lecture reported in Med. Gaz. vol. xi. p. 469); and Mr. Morgan, after mentioning that in some cases cerebral congestion and increased vascularity or morbid deposits in the spinal membranes have been discovered, declares that in other cases he has looked in vain for the same appearances. (Op. cit. p. 28.) The following passage in a lecture delivered by Professor Mayo, at King's College, has just caught our attention. "In the museum of St. Thomas's Hospital, I am informed by Mr. Green, there are two specimens of the spinal cord, the membranes of which are studded with little cartilaginous and earthy flakes, taken from patients who died of tetanus. These small deposits did not, it is to be presumed, produce the tetanus, but they probably had made the spinal cord preternaturally irritable. (Med. Gaz. Jan. 17, 1835.)

Baron Larrey states that he often found the pharynx and œsophagus in a state of constriction, and their mucous membranes inflamed, and covered with a viscid reddish-coloured secretion, (Op. cit. i. p. 248); appearances which it is more reasonable to attribute to the violent action in these parts, than to consider as concerned in the pathology. Some observers have thought that they recognised the effects of inflammation in the stomach and intestines, but they do not specify any thing more than such alterations of colour as are often the result of cadaveric changes. We except from this remark a case related by Andral, (Clinique Médicale, t. iv. p. 444), in which dissection presented very unequivocal signs of gastritis; but this was evidently the *exciting* not the *proximate* cause of the attack. This distinguished pathologist conjectures that the patient must have had a very strong predisposition to the disorder, and that any lesion would have produced the seizure. Dr. M'-Arthur found in his dissections a very peculiar appearance in the contents of the alimentary canal, particularly in the stomach. In one case "the villous coat of the stomach was covered with a peculiarly offensive smelling yellow matter," (Med. Chir. Trans. vol. vii. p. 469); the mucus in the œsophagus was of the same colour; and in another case, "the yellow fluid effervesced on coming in contact with the external air." (Med. Chir. Trans. vol. vii. p. 475.) Fournier-Pescay also speaks of a yellowish or greenish coloured mucosity found in the stomachs of some of his patients. Worms we have already mentioned, have been frequently found in the intestines; they are particularly taken

* See particularly the notice of a case examined by Dupuytren, in Med. Chir. Rev. July, 1818; also two cases by Professor Brera, of Padua, in Lond. Med. and Phys. Journ. September, 1818; and one by Mr. Brayne, in Med. Repository, July, 1831.

notice of by Morgagni, Stoll, Larrey, and Dr. O'Beirne.

Anomalous appearances have been observed in other parts of the body. A writer in the Edinburgh Medical and Surgical Journal (vol. xv. p. 289,) quotes from Meyer a case in which there was discovered an ossification of the pleura, which must have irritated the phrenic nerve; and one from Vater in which the par vagum was irritated by an ossified gland. The heart was found to be preternaturally contracted, so as to occasion considerable resistance to the knife, in a case related by Mr. Howship. (Lond. Med. and Phys. Journ. vol. xxiv.) Mr. Swan, in his treatise on tetanus, details some dissections in which he discovered inflammation of the abdominal ganglions. It must not be omitted, that in many cases of the traumatic species, the nerve in the neighbourhood of the wound has been found inflamed and thickened, while in others nothing unnatural could be detected.

Theory.—Upon the above post-mortem appearances it may be remarked in general terms, that they are by no means constant; that they vary in degrees that hold no correspondence with the difference of the cases; that many of them are accidental accompaniments; and that with regard to others it is extremely doubtful whether they are actual morbid lesions or mere cadaveric alterations. Consequently, upon facts of this description it would be absurd to attempt to erect any theory of the disease. Unassisted by morbid anatomy, the speculator is reduced to the data afforded by physiology and by the symptoms; and he is not likely to be questioned if he pronounces that the malady belongs essentially to the nervous system, whatever other be secondarily affected. He is baffled, however, in his attempts to explain the rationale of the derangements in tetanus, and must confess with the candid and enlightened Abercrombie, that "its pathology is still involved in great obscurity." (Disease of the Brain and Spinal Cord, p. 396.)

That the pathology of any of the neuroses should be obscure, when so little is known of the instrumentality of nervous matter, can excite no rational astonishment. But in some of the diseases belonging to this class, there are states of the organization which show clearly enough that the mechanism was impeded or in a preternatural condition, though the action of the mechanism and the manner of its obstruction are entirely withdrawn from our observation. Thus we often find extravasations of blood, the products of inflammatary secretion, changes in the membranes, morbid states of the tissue, consisting in ramollissement, induration, adventitious growths, &c.; but these appearances are valuable to us, not because they explain in what manner the function was impeded, or in other words what alterations took place in the arrangement of the ultimate nervous molecules, but because they are connected with certain conditions of the system less or more under the control of our art. Such lesions, however, belong to a few only of the circumstances which are necessary to the proper performance of the nervous function; and in the nervous matter itself there may be myriads of other conditions, owning no connection with any that are subject to our cognizance, but the disturbance of any one of which may be amply sufficient to occasion a fatal derangement. The imperfect pathology of epilepsy, chorea, mania, hysteria, hypochondriasis, &c., affords but too many illustrations of the truth of these remarks; and a still more striking testimony is borne by the autopsies of hydrophobia, and, as we have seen, of the scarcely less formidable disease under consideration. In all these instances, presenting no constant alterations of capillaries, of texture, or secretion, we are forced to believe that the essential morbid change, whatever it be, must exist in those parts or actions of the mechanism which lie beyond our perception.

Many conjectures have been thrown out as to the division of the nervous system which is more particularly involved; but the prevalent opinion (which originated with Galen) is, that the spinal cord is the principal seat of the disease; an opinion founded upon the idea that this organ is the primordial agent of voluntary motion. Fernelius is very confident upon this subject—"Hujus morbi causam et vitium in spinæ initio contineri extra controversiam est." (Pathologia, liv. v. cap. iii.) The same opinion, we are told by Dr. Abercrombie, was entertained by Hoffmann, Ludwig, Lieutaud, Burserius, and Belfingerus. The absence of any derangement of sensibility or of intellect in tetanic patients has led most observers to the conviction that the brain is not involved; but others, and among them Fournier-Pescay, fancy that this organ cannot be said to be free from disorder, inasmuch as the spastic action extends to muscles which derive their nerves from within the cranium. This doubt, however, cannot weigh with those who believe that all the cerebral nerves, as they used to be called, are capable of being traced into the medulla oblongata, or at least into its superior prolongations. On the other hand, it cannot, we think, be maintained that the disease is confined to the spinal cord. The early symptoms, namely, the stiffness about the throat, and the spasms of muscles supplied with nerves from the medulla oblongata, prove beyond all question that this part is first affected, and that in simple trismus there is no reason to think the cord at all implicated. Whether in more general tetanus the spasms are primarily excited by irritation of the cord, or some remoter organ, cannot be fully determined till the physiology of these organs is better established. The *possibility* of the spasms being originated in the medulla spinalis may, we think, be fairly deduced, were other proofs wanting, from the experiments of toxicologists. Thus Professor Emmert of Bern found that on inserting the extract of false Angustura bark into the hind leg of an animal, after its spinal cord had been severed at the loins, the hind-legs as well as the fore-legs were thrown into spasms; and also, that if the medulla oblongata be cut asunder, and respiration artificially preserved, universal spasms might be produced by the introduction of the same substance. (Christison on Poisons, p. 761.) But the researches of Flourens and Magendie prove that the cerebellum is so importantly concerned in muscular motion, that it would be wrong to leave this organ out of consideration, when reasoning upon the seat of such a malady as tetanus; a

conviction rendered still more forcible by a case related by Orfila and Ollivier of poisoning by nux vomica, in which there was "found much serous effusion on the surface of the cerebellum, and softening of the whole cortical substance of the brain, *but especially of the cerebellum.*" (*Christison*, p. 757, quoted from Arch. Gén. de Méd. viii. 18.)

One of the most laborious and ingenious inquirers into the functions of the nervous system, Dr. Bellingeri,* attempts not only to determine the seat of tetanus, but to describe the limits peculiar to its separate varieties. Thus, as he supposes the motions of extension to depend upon the cerebellum and the posterior strands of the spinal cord, while those of flexion originate in the anterior strands and in the cerebrum, the former parts must in accordance with this hypothesis be affected in opisthotonos, and the latter in emprosthotonos. The reception of this explanation will depend on the estimation in which the Italian professor's doctrine of nervous antagonism is held; but we have no space for a discussion of its merits.

Treatment.—In this division of our subject we regret that we can do little more than recount a series of defeats, incurred by almost every therapeutical agent that has been employed against the terrible malady under consideration.

Opium has been more extensively resorted to than almost any other remedy; and certainly some of its well-known qualities are calculated to excite considerable expectations of benefit from its administration in a disease of which spasm is the most formidable symptom. Some practitioners have fancied that their anticipations have been realized, and have published cases in corroboration of their good opinion of this medicine. But a careful scrutiny of these histories tends very little to alter the unfavourable estimate which our own experience has compelled us to form of its virtues in tetanus, for they nearly all appear to have been instances of the milder form of the disease. We have known half-ounce doses of the tincture administered at brief intervals in acute cases, and not the least impression made on the system. In some instances, when stupor has been produced after immense doses, there has been anything but a remission of the morbid action of the muscles; and the observation of cerebral diseases constantly shows us that coma and spasms are by no means incompatible. There are several cases on record proving the enormous quantities that may be administered with impunity, though not with benefit. It is right to mention, however, that under the treatment of Dr. Gloster of St. John's, Antigua, a negro who had contracted the disease from exposure to cold at night, recovered after taking the drug for seventeen days, and the greater part of that time in doses of twenty grains every three hours. (Good's Study of Medicine, iv. p. 362.) Mr. Abernethy once found ℥xxx of solid opium undissolved in the stomach. Systematic writers uphold the employment of the medicine, but it would appear for theoretical rather than for practical reasons, while those who give the results of their own experience express the greatest dissatisfaction with the remedy. Among the latter we find the distinguished names of Rush, M'Grigor, and Fournier-Pescay. The strongest testimony in its favour that we have met with, is that of Baron Larrey, (Op. cit. p. 271); he was in the habit of exhibiting it with camphor and nitre in emulsion of almonds, in which combination he found it most easily swallowed. Dr. Latham was very partial to its use in combination with ipecacuanha. There are on record three cases by Professor Mursinna of Berlin, treated with opium, in doses of from fifty to one hundred drops of the tincture every hour. (Edin. Med. and Surg. Jour. vol. ii.) They all recovered; but it is scarcely necessary to add that they were all idiopathic and apparently mild.

[Twenty grains of opium, according to Dr. J. H. Bennet, (Tweedie's *Library of Medicine*, 2d Amer. edit. p. 80, Philad. 1842,) have been given every three hours for several days.]

Bleeding, one of the most powerful of our antispasmodic resources under certain circumstances, has been the subject of some diversity of opinion, as to the propriety of its employment in tetanus. Few, however, are averse to it in the very beginning of the attack. The best guide in this as in many other diseases is the constitution of the individual; in some habits we have not the least doubt that it would aggravate the violence of the disease.† There is not the least evidence to prove that it has any directly curative effect on tetanus; and if it exerts any beneficial influence, it is only as a preparative or auxiliary to other measures. Dr. Dickson advises its use as a preventive of the traumatic species, when the wound is inflamed and swollen, and the habit plethoric. (Med. Chir. Trans. vol. vii.) Mr. Earle found it a very useful palliative in a case which ultimately terminated in death. In one of the successful cases related by Hennen, venesection was one of the measures employed, but the case was confessed to be chronic. Larrey speaks favourably of the measure, and Sir James M'Grigor, though it appears in his catalogue of remedies that had generally failed, seems disposed to recommend it for want of a better resource. Perhaps, in the present state of our knowledge, the most that we can say for the measure is, that till we are better acquainted with the pathology of the disease, it would be scarcely justifiable to lose sight of a remedial agent, of which experience, independently of theory, shows us the utility in a very extensive range of diseases, and which is known in some complaints to exert a most powerful control over symptoms which constitute the severest part of the malady under consideration. It is almost superfluous to hint that great caution must be used in the application of the remedy, as the production of syncope might be immediately fatal. No better rule can be devised than that of Aretæus: "ἐσαπαξ ἀφαιρέειν, εὐμέτρως, μὴ μέχρι λειποθυμίης και περιψύξιος." (De Curat. Acut. Morb. lib. i. cap. 6.)

The warm-bath would for obvious reasons occur to the mind of any practitioner who had had no previous experience of the disease, and there is

* A very good abstract of this author's doctrines is given in the Edin. Med. and Surg. Journ. for Oct. 1834 and Jan. 1835.

† Dr. Cullen says, "Bleeding has been formerly applied in this disease; but of late it has been found prejudicial, excepting in a few cases, where, in plethoric habits, a fever has supervened."

a certain amount of testimony in favour of its employment; but the majority of observers have either relinquished it as useless, or condemned it as prejudicial. Among the latter was Dr. Hillary of Barbadoes. The cold-bath has had strong recommenders, particularly Drs. Lind and Currie. The latter, in his Medical Reports, (Vol. i. p. 136,) gives the case of a young soldier, in which immersion in cold water, after being pushed to the greatest possible extent, was quite successful; but after reading this case, we are disposed rather to think of the singular good fortune that prevented the patient from dying in the middle of the experiment, than encouraged to adopt it in our own practice. Sir James M'Grigor pronounces the measure to be "worse than useless:" and Dr. Parry's testimony is scarcely less condemnatory. (Op. cit. p. 22.) We remember a case in which it greatly aggravated the violence of the spasms. Mr. Morgan relates an instance that occurred in St. Thomas's Hospital, in which a tetanic patient was plunged into a cold-bath at his own request—"All the symptoms disappeared in a moment, and he was almost immediately taken out of the bath—but he was taken out lifeless." (Op. cit.)

Cold affusion has the warrant of very ancient authority. Hippocrates prescribes it in the idiopathic species, but strictly limits it to cases of this kind. (Aph. 21, sect. v.) In other cases, he advises warm fomentations and inunction. (De Intern. Affect. sect. v.) Schenckius records two instances of successful treatment by cold affusion. (Observationes Medicæ Rariores, lib. i. p. 127.) The most earnest of the modern recommenders of this measure are Drs. Wright and Currie. The former, in a paper which was published in the London Medical Observations, detailed its good effects in the West Indies. The latter adduces two cases in which it was used in conjunction with other remedies, and which recovered; but they were both of the chronic kind. Latterly there has been but little experience of its beneficial operation.* It has been tried upon animals affected with tetanus, and failed; there is a ludicrous account of its unsuccessful application in the case of a horse, in one of Mr. Abernethy's lectures, (Lancet, vol. v.); and Dr. Parry states that it was quite useless to some lambs which were suffering from the disease. Dr. Elliotson relates an instance in which, after a pail or two of water had been dashed upon a tetanic patient, he fell down dead as if shot. In connection with this subject we shall introduce a curious case, narrated by Sir James M'Grigor, of a soldier who recovered, apparently in consequence of exposure to wet and cold. "The symptoms of the disease occurred from a slight wound of the finger, and are stated to have been unusually severe. As it was impossible to think of leaving the man in the wretched village where he was attacked by the disease, he was carried on a bullock-car after the battalion. During the first part of the day he was drenched with rain, the thermometer standing at 52°; but after ascending one of the highest mountains in Gallicia, the snow was knee-deep, and the thermometer below 30°. The patient was exposed to this inclement weather from six o'clock in the morning till ten at night, when he arrived half starved to death, but perfectly free from every symptom of tetanus."

[Recently, the resinous extract of Cannabis Indica, Indian Hemp or Gunjah has been recommended in the traumatic form of the disease by Dr. O'Shaughnessy. It was given, at first, in doses of two grains every third hour, and afterwards of three grains every second hour, until the usual intoxicating effects were induced; when the spasms were in some cases mitigated, and in others wholly removed. (*New Remedies*, 4th edit. p. 135, Philad. 1843.)

Dr. Marshall Hall, (*Principles of the Theory and Practice of Medicine*, p. 299, London, 1837,) after laying down what he regards as the first indication of treatment in traumatic tetanus, viz.,—to divide the injured nerves, observes, that the second is "to subdue the spasmodic affection by such remedies as the hydrocyanic acid." We are satisfied, that narcotics are more powerful agents. Andral, indeed, (*Cours de Pathologie Interne*,) says, that the hydrocyanic acid has never succeeded; but it is asserted, that it was prescribed with advantage in a case of traumatic tetanus in the dose of from two to twelve drops, after opium had been given in vain. (Trevezant, Froriep's *Notizen*, Bd. xiv. No. 15, s. 324.)]

Among the measures directed immediately against the spasms, we may mention tobacco in the form of enema, strongly recommended by Dr. O'Beirne, in consequence of a case apparently cured by the use of this substance. (Dub. Hosp. Rep. vol. iii.) In the Peninsula, "when tried in the advanced stage, it seemed to have no effect:" (*M'Grigor.*) [Yet Dr. J. H. Bennett (*Op. cit.*) is disposed to regard it as the most efficient remedy of the class.] Musk is extolled by Fournier-Pescay, who boasts of having been the first practitioner who had treated with success an acute traumatic specimen of the disease. His dose was ten or fifteen grains; and he often gave two drachms in the course of the day. Ammonia is mentioned by the latter author as having been very efficacious in the hands of M. Francois. Oil of turpentine has been lauded for its power of relaxing the spasms in certain cases of locked-jaw, but they appear to have belonged to the milder species. We have already mentioned an instance that fell under our own observation.

[In a case of tetanus algidus, which fell under the writer's observation, the patient, who lived in the country, was taken, in the violence of the opisthotonos, to a brook which ran by the house, and the cold affusion was liberally administered. Narcotics were likewise given, and under the combination he got well.]

Dr. Rush, believing the diathesis in which the disease occurs to be one of debility and relaxation, administered wine and bark with a liberal hand, and not without success. Others have confirmed his opinion of these remedies, at least in the chronic species. In a case of this description, which lasted forty-two days, Dr. Currie administered one hundred and ten bottles of port wine. (Med. Reports, i. 148.) Some authors advise ardent spirits in large quantities, and one of them goes so far as to advise us to produce intoxication, but this is no easy matter. It is scarcely less difficult in teta-

* In the Revue Médicale, 1833, there is a case of considerable severity in which it appeared to do good.

nus to intoxicate with alcohol, than to induce stupor by opium.

[In one successful case, according to Dr. Brigham, Dr. Hosack administered three gallons of wine in the course of three days. He was led to regard the disease as one of debility; and was informed by General Moreau, that lock-jaw was of rare occurrence in an army, when it first took the field; but that it was produced by the slightest wounds when the soldiers had become fatigued and debilitated by long marches and frequent battles.]

Mercury has been tried both externally and internally, and generally failed; the same insensibility being manifested in the system to the peculiar operation of this medicine as of those just mentioned. The indication for its employment is by no means obvious, and we are inclined to believe that the principle which first suggested the use of it, was that of exciting a commotion in the body, which in some way or other should render it a less convenient habitation for the disease; a principle upon which, however much they may be ashamed to confess it, practitioners have been but too often compelled to act. Among those who speak most favourably of this medicine, is Dr. Rush, and apparently in consequence of his notion that it has a tendency to create a tonic diathesis.

The following is Sir James M'Grigor's summary of experience respecting the remedies which we have mentioned.

"The remedies which have been chiefly trusted to for the cure of this formidable disease, are opium, mercury, wine, warm and cold bath, venesection, ipecacuanha, and digitalis in large doses, enlargement of the original wound, and amputation of the limb. These have been tried alone and in various combinations, and I am obliged to confess that the whole failed in almost every acute case of tetanus which occurred. The three first have been administered in unlimited doses without effect; the cold bath is worse than useless."

Dr. Elliotson, encouraged by the success which he had met with in the treatment of chorea and other neurotic affections by the subcarbonate of iron, was induced to exhibit this substance in three cases of tetanus, two of which recovered. (Med. Chir. Trans. vol. xv.) The doses were from ʒij to ʒss every two hours, administered in treacle. He is said to have stated in a lecture delivered at the London University, that a gentleman in the West Indies had been very successful with the same remedy since the publication of the above cases. (Med. Gaz. vol. xi.)

If there be one class of remedies on which we should be inclined to put more reliance than on another, it is that of purgatives, both on account of the obstinate costiveness which attends the disease, and because we have in daily practice such convincing proofs of their strong repulsive influence on diseases of the cerebro-spinal centre. Hamilton and Abernethy, the chief advocates of this treatment, founded their expectations of its efficacy less upon the principle of counter-irritation than on their views as to the frequent origination of the disease in depraved conditions of the abdominal secretions. M'Grigor and Hennen consider purgatives to be some of the most hopeful of our remedies. The quantities required in some cases to produce any effect are all but incredible. In a case related by Dr. Briggs, (Edin. Med. and Surg. Journ. vol. v. p. 149,) the following quantities were administered: "The quantity of medicine taken from first to last is certainly very large, amounting, as far as can be ascertained, for the first twenty-five days, to calomel gr. 320, scammony gr. 340, gamboge gr. 126, powder of jalap ʒv. and ʒviiss, infusion of senna, with tincture, lb.x⅔, colocynth pill ʒiss and gr. 45; of which *the greatest part was taken within the first week*, namely, calomel 280, scammony 260, gamboge 110, jalap ʒiij, gr. x., infusion lb. v⅝. The quantity given in little more than forty-eight hours, from the morning of the seventeenth, is perhaps unprecedented in this country, amounting to, scammony gr. 210, gamboge 89, jalap ʒj. and ℈iv., infusion lb. ij⅓, calomel gr. 80, and all this without causing either sickness or griping, but, on the contrary, with the most decided benefit."

Mr. Morgan, utterly dissatisfied with all the attempts that have hitherto been made towards the cure of the disease in its acute form, proposes to introduce into the system a substance which has the property of producing on the nervous system a condition directly opposite to that which is developed in tetanus, namely, paralysis. In support of the propriety of this plan, he adduces some experiments on animals, in which the artificial tetanus induced by inserting into the wound a poison called "chatic," and obtained from Java, was removed or abated by the counteraction of ticunas, a North American poison. (Op. cit.) We are not aware whether this able surgeon has followed up his experiments by trials on the human system, but we quite coincide with him in the opinion that it is incumbent on us to look about for new remedies, since the old ones have all failed. Upon this ground we are disposed to suggest a trial of strychnia; not that we have become followers of Hahnemann, but that it is a simple and undeniable fact that disorders are occasionally removed by remedies which have the power of producing similar affections. It is quite unnecessary to explain this fact by an arbitrary principle, that an artificial irritation excludes a spontaneous irritation of the same kind. A more rational ground for an expectation of benefit from homœopathic medicines may be found in the consideration, that such agents prove by their occasional production of symptoms like those of the disease to be treated, that they act on the part which is the seat of that disease, and consequently that there is a probability that in their operation on that part, (whether it be in a sufficient degree to produce a similar disease or not,) they may effect a beneficial change. Oil of turpentine, for instance, having been known to produce a discharge of bloody urine, might be rationally administered in a case of spontaneous hæmaturia, not because it has a tendency to produce this disorder, but because that tendency shows it to have a specific action on the vessels from which the hemorrhage takes place. As to the dangers incurred in the experiment which we propose, we think it sufficient to say with an old writer "Satius est aliquid nonnullâ fiducia, vel cum periculo facere, quam ademptâ spe certo perire; et potentibus extremisque præsidiis pugnare,

quam nihil agere." (*Jason*, de Morbis Cerebri, ex Valesio, cap. 21.)

The application of blisters, moxas, the actual cautery to the spine, and a hundred other remedies and plans of treatment have been proposed, with an account of which we have not thought it worth while to burthen our pages. Tetanus, like cholera and other intractable disorders, has a host of alleged remedies, the very multitude of which is a proof of their inefficiency.

[It has been affirmed, indeed, by Dr. Hartshorne, of Philadelphia, (*Eclectic Repository*, Philad. 1819, and *Med. Recorder*, vol. 2,) and others, that benefit has resulted from the application of potassa along the spine, so as to inflame the surface. Dr. Hartshorne's mode of application is to tie a piece of sponge to a fork, and after dipping it in a solution of the caustic in water, in the proportion of a drachm to an ounce, to apply it rapidly along the spine twice or thrice, if the patient can bear it.]

Of the local treatment of the traumatic species we have nothing more to say, than that very little benefit appears to have been derived from the various methods to which surgeons have resorted. Amputation of the injured limb, counter-irritation in the wound, division of the neighbouring nerve,* pressure by the tourniquet, stimulating applications, &c., &c., have been found useful by some, and altogether inefficacious, if not prejudicial, by others. For more particular information upon these points we must refer to works on surgery.

J. A. Symonds.

THROAT, DISEASES OF THE. — The throat in the ordinary acceptation of the term includes all that region which extends from the posterior opening of the mouth to about mid-way down the neck. In this region there are a number of parts, the integrity of which is essential to the functions of deglutition, the voice, and of respiration.

The *pharynx* communicates with the mouth through the isthmus faucium, which is bounded above by the velum pendulum palati and uvula, on each side by the folds called pillars of the palate, between which are the tonsils, and beneath by the root of the tongue and epiglottis.

The *velum* or soft palate is a compound membranous septum, composed of mucous membrane, loose cellular tissue, submucous glands, and muscular and fibrous membrane: it seems to perform a valvular office in preventing the ascent of food and other ingesta, in the process of deglutition, to the upper part of the pharynx, and thus hindering the ingesta from passing into the posterior nares.

The *tonsils* consist of a number of deep mucous follicles or crypts surrounded by and deposited in cellular tissue, arranged in somewhat of a circular form, and situate on each side of the isthmus faucium between the pillars of the palate. They are largely supplied with blood from the pharyngeal, palatine, and labial arteries, some of the ramifications of which are of great size; they lie in the immediate vicinity of the internal and external carotid arteries.

The pillars of the palate bound the tonsils in front and behind: they are folds of mucous membrane containing muscular fasciculi: the anterior extending from the velum to the tongue surrounds the *palatoglossus* muscle; the posterior commencing at the same point is lost upon the lateral part of the pharynx, and involves the *palatopharyngeus*.

The *epiglottis* is connected to the root or base of the tongue by three folds of mucous membrane, which pass off from the anterior surface of the former to the dorsum of the latter; it is a triangular lamina of cartilage with curvilinear base, covered by mucous membrane, and tied below by a ligament prolonged from its apex to the angle of the thyroid cartilage; behind it is connected to the arytenoid cartilages by folds of mucous membrane, which pass off from its lateral margins, the *aryteno-epiglottidean* folds.) These folds form the lateral boundaries of a triangular opening that leads into the larynx; it is the false glottis so called in contradistinction to the true glottis or rima glottidis, which is bounded laterally by the chordæ vocales. Below and behind the false glottis the pharynx communicates with the œsophagus.

When the posterior wall of the pharynx is slit up, the following parts are brought into view proceeding from below upwards — the posterior part of the larynx, the glottis, the epiglottis and a small portion of the root of the tongue, the isthmus faucium, the velum, the posterior nares.

We shall arrange the diseases of the throat according to the parts in which they are particularly seated.

I. Inflammation of the Throat.

To the various forms of inflammation of the throat several names have been given by nosologists. Hippocrates described them under the term *paristhmia*, from παρὰ and ἰσθμὸς, the literal meaning of which is *morbus faucium*, or disease of the throat. The Greek writers after Hippocrates employed the terms *cynanche*, *synanche*, *paracynanche*, (from κύων, *a dog*, and ἄγχω, *to suffocate*, or *strangle*,) from the circumstance of dogs being supposed to be subject to it. Latin writers have adopted the term *angina*, (from the Greek word ἄγχω, *to strangle* or *suffocate*,) while English authors have invented the name *squinsy*, *squinancy*, and *quinsy*. Dr. Mason Good proposed to vary the Greek term to *paristhmitis*, in accordance with the terminology of the various forms of inflammatory diseases.

1. **Aphtha Anginosa.** — A species of sore throat to which this name has been given is sometimes prevalent in the autumn, when the season is cold and damp. It is generally accompanied by slight feverish indisposition, the throat feels rough and painful, and on examining the fauces, the tonsils, velum, and uvula, are of a dark red colour, which extends along the margin of the tongue, the body and root of which is coated with a white fur. In a day or two after, small white specks or aphthæ form on the throat and tongue, and disappear in a few days, though in some instances they leave small superficial ulcerations in places where they have coalesced. The duration of this affection is various: it is generally short, but occasionally successive crops of aphthæ appear

* A case in which this operation was beneficial may be found in the Dublin Journ. of Med. and Chem. Science, vol. v. p. 311, extracted from the Calcutta Med. and Phys. Trans.

and protract it for a week or two. It has been sometimes observed in persons attending those labouring under the more malignant forms of fever, small-pox, or scarlatina. It requires very little treatment; mild aperients, bland diet, cooling drinks, and saline medicines being generally sufficient to remove it. The mouth and throat may be frequently washed with a gargle composed of mel boracis and almond emulsion.

2. **Pharyngitis.**—Simple inflammation of the mucous membrane of the throat is a common disease in moist variable weather, and frequently epidemic in the spring. It is in general a mild disease, and troublesome principally from its liability to recur from very trivial causes, such as exposure to cold or sudden variation of temperature. The inflammation may be seated in the mucous membrane which covers the isthmus faucium, velum, and tonsils, [isthmitis,] or exclusively in the pharynx. When it occurs in the former situation, the symptoms are dryness of the throat, with frequent and painful attempts to swallow. If the inflammation extended to the Schneiderian membrane, there is, in addition, a sensation of dryness of the nostrils with frequent sneezing, succeeded by slight increase of the nasal secretion, which generally relieves these uncomfortable feelings. If the patient cannot breathe through the nose, but is obliged to keep the mouth open during sleep, the mucus which is secreted by the inflamed membrane becomes dry and adherent, so that on awaking there is some difficulty in dislodging it. When the inflammation extends to the glottis and larynx, in addition to the other symptoms there is frequent cough with hoarseness.

On examining the throat, the membrane covering the velum, uvula, and tonsils, appears redder than natural and slightly swollen, and the tonsils are often covered with grey mucus, and sometimes with thin white concretions.

This form of pharyngitis generally terminates in a very few days by spontaneous resolution or by mild treatment, though in severe cases sometimes by suppuration, an abscess forming either in the velum or in the uvula: when it forms in the uvula, it is known by the increased size, while abscess of the velum is easily distinguished by the difference in the size and shape of the two halves, the one being depressed and convex, the other raised and of a concave or semilunar form. Besides, the sensation of a tumour or of fluctuation on the introduction of the finger will often indicate the existence of matter.

This affection sometimes assumes a chronic form, commonly termed relaxed sore throat, which is troublesome from its being easily induced, as well as from the uneasiness in swallowing and feeling of dryness in the throat with which it is accompanied.

When the inflammation is seated in the posterior pharynx, either in the superior or inferior part, the symptoms are very similar to those just described. It is to be distinguished chiefly by examination of the throat, when the upper and posterior surface of the pharanx opposite the superior cervical vertebræ appears red and injected, and covered with adherent mucus. In some cases, however, the membrane, instead of being covered with mucus, becomes more dry than natural, and continues so while the inflammation lasts. This form of pharyngeal inflammation generally terminates in resolution, rarely in suppuration, though we have seen one case in which an abscess formed in the inferior part of the pharynx quite out of sight, and destroyed the patient by its pressure on the glottis. Guersent mentions two similar cases, but in both the abscess burst and the patient was immediately relieved.

The treatment of the milder forms of pharyngitis is in general easily accomplished, the remedies which are commonly resorted to in common catarrh being in slight cases sufficient to remove it. When the inflammation is more considerable, and the throat consequently very painful, it is necessary to apply leeches under the jaw or behind the ears, and to apply afterwards a large warm fomentation or an emollient poultice, which answers the double purpose of promoting the bleeding and of resolving the inflammation of the throat. The inhalation of the vapour arising from warm water to which a portion of vinegar is added also conduces much to the same end, and is preferable to the employment of gargles. The bowels are at the same time to be freely opened, and if the skin be warm, the ordinary saline diaphoretic medicines are to be administered. If these measures fail to remove the inflammation, or when a chronic form supervenes, a blister may be applied to the external fauces.

[In the dusky inflammation, which indicates great hyperæmia of the capillary vessels of the mucous membrane, perhaps the most effective agent, at all periods of the disease, is scarification with a lancet, which may be superficial if the inflammation be confined to the mucous membrane, —deeper if the parts beneath be involved. The writer has found the advantage of this course in his own case, and has seen it successful when practised on others.]

When an abscess forms in the velum or uvula, or in the posterior pharynx, it in general bursts spontaneously; if it do not, and more especially if it be seated in the submucous cellular tissue of the posterior pharynx, it should be opened by the throat lancet. In some cases the abscess is situated so low in the pharynx that it cannot be seen, as in the instance which occurred to us: under such circumstances the danger of fatal consequences from pressure on the glottis may render an opening into the larynx or trachea expedient. For some excellent practical remarks on abscess in the neighbourhood of the larynx, we refer the reader to Mr. Porter's valuable work on the Pathology of the Larynx and Trachea.

A more severe form of pharyngeal inflammation is that which is accompanied by the formation of a false membrane, (**angina membranacea.**) In this affection, though the mucous membrane is intensely inflamed, it is evident that the membraniform exudation forms an essential constituent of the disease, and is not altogether the result of the intensity or duration of the antecedent inflammation, since it has been generally found to be less under the control of bloodletting, but more successfully arrested by local stimulants or escharotics.

This peculiar disease has been minutely inves-

tigated by Bretonneau, a physician at Tours, and subsequently by Guersent, physician to the Children's Hospital at Paris. It raged epidemically in 1818 and for three succeeding years, in Tours, where it first made its appearance among some troops who had recently returned from the island of Bourbon: in the beginning it assumed the character of scorbutic affection of the gums, and was treated with antiscorbutic remedies, but without the least benefit. The application of the hydrochloric acid, however, at once removed the disease. About the same time the angina maligna appeared at Tours—an affection which very few practitioners had ever witnessed in that situation. At the beginning of the epidemic, which attacked both children and adults, the death of the former was generally ascribed to croup, from the suddenness of the seizure and its being attended with the usual symptoms of that disease; in adults the fetor of the breath and the livid appearance of the throat, gave a strong suspicion that the disease was angina maligna. Bretonneau, however, ascribed the fetor of the breath and gangrenous aspect of the fauces to the putrid condition of the false membranes, and not to gangrene of the affected structures; and conceiving that the redness of the mucous membrane without swelling or thickening of its tissue, accompanied by a concrete membranous exudation, to be so remarkable as to deserve the name and character of a specified inflammation, he designated this phlegmasia by the term *diphtherite*, from διφθέρα, *pellis, exuvium, vestis coriacea*. Under this term, he has included not only the acute and gangrenous varieties of pharyngitis, both of which are accompanied by exudation of a false membrane, but also inflammation of the trachea; and contends that this peculiar disease (*diphtherite*) and croup are identical, arising from the same causes, and requiring the same mode of treatment. To this we by no means agree, though we admit he has great merit in the diligence and zeal with which he has investigated the morbid anatomy of this peculiar affection.

The state of the question appears to be this.—In true tracheitis or croup there is inflammation of the mucous membrane, generally followed by exudation of a false membrane, but the disease is limited to the trachea and does not extend to the throat. In the pellicular pharyngitis (*angina membranacea* or *diphtheritis*), [*diphtheritic inflammation of the pharynx*] the inflammation commences in the pharynx, and in particular cases, or during an epidemic, the inflammatory action involves not only the pharynx, but dips into its several apertures, and in this way a false membrane of greater or less extent may be formed in the trachea. The constitutional symptoms and treatment of the two diseases are essentially dissimilar. In croup the local symptoms denote active inflammation of the trachea, and the symptomatic fever is inflammatory, requiring vigorous antiphlogistic treatment; whereas in angina membranacea, though the accompanying symptoms, general as well as local, often denote an acute disease, yet in many cases, and even during an epidemic, the tendency of the local inflammation is to assume a gangrenous character, the type of the accompanying fever is typhoid, and the treatment tonic and stimulant. In short the only similarity between the two diseases is, that in both there is inflammation of a mucous surface which terminates in the formation of a false membrane, the one commencing in the pharynx and in some cases extending to the trachea, the other originating in, and in its progress being confined to the trachea. We find the same membranous inflammation occasionally in the symptomatic angina of scarlatina, in which disease the throat is sometimes covered with a false membrane extending into the glottis and trachea, and giving rise to symptoms of croup.

In the description which has been given of this disease, the same circumstances which are observed in inflammation of mucous membranes in general are recognised. The same anatomical appearances of the membrane, as well as the exudation of lymph on its surface, occur in gastro-enteritis for example, or in inflammation of the internal lining of the uterus. The more remarkable circumstance is in the two opposite states of the system with which the local disease is associated; the one acute or sthenic, the other low or asthenic. We see, however, no necessity for distinguishing inflammation of a mucous membrane with membranous exudation by a particular name, merely because it occurs in a particular region of the body; it tends to multiply our nomenclature, and in some degree to abstract the mind from those general appearances which disease presents in tissues of the same class.

In the commencement of angina membranacea, the symptoms are very similar to those of common inflammation of the throat. If the patient be old enough to express the feelings, the first indications are stiffness in the neck and sense of heat and pain in the throat: some degree of swelling of the cervical glands with feverish indisposition is often at the same time perceptible. So far the progress of the symptoms resembles other forms of inflammatory sore throat; from which, however, the angina membranacea or diphtheritis is soon distinguished by the false membrane with which the throat is covered in the course of the next day, or sometimes within a few hours of the first feeling of indisposition.

In the early stage, the first appearance is the greater vascularity of the mucous membrane of the throat, which exhibits a number of red points or streaks over the inflamed surface, but without sensible tumefaction. The redness is soon succeeded by a number of white spots, which are at first distinct or isolated, and apparently confined to the mucous follicles, but they gradually increase in number and size, and finally coalesce so as to form a layer of various extent and thickness. In some cases, there are several distinct patches exhibiting intervening portions of inflamed mucous membrane; in others, a considerable portion of the mouth and throat is covered with a continuous layer of false membrane attached to the subjacent mucous membrane by processes which dip into the lacunæ or follicles; or in still more severe examples, they extend from the mouth and throat into the nasal fossæ, (and according to Guersent, as far in some instances as the frontal sinus, but seldom reaching the external openings of the nostrils,) into the œsophagus, air-passages, and,

as in one case observed by Bretonneau, into the Eustachian tube. In two infants, a membranous tube was found lining the œsophagus down to the cardiac orifice of the stomach. These false membranes vary in form as well as consistence; they are sometimes so thin as to be transparent, but often acquire considerable tenacity, and when they descend into the air-passages assume a tubular form. When they are thrown off, the surface from which they have been detached is red, but there is no abrasion; and the process is often renewed several times unless arrested by means to be afterwards noticed.

The colour of these false membranes is not always uniform. When the aspect of the symptoms denotes an acute or inflammatory disease, they are white, or of a pale cream colour; but when the local and constitutional symptoms assume a typhoid form, the throat acquires a dark red or livid hue, and the exudation a light grey colour, or when blood is exhaled from the surface of the membrane, it becomes of a dark grey or ash colour. This appearance of the exudation, and the fetor which it acquires under such circumstances, renders it liable to be mistaken for sloughing of the mucous membrane. There is, however, the most perfect integrity of the membrane beneath these concretions, except in some very few instances, in which slight erosion has been discovered.

In former times, when the nature of diseases was less frequently proved by morbid dissections, it is no wonder that this affection should have been considered a gangrene of the throat. Even Bretonneau was convinced of the error only by repeated inspections after death, and his testimony on this point is very strong. In comparing the morbid appearances found on dissection in fifty-five subjects of all ages, who in the space of two years had fallen victims to the epidemic angina, in no case, even of the most malignant nature, was there any thing like gangrene of the parts. Ecchymosis of small extent, with occasional slight erosion of those surfaces where the disease had longest existed, were the most severe lesions observed. In one instance only, the false membrane was confined to the trachea; in one-third of the cases it extended to the great divisions of the bronchi; in six or seven it reached the ultimate ramifications of the bronchi; in the others it terminated at various depths of the trachea. Bretonneau avers that the mechanical obstruction of the breathing appeared to be the immediate cause of death in all.

There are two forms of this anginose affection —the *acute* and the *malignant*; the one differing from the other in the intensity of the local as well as of the general symptoms.

1. In the *acute angina membranacea*, the inflammation of the pharynx and the constitutional symptoms denote an acute or phlogistic disease. The exudation is limited to the throat, and does not extend to the different openings of the pharynx. It is preceded and accompanied by the usual symptoms of guttural inflammation; on examining the fauces the mucous membrane is of a bright red colour, and there are patches of false membrane on the tonsils, velum, or posterior pharynx; or in severe cases the throat is covered with a continuous layer of a white concrete substance. This is by no means an uncommon accompaniment of measles, scarlatina, or small-pox, but more frequently occurs as an idiopathic affection in children who are delicate, or who have been much reduced by previous disease, and in such as are ill-fed and live in crowded districts.

When the guttural inflammation is still more acute, the mucous membrane is not only of a brighter red colour, but there is considerable swelling of the palate and tonsils; the exudation appears in the form of masses of lymph on the surface of the throat, of a grey or yellowish white colour, and differs from the smooth continuous layers of the other forms of diphtheritis, in so far that the masses are soft, and may be easily detached by any hard body, or even by the point of the finger, without the least inconvenience; and when they are thus removed, they are soon reproduced. These crusts often appear on the pharynx, and occasionally form on the œsophagus, but never extend to the larynx. To this variety the term *angina pultacea* has been applied, though there seems to be no necessity for giving a distinct appellation merely from the form or consistence of the false membrane.

In the acute form, the constitutional disturbance is in general moderate; the pulse is seldom frequent but full, the skin warm, the throat slightly painful, and deglutition gives little uneasiness.

In other and more severe instances, the membranous formation commences in the pharynx and extends to the larynx and trachea, and sometimes even to the bronchi, and to this extension of the false membrane to the air-passages is to be imputed the greater danger of this form of the disease.

When the exudation occurs simultaneously in the pharynx and trachea, the symptoms assume a mixed character. In addition to those which are observed when the pellicular inflammation is confined to the throat, the symptoms of croup are superadded—hoarseness, pain in the anterior part of the larynx and trachea, harsh dry cough, great difficulty of breathing, the inspirations being long, and the expirations short and accompanied with a hissing noise.

2. In the *malignant angina membranacea* which corresponds exactly with the affection described under the name *cynanche*, or *angina maligna*, the *putrid or malignant sore throat*; or the *angine gangreneuse* of the French writers, the local and constitutional symptoms evince a malignant disease. It has been clearly shown, however, by Bretonneau, that the angina maligna, which is often epidemic, is not of a gangrenous nature, as had been previously supposed, but that it is a true pellicular inflammation analogous to croup, and that the crusts which were supposed to be sloughs are false membranes.

In the angina maligna there is from the beginning great prostration and disorder of the nervous system; the pulse is weak though not very rapid, and the skin moderately warm, or even cool. There is at first not much apparent affection of the throat, but the act of deglutition is very soon observed to be performed with great difficulty, so that liquids are often returned through the nostrils, which cannot be accounted for by the trivial de-

gree of swelling of the throat; the submaxillary lymphatics become swollen and painful, the breathing hurried and laborious; now and then there is threatening of suffocation, and an acrimonious secretion, occasionally mixed with portions of false membrane, is discharged from the nose. When these membranes are tinged with blood, and especially when at the same time blood exudes from the lips and gums, their dark or almost black appearance and intolerable fetor have frequently caused them to be mistaken for sloughs; the surface, however, from which they are detached is perfectly entire, the mucous membrane is not even softened, nor is there the peculiar odour of gangrene. When the false membrane has extended to the larynx and trachea, the breathing becomes laborious and often convulsive, the nostrils dilated, the veins of the neck prominent, the cough frequent and harsh, and the sound of the voice croupal. Its extension to the bronchia is indicated by the increased dyspnœa, by the limpid mucous expectoration, occasionally mixed with shreds of false membrane, sometimes bearing the mould of the portion of air-tube from which it has been expelled, and by the mucous sound of the respiration on the application of the ear or the stethoscope.

When the patient is to be destroyed by the tracheal disease, the powers gradually become exhausted, the efforts to carry on the respiration are feeble and languid; the chest heaves, the countenance assumes a pallid hue, the eyes sink, and fatal coma supervenes, or sometimes the sufferer is carried off in convulsions. In other cases, the immediate cause of death may be traced to disease in some organ which has arisen during the progress of the affection. In the majority of instances, however, the general powers gradually, sometimes rapidly give way; delirium comes on followed by coma; the breathing becomes quick, the pulse very soft, and death takes place, often unexpectedly, in a day or two, sometimes within twenty-four hours after the first appearance of the symptoms,

On the dissection of those who die of angina maligna, the mucous membrane appears of a dark red or livid colour, and covered with a dark ash-coloured exudation.

In the epidemic described by Bretonneau, there seems to have been a remarkable uniformity in the morbid appearances. In every case he examined, with one exception, the false membrane was found covering the tonsils and pharynx, and extending to the larynx and trachea; in the solitary instance alluded to, the membrane was confined to the trachea. Precisely the same appearances were uniformly met with in the cases which came under the observation of Guersent. It is upon these facts that the French pathologists have founded their conclusions as to the identity of croup and angina maligna, but from which the majority of British pathologists dissent.

This more severe and fatal form of angina maligna prevails chiefly among feeble children, or those who have gone through severe attacks of acute diseases: it is not unfrequently epidemic in low districts, or in hospitals and workhouses.

From what has been stated, it is apparent that the appearances and symptoms of diphtheritic or pellicular inflammation are by no means uniform. This difference is in a great measure owing to the dissimilar circumstances under which the disease arises, and especially the state of the system at the time the disease appears. Thus when it occurs in children or in adults, who live in a salubrious air and are properly nourished, all those who have witnessed this disease agree, that the constitutional as well as the local symptoms present a very different aspect compared with those observed when it occurs in persons of a feeble habit, or in children who are ill-fed, indifferently clothed, and who live in crowded districts or in low damp situations. In the one class of persons the symptoms indicate a phlogistic, in the other a low asthenic disease; the different character of the local and constitutional symptoms depending not so much on any peculiarity of the disease itself, as on the general habit or constitution of the patient, and the more or less favourable circumstances under which an individual or community may happen to be placed at the time it appears.

The prognosis of angina membranacea depends on the form or type of the disease. When the false membrane is confined to the pharynx, and the symptoms denote an acute disease, there is seldom danger, particularly if proper measures be early resorted to. But if the inflammation and subsequent exudation occur simultaneously in the throat and windpipe, or spread from the former to the latter, the danger is imminent, even under the most prompt and energetic treatment.

In angina maligna there is always danger; it proves fatal in a very large proportion of cases, as the records of epidemics give melancholy proof. To the affection of the throat and air-passages is superadded a malignant form of fever, either of which is sufficient to destroy life. There is no wonder, then, that so many children perish under the combined influence of local and constitutional symptoms of such severity, which apparently bid defiance to any mode of treatment hitherto proposed. Some epidemics are more fatal than others, the disease sparing, it would appear, no class of the community, but destroying indiscriminately those who enjoy the comforts of life and such as pine under privation of every kind.

Nothing has been ascertained with precision as to the causes of angina membranacea, either of the acute or malignant form. It prevails chiefly in moist situations in the spring months, and though adults be not exempt from it, it occurs more generally among children. The malignant form has often appeared in hospitals and workhouses; and it has been generally observed that when it broke out in such situations, it was confined to young children, and that the first cases occurred when the wards were crowded, under which circumstance it spread with frightful rapidity. There can be little question of its being occasionally propagated by contagion, though from its rapid and extensive diffusion, and the various types or characters it at different times assumes, it appears to be primarily induced by some of the obscure causes which influence epidemics in general, and of which little is known beyond the observation of their effects in the production of disease.

In the acute forms of angina membranacea (*diphtheritis*), should there be general excitement, it will be necessary to adopt vigorous treatment. General bloodletting, in spite of the opinion of Bretonneau and some other French physicians as to its inutility, is to be premised, followed by the application of leeches to the neck and under the jaw, or cupping on the back of the neck, and counter-irritation, according to the state of the local symptoms. The bowels are to be freely evacuated, after which it has been recommended to administer emetics, especially the tartarized antimony, from time to time, uness some local inflammation render this class of remedies inexpedient.

Mercury, which seems to exert a direct and almost specific influence in inflammation of the mucous membrane of the throat and air-passages, has been highly extolled by the French physicians in the treatment of diphtheritis. It was first employed by Dr. W. Conolly of Cheltenham, then resident physician at Tours, and with such invariable success that the French practitioners, although with some reluctance, adopted it in their own practice. (London Medical Repository, December, 1826, p. 499.) To ensure its success the full mercurial influence is necessary. With this object two grains of calomel are to be given every second hour, and should there be evidence of the false membrane extending to the larynx and trachea, so that a more rapid mercurial action is necessary to arrest the inflammatory process, mercurial frictions are to be at the same time applied to the neck, or to the chest and arms. As soon as the mercurial action is perceptible in the system, or when there is a visible improvement in the local disease, the calomel is to be given at longer intervals, or at once discontinued. Bretonneau speaks in extravagant praises of the efficacy of the mercurial treatment of diphtheritis, and gives in illustration several well-related cases in his work, to which we refer. Guersent also advises this treatment, but he gives the exhibition of the calomel in half-grain or grain doses, to prevent its purgative effect. If any local inflammation have arisen either in the brain, in the chest, or in the abdomen, it is obvious that appropriate treatment must be employed. In the severe cases of angina membranacea, these lesions frequently supervene and render the aspect of the case more formidable.

Bretonneau ascribed much of his success in the treatment of diphtheritic inflammation to topical applications. Of these the muriatic (hydrochloric) acid, first employed by Van Swieten, and subsequently by others, in sloughing phagedena of the mouth (cancrum oris), appears to be decidedly the most efficacious. When the epidemic angina maligna first appeared at Tours, it resisted the various remedies employed, but the application of this acid to the throat had an immediate and beneficial effect in arresting the progress of the disease. The first case in which Bretonneau employed it was in a child eight years of age, who had for several days before she was brought to the hospital, well-marked symptoms of angina maligna. On examining the fauces, the throat appeared sphacelating, one of the tonsils was almost detached, being only suspended by some cellular tissue. There appeared no hope of recovery. A sponge dipped in hydrochloric acid was however applied to the throat; next day the symptoms were much improved, and the false membranes were detached. The acid was again applied, after which the child rapidly recovered.

From the successful result of this case the acid was afterwards in many cases applied and with similar good effects. The following is Bretonneau's method of applying it. A piece of fine sponge, securely fixed on the end of a probang, and bent to a convenient form, is to be dipped in concentrated hydrochloric acid. The sponge thus soaked in the acid is to be gently pressed on the surfaces to be cauterized, so that they be just moistened with it. Bretonneau thinks it best to let the first applications of the acid be energetic, and not too frequently repeated, and therefore advises the application of the undiluted acid at once, except in cases where the diphtheritic inflammation has extended further than can be seen. Under these circumstances, it may be diluted with honey, in the proportion of one-third of the former to two of the latter. The first effect of the application of the acid is to give the inflammation of the throat a more unfavourable aspect, the false membranes appearing to be increased in thickness as well as in extent. In twenty-four hours the action of the acid is completed, and if the false membranes do not seem to have extended, or if they are becoming detached, it is evident that the progress of the inflammation has been checked; the acid should then be applied somewhat diluted, and at such intervals as the progress of the local disease indicates, though it is seldom necessary to repeat this corrosive application more than two or three times.

It is quite evident, however, notwithstanding the successful termination of the cases treated by the application of the hydrochloric acid, as reported by Bretonneau, that when the false membranes have extended to the larynx and trachea, this or any other topical application, however powerful or corrosive, can have no influence in arresting their further formation, or in accomplishing their removal from the air-passages.

The only class of cases, therefore, to which the acid can be topically applied with beneficial results, is when the false membranes are limited to the pharynx, and do not extend to the air-passages. It is even possible that by checking the inflammatory action in the throat at first by this acid, the further progress of the disease may be stopped.

We can only allude to the employment of the hydrochloric acid fumigation, proposed by Bretonneau in cases where it was no longer possible to employ the concentrated or the diluted acid, in terms of disapprobation, as it was evidently on an unwarrantable principle,—that by exciting inflammation of the mucous membrane of the lungs, the specific inflammation might be modified, one less dangerous and more easily removed being substituted. This practice having in his hands completely failed, is now justly consigned to oblivion.

[Recently, M. Velpeau has strongly urged the use of alum, even in the early stage of every form of angina. He employs it either as a gargle or

in powder. The tip of the finger, moistened, is to be covered with powdered alum, and then rubbed over the inflamed parts, the tongue being depressed with the handle of a spoon. It may also be applied with a small brush or a piece of sponge fixed on the end of a small stick; or may be blown into the throat through a tube. But M. Velpeau prefers the use of the finger, as it can, in general, readily reach every point of the inflamed surface; and, moreover, an intelligent patient can apply the powder with his own finger. The application should be made twice or thrice a day, and in the meantime the patient should frequently gargle his throat with a solution of from one to four drachms of alum in four fluidounces of barley-water. In mild cases, the gargle is found to be sufficient.]

A more manageable topical corrosive application in diphtheritic inflammation is the nitrate of silver, which was first recommended by Mr. Mackenzie of Glasgow. (Edin. Med. and Surg. Journ. 1825.) He recommends a solution of lunar caustic, in the proportion of a scruple to an ounce of distilled water. By means of a large camel-hair pencil, this solution is to be freely applied to the mucous membrane of the throat, once or twice a day, according to the severity of the symptoms. In cases of croup, in which the fibrinous exudation commences in the throat, and ultimately spreads to the larynx and trachea, he has found this topical application successful, not only in removing the false membrane from the throat, but he has been induced to ascribe the rapid alleviation and ultimate removal of all the other symptoms to this remedy, even in cases in which, from the severity and peculiar nature of the symptoms, he had every reason to believe that the larynx and trachea were covered with a false membrane.

When every remedy has failed, and when the patient must inevitably die from the false membrane in the trachea, it has been proposed to make an opening in the windpipe. Bretonneau performed this operation in several instances, and in one it was successful. When we consider the impossibility of discovering the depth to which this membrane in the trachea may extend, the probability of the tracheal inflammation being renewed or increased by this operation, and the necessary introduction of a tube to carry on the respiration, we feel little disposed to advise it, though we are aware that it has been several times successfully performed in this country in cases of croup.

In the angina maligna, in which the local and general symptoms exhibit a malignant aspect, the advantages of any mode of treatment are exceedingly doubtful. It is a very fatal disease, more especially when it occurs epidemically in a crowded district among the children of the poor. Even among the better classes it often destroys with astonishing rapidity; its victims, indeed, seem never to recover from the first shock of the disease. Any form of bloodletting, general or local, is inadmissible, and even injurious. Emetics are sometimes in the very beginning useful, unless there be much prostration, when they do harm. Blisters may be applied to the back of the neck or to the angles of the jaw, and the strength supported by strong broths, and wine with sago, according to circumstances. The carbonate, or the aromatic spirit of ammonia, or the quinine, may be exhibited with the same view. If the state of the mucous membrane of the bowels admit of the administration of calomel, it should be prescribed with the hope of arresting the inflammation in the throat and air-passages. If the local disease be complicated with gastro-enteritis, this remedy cannot be safely exhibited. Some practitioners speak highly of the oxymuriatic acid taken internally in liberal doses. With regard to topical applications, the diluted hydrochloric acid, or a solution of the nitrate of silver, applied in the way already recommended, may be employed. It is, however, a discouraging reflection that a large proportion of cases of angina maligna treated in the most skilful manner, are rapidly destroyed.

3. **Sloughing Phagedena of the Mouth, [Gangrenous Stomatitis and Pharyngitis,]** (*cancrum oris—gangræna oris—necrosis infantilis—cancer aquaticus–water-canker.*)—Though this affection, from its commencing in the gums and cheeks, and spreading in many instances to the throat, be not strictly included in the class of diseases we are now considering, its importance and severity entitle it to particular consideration. It has been already mentioned, in the article MORTIFICATION, as a form of sphacelus from general debility. There are other forms of it, however, which, as well as that terminating in sphacelus, we shall now describe.

It occurs most frequently in infants about the period of the first dentition, though sometimes in children from three to seven years of age. Dr. Hamilton, (Observations on the Remittent Fever and Water Canker,) who has given the fullest account of this disease, mentions one case of a boy, eleven years old, which terminated fatally, and another of a married woman, twenty-two years of age: we have seen one case of a male at thirty-five years of age. In the milder forms, generally observed, according to Dr. Cumming,* in infants at the breast, before the upper incisors make their appearance, and in which the disease does not proceed beyond the ulcerative process, the first indication is a purple spongy appearance of the gum, either of the upper or lower jaw, but rarely of both at the same time. The ulceration gradually advances till it completely destroys the gums and exposes the teeth; the ulcerated surface being much disposed to bleed, by which the ulceration is often in some measure disguised. There is more or less feverish disturbance, the tongue is white, the mouth feels hot, the salivary discharge increased, and the bowels confined.

The disease in other instances assumes a much more formidable aspect, the ulceration of the gums passing into gangrene and sloughing, and extending rapidly to the cheek and lips. In these cases the diseased surfaces become dark and livid, the breath exhales a gangrenous odour, the alveolar processes become exposed and carious, the teeth drop out, the caries extends to the jaw-bone, the tongue becomes partially destroyed, the cheek perforated, and an acrimonious secretion from the diseased mass issues in considerable quantity, ex-

* Observations on an Affection of the Mouth in Children. Dublin Hospital Reports, vol. iv.—An excellent succinct account of this disease.

coriating those parts of the skin to which it happens to be applied. The gangrenous inflammation occasionally begins first in the cheek or lips, and extends to the gums; when it commences in the cheek, a shining, red, painful swelling is observed externally, the inner surface corresponding with this tumour presenting an irregular foul gangrenous ulcer. The local affection is always accompanied by irritative fever, and often by purging; and at length the unhappy victim, sometimes in the course of a very few days, falls a prey to the disease, worn to a skeleton by the local and constitutional irritation.

This formidable variety of phagedenic ulceration of the mouth occurs generally in children from eighteen months to two years of age, whose pale, sallow, or bloated appearance shows the effects of living in an unhealthy crowded atmosphere, combined with scanty clothing and improper nourishment. It is often a sequela of remittent fever, or of measles, small-pox, and scarlatina. We have seen it occasionally in children during the progress of continued fever. It is always very dangerous, and often fatal. Dr. Hamilton never saw it destroy children who enjoyed the comforts of life, and he had seen but one instance where it proved fatal in which the lower jaw only was affected. In this child, who had recovered from measles about a month, the disease was on each side, and she had pulled out several of the molar teeth, before her parents knew that there was any disease of the mouth.

The two following cases will give an idea of the occasional rapid progress of this disease. A child about two years of age, the daughter of a labourer in Lynn, whose habitation was on the banks of the reservoir, was brought to Dr. Hamilton. The gums of the upper jaw had been ulcerated some days, and were almost destroyed. The disease had proceeded with frightful rapidity, for in two days after, part of the lip under the nose was perforated, and in other two days, the lip was entirely gone. The nose and cheeks next became involved, the soft parts rapidly sloughed, and the maxillary bones were destroyed. In less than a week the child died.

In another girl five years of age, who had recovered three weeks from mild small-pox, the ulceration was reported to have existed only a week, though the disease had made great havoc. The ulceration had extended from the gums to the palate, which, as well as the plates of the maxillary bone, was destroyed, so that there was a large perforation into the nose, the cavity of which was involved in the disease, the septum and spongy bones being carious. The fetid acrimonious discharge from the mouth and nose produced ulceration of those portions of the skin with which it came in contact. In less than two days after, the cartilage of the nose was destroyed, and the disease had spread to the upper lip; it then continued progressively to involve hard and soft parts, until the nose, cheeks, eyes, and lips were successively destroyed. It had even extended to the brain, through the cebriform lamella of the ethmoid bone and orbits, before the unhappy child fell a victim to the disease, which occurred nine days after she was first seen by Dr. Hamilton. Before death, all the soft parts, and even the bony structure, of the face were destroyed, a black eschar only remaining. The spongy bones, the plate formed by the maxillary and palate bones, which constitute the base of the cavity of the nose and arch of the mouth, were annihilated, and the tongue and throat exposed to view through the vast chasm which the nose and those other parts formerly occupied.

It is of great consequence to distinguish this dangerous affection in its early stage. It can scarcely be mistaken, if the circumstances which have been stated be attended to. It has very little resemblance to the infantile thrush, (aphthæ lactantium, [q. v.]) a vesicular disease which appears first on the edges of the tongue, or at the angles and inside of the lips, and often extends over the whole surface of the tongue, cheeks, palate, and pharynx. The vesicles break, and the exudation concretes into minute white specks, which become detached and leave the surface smooth and red, this process being repeatedly renewed, till the whole mouth and throat become covered with a white granular incrustation. The circumscribed nature of the phagedenic ulceration of the mouth, and the origin and progress of even the mildest forms, are sufficient to distinguish it from this aphthous disease.

It bears a much greater resemblance to scorbutic gangrene of the gums, though from this it may be also easily distinguished. Phagedenic ulceration of the mouth, or cancrum oris, generally appears in children, who are by no means so liable to scurvy as adults, besides that the usual external symptoms of scurvy are never observed in this disease. The appearance and progress of the local symptoms in the two diseases are also different. In the one, the ulceration or gangrene appears sometimes in the cheek or lips, but more frequently in the gums; but in whatever part it first begins, it is confined to one side of the mouth, and never extends to the opposite. In scurvy, the affection of the gums is not limited, but affects both upper and under jaw; the gums become tumid, and as the disease proceeds, livid and disposed to bleed; a fungus shoots up, covering the teeth, which do not fall out as in cancrum oris, unless the sockets formed by the alveolar process become decayed. In both diseases the odour of the breath is extremely offensive, and in both the saliva is increased at first, but in cancrum oris the salivary discharge soon acquires a corrosive quality, which it never or very rarely does in scurvy. In the worst form of cancrum oris, there is caries of the bones of the jaw and face, which never happens in scurvy. Finally, the constitutional symptoms are essentially different. Cancrum oris is always, from the very commencement, accompanied with irritative fever, which never occurs at any stage of scurvy, unless some accidental disease arise in its progress. The pale, bloated, sickly appearance of the face, the bluish or livid spots on the trunk and extremities, and the œdematous swelling which often succeeds in scurvy, are never observed in cancrum oris. The appearance of the blood, too, is characteristic. In scurvy it is fluid, of a dark red colour approaching to black, and when it stands, little if any serum separates; in cancrum oris, though the blood be pale and its fibrinous principle be deficient, it is florid and coagulates, abundance of serum separating from it.

Cancrum oris is almost exclusively confined to the children of the poorer classes, who live in crowded districts, and consequently in an impure atmosphere. This circumstance, combined with improper and scanty food and insufficient clothing, seems to be a predisposing cause of the disease, by debilitating the system and favouring those changes in the blood, which favour the origin of this and other malignant diseases.

It appears, also, to be produced by some circumstances peculiar to certain localities, as we find from Dr. Hamilton's account, that it is very prevalent in Lynn and its neighbourhood, which is low and marshy; he consequently conceives, that it is the endemic disease of a low, moist, fenny, or marshy country, as it is unknown in high and dry situations even within twelve or fourteen miles distance from the town. Instances of slight attacks were common in Lynn, and when early application for relief was made, were soon recovered from; yet those children who have been early attacked with it were frequently, sometimes yearly, liable to slight returns of the disease, which happened to some until they arrived at puberty. It has been observed to be most malignant and fatal in warm weather after a rainy season, or when epidemic diseases of a putrid cast, particularly the small-pox, measles, and angina maligna have prevailed. It was frequently fatal in children recovering from either of these epidemics, although the preceding exanthematous disease was mild.

It appears to be neither epidemic nor contagious, for Dr. Hamilton states that, although the discharge from the ulceration be so virulent, and the fetor so intolerably offensive, he has often seen one child in a family of many, singly affected with it, while the rest who lived in the same room, and probably ate and drank with the sick child, have escaped.

From the resemblance between this affection and that arising from the injurious effects of mercury on the mouth, a question has arisen how far the administration, or rather the injurious effects, of this mineral might contribute to the production of this disease. Though in many cases mercury might have been accidentally given in the early stage of the affection, from which suspicion may have arisen of some connection between its administration and the production of this disease, yet in very many, if not the majority of instances of the very worst forms, not a particle of this mineral had been given; besides, the testimony of almost every writer against such a supposed origin at once sets this question at rest.

In the milder forms of phagedenic ulceration of the mouth when the ulcerative progress is confined to the gums, the treatment is generally easily accomplished. Aperient medicines, repeated according to the state of the bowels, are indispensable. After their operation, the fever and heat of the stomach abate, and the ulceration of the gums soon heals, often without any external application whatever. Should, however, the ulceration become indolent and indisposed to heal, the surface should be touched with the oxymel æruginis, tinctura ferri muriatis, or with a mixture containing one drachm of muriatic acid and one ounce of honey of roses. This acid was first employed by Van Swieten, with the best success, in this affection. It is necessary to attend strictly to the general health of the infant for some time after the ulceration is healed, as it is extremely liable to return, when from any cause the system suffers irritation.

When the disease assumes the character of sloughing phagedena, the constitutional treatment must depend on the acute, chronic, or malignant aspect of the symptoms. When the phagedenic ulceration is extending rapidly, and the local and general symptoms indicate subacute inflammation, the child should be moderately purged by occasional doses of calomel and rhubarb, and the concentrated extract of sarsaparilla, with minute doses of a solution of the chloride of mercury, afterwards given. The efficacy of these measures will be materially assisted by removing the child to a pure atmosphere, giving proper liquid nourishment, and cleansing the skin by the warm bath or tepid ablution with salt and water. In proportion as the general health improves, the ulceration of the mouth assumes a better appearance.

As local applications, the muriatic acid mixed with honey of roses, combined in the proportions recommended, is the most efficacious. The mouth may be rinsed in the intervals with a strong acidulated decoction of bark, to which, if there be much pain, a proportion of laudanum may be added. It is often difficult, indeed impossible, to get a child to use a gargle effectually. The mouth should, therefore, be washed frequently by means of a syringe, and a piece of lint soaked in the muriatic acid mixture kept constantly applied to the ulcerated surface. Dr. Hamilton, in the commencement of the ulceration, and before it had extended to the jaw, applied in the same way the black-wash, and often with great advantage.

Various other local applications have been proposed,—alum, sulphate of copper, nitrate of silver, butter of antimony, myrrh, verjuice, &c.—but they are all inferior to the muriatic acid or black-wash.

When the teeth become loose, especially if they are encrusted with tartar, or carious, they should be at once removed, as they prove a source of additional local irritation.

In the most malignant form of the disease, in which there is gangrene of the soft parts and caries of the bones, the best directed measures seldom avail, and the child sinks rapidly. From the putrescent aspect of the general as well as local symptoms, a stimulant antiseptic plan of treatment is indicated. The strength of the child should be supported by strong broths containing sherry wine, and as large doses of sulphate of quinine as the stomach will bear, to which, as circumstances may require, the carbonate or the aromatic spirit of ammonia may be added. It is sometimes necessary to tranquillize the child by narcotics, and with this view, the Lancaster black-drop or the muriate of morphia may be administered in small doses every five or six hours.

The local applications to the mouth adverted to may also be employed, though Van Swieten, who recommended the application of undiluted concentrated muriatic acid to the worst forms of the disease, acknowledged that he never saw any benefit from it when the bones had become diseased. It is proper, however, to cleanse the surface of the ulceration by the frequent use of the

acidulated bark gargle, thrown into the mouth by the syringe; and to correct the horrible fetor, lint dipped in a solution of the chloride of lime should be kept constantly applied to the sore. This will not interfere with the occasional application of the muriatic acid, should it be deemed advisable to employ it.

Mr. Wallace (Note to Dr. Cumming's paper in vol. iv. of the Dublin Hospital Reports) states that in many of the worst cases of this affection, he has succeeded in effecting a cure by the internal exhibition of the carbonate of ammonia, in conjunction with the application of pure nitric acid to the sore. The dose he recommends in the commencement is five grains of the carbonate increased to ten or even twenty, administered at longer or shorter intervals, according to circumstances. We are aware that in some very bad cases, in which, besides sloughing of the soft parts, the jaw-bone was affected, recovery has taken place. Such instances, while they give encouragement on the one hand, even under the most unpromising circumstances, should not induce us to place too much confidence in any plan of treatment, since it is well known that in the worst forms of sloughing, phagedena of the mouth, very few recover under the most judicious treatment. [See farther on the subject of the treatment of gangrenous stomatitis: Art. MORTIFICATION.]

II. DISEASES OF THE TONSILS.

1. **Tonsillitis.**—[*Amydalitis.*]—The clusters of follicles in the pharynx which are connected with cellular tissue and form the tonsils, are liable to inflammation and its consequences. Inflammation of the tonsils, which is very common in moist variable weather, is announced by sensation of dryness, heat, and pain in the throat, with painful deglutition. The secretion with which the throat is lubricated becomes at first suspended, so that the throat feels dry; but it is afterwards increased in quantity and more viscid. In general, the inflammation is not confined to the tonsils, but extends to the palate and uvula; the latter becomes elongated, and thus irritating the epiglottis, causes frequent desire of swallowing and more or less cough, by which the viscid secretion of the throat is expelled. When both tonsils are swollen, the act of deglutition is attended with extreme pain; hence to avoid such painful efforts, the saliva is allowed to flow from the mouth: in some cases the swelling is so great that the patient becomes incapable of this effort, so that, from the resistance which is offered by the swelling of the throat, what is attempted to be swallowed is not unfrequently returned through the nostrils. Sometimes the inflammation spreads along the Eustachian tube, and gives rise to pain in the ear, deafness, and sensation of obscure sounds; or from the pressure of the tonsils exerted on the windpipe, there is often considerable difficulty in breathing, accompanied with peculiar alteration in the sound of the voice, which is often alone sufficient to indicate the nature of the disease.

These local symptoms of inflammation of the tonsils are usually accompanied with full or hard accelerated pulse, heat of skin, pain in the head, redness of the face, and urgent thirst. When the throat is examined, which is often difficult in consequence of the pain occasioned by depressing the lower jaw, one or both tonsils, and the arch of the palate and uvula appear swollen, and the membrane covering them is of a bright scarlet or deep red colour, with masses of lymph appearing here and there on its surface.

Inflammation of the tonsils terminates either in resolution or in suppuration; the former and more favourable result may be spontaneous, or the result of the treatment employed.

When the disease does not yield to the measures pursued with the view of affecting resolution, suppuration will most probably be the consequence. The formation of purulent matter in the tonsils is announced by the pain of the early or acute stage becoming gradually more dull or obtuse, though from the increased tumefaction of the tonsils the difficulty of swallowing and of breathing is more considerable, and by the peculiar sound of the voice. As the abscess increases in size, the patient is often unable to speak, and can only make himself understood by signs or by writing. If the throat be examined at this stage of the disease by means of the finger, the existence of matter is placed beyond a doubt, by the evidence of fluctuation in the tonsil, or even by the pointing of the abscess, which at length bursts sometimes when the patient is asleep, or when some effort is making either to dislodge from the throat the viscid mucus, or in the act of coughing or of retching. The pus is always fetid, and the fetor is often the only announcement of the bursting of the abscess. Some writers allude to cases in which those abscesses have pointed and discharged by an opening in the neck: we have never seen an instance of this kind.

The progress of the inflammation is not always the same in both tonsils; sometimes an abscess forms in both, though more frequently only in one, the inflammation in the other terminating in resolution. Inflammation of the tonsils always leaves a great susceptibility to future attacks: these recurrences generally observe a similar progress, though there is sometimes great difference,—the symptoms and termination varying with each attack. When, however, the inflammation of the tonsils has ended in abscess, the most energetic treatment is often inadequate to prevent the same termination; indeed, we have so repeatedly witnessed the rapidity with which under such circumstances, the inflammation has terminated in suppuration, and the inefficacy of the most prompt adoption of antiphlogistic treatment at the onset of the disease, that we commonly at once pursue the measures which are calculated to promote the process of suppuration.

Another circumstance to be noticed is, that although, in general, after the disease has subsided, the tonsils resume their natural size, and thus leave no trace of previous inflammation, still, in some cases, these bodies remain for a long time enlarged, accompanied with chronic inflammation of the investing mucous membrane and relaxation of the velum and uvula.

The termination of tonsillitis in gangrene is exceedingly rare. Guersent has met with two cases, both of which proved fatal, though the gangrenous inflammation in both was only a concomitant of more serious disease. In one, the affec-

tion assumed the ordinary characters of severe inflammation of the tonsils, which appeared to be materially relieved by antiphlogistic treatment; soon afterwards, however, the tonsils and surrounding parts assumed a livid colour, accompanied with a gangrenous odour, and a secretion from the throat which resembled the lees of wine. Death took place on the seventeenth day. On examining the body, the tonsils and soft palate were softened and disorganized, and of a black or dark grey colour. One portion of the right lung exhibited a similar appearance and gangrenous odour. In the other case, the tonsils appeared very slightly inflamed at first, but in three or four days, they assumed a brown colour, the breath emitted a gangrenous smell, and when an incision was made into them no pain was felt. The strength declined gradually, vomiting came on, and though there was very little febrile disturbance, the patient died in consequence of intense gastro-enteritis of a low or adynamic form, (*gastro-entérite adynamique.*) On dissection the mucous membrane of the stomach and portion of the small intestine was found of a bright red colour; that of the stomach was covered with a false membrane, white, soft, and elastic.

Treatment.—In the early stage of tonsillitis the treatment is in general a matter of no great difficulty. If the local symptoms be severe and accompanied with smart symptomatic fever, there can be no question as to the necessity for general bloodletting to an extent which the symptoms demand. In the more mild forms, however, employment of the lancet may be dispensed with, the local abstraction of blood being in general sufficient: indeed in all cases, whether the constitutional excitement demand the general detraction of blood or not, the local symptoms are much benefited by the application of leeches under the jaw, or by cupping behind the ears or on the back of the neck, which latter mode has the great advantage of abstracting more rapidly and powerfully from the seat of the disease. We have seen great relief from scarifying the tonsils. This operation, however, should never be performed with a common lancet, but with an instrument constructed for the purpose, and furnished with a silver canula, which admits of the lancet being protruded to a regulated extent, so that if the patient make an unexpected motion of the head, no injury may follow.

After general or local bloodletting, the patient should be freely purged by any of the ordinary active cathartics, but especially the saline, dissolved in infusion of senna. Calomel should be avoided from the possibility of its producing salivation, which always proves a most distressing addition to the sufferings of the individual.

If there be considerable dry heat of skin with thirst, any of the common saline remedies,—solution of the nitrate of potash, the citrate of potash or ammonia,—with the addition of ipecacuanha or antimonial wine, may be advantageously given, the patient being at the same time kept cool, and, in short, treated on general antiphlogistic principles.

[Recently, the free use of pulvis ipecacuanhæ et opii, aided by warm diluents, has been strongly recommended by Dr. Christison, (*Dispensatory*, Edinb. 1842,) with the view of cutting short this phlegmasia as well as others.]

With regard to the local treatment, the inhalation of the vapour arising from hot water, to which the solution of the acetate of ammonia or even the acetous acid is added, should be frequently employed. Some practitioners prefer the use of astringent gargles, such as the compound infusion of roses acidulated with diluted sulphuric acid, or of a gargle composed of one part of the solution of acetate of ammonia and of rectified spirit of wine, and four of distilled water. In our own experience we have always observed greater benefit from the inhalation of the vapour of hot water, which can be most easily employed by Mudge's inhaler, the flexible tube of which is furnished with a valvular apparatus on the same principle as the poison syringe invented by Read.

If these measures prove ineffectual in subduing the inflammation of the tonsils, it is probable that it will terminate in suppuration, which is announced by an increase in the local symptoms, and especially by the evidence of fluctuation,—a soft tumour being generally perceptible when the tonsil is examined by the finger. The object is then to promote this termination by the application of emollient poultices, and by the diligent application of the vapour of warm water. If the abscess be large and threaten suffocation, or even if it should prove an impediment to respiration, it may become expedient to open it, though such an operation is only necessary under circumstances of extreme suffering and danger, as the abscess generally bursts spontaneously and the patient is speedily relieved.

In cases of impending suffocation it may be necessary to make an opening into the larynx. Such extreme cases are happily of rare occurrence.

2. Hypertrophy of the Tonsils.—We have alluded to this disease as the effect of repeated attacks of inflammation of the tonsils: it is, however, in some instances congenital, and occasionally appears to be hereditary, and in such individuals it is often associated with traces of the strumous diathesis. The enlargement generally exists without induration of the tonsil, more especially when it occurs in young persons: when it arises as a consequence of inflammation, and more particularly in elderly people, the enlargement is generally accompanied by induration. This state of the tonsils has been often pronounced to be *scirrhous degeneration*, though the tonsils appear to be remarkably exempt from scirrhous disease; it is, therefore, more consistent with pathological anatomy to ascribe those cases of supposed scirrhus of the tonsils to hypertrophy and induration alone.

Hypertrophy of the tonsils is a troublesome affection; impeding deglutition and often the breathing, and altering materially the sound of the voice. It also gives rise to inflammation of the mucous membrane of the throat, and thus renders the individual liable to constant sore throat, forming, as Andral states, an instance of the development of a tissue beneath a mucous membrane being a cause, instead of an effect of an acute or chronic irritation of that membrane.

The treatment of this affection is chiefly local,

and consists in endeavouring to reduce the size of the tumour by gargles composed of the more powerful astringents, — infusions of oak-bark or galls with the sulphate of alum, or the infusion of catechu with the tincture of kino. These, however, are seldom of much use. Iodine has been administered both internally and externally, though with uncertain success. The various counter-irritants have also been applied externally,—repeated blisters, the tartar-emetic ointment, &c. All these remedies are, however, in most instances ineffectual in reducing the size of the tonsils, so that it becomes at length necessary to have recourse to the excision of the projecting portion of the diseased growth.

[Dr. Isaac Parrish, of Philadelphia, (*Quarterly Summary of the Transactions of the College of Physicians of Philad.* Nov. and Dec. 1841, and Jan. 1842,) has observed a peculiar change of the voice induced in two cases by the excision of the tonsils. The voice was rendered shrill and whistling, indicating the influence exerted upon the function by a special modification of the vocal tube.]

3. **Disease of the Follicles of the Tonsils.** —Besides inflammation of the follicles and the cellular tissue in which they are imbedded, (*tonsillitis,*) the follicles themselves, as well as their lacunæ or orifices and the fluid contained in their cavities, are liable to alteration. The follicles in this situation are subject to the same diseases as those in other mucous membranes,—namely, inflammation, enlargement, induration, or softening. The fluid which they secrete may be converted into pus, or into a peculiar concrete substance resembling in consistence tuberculous matter, or into a calculous concretion, varying in size from a millet-seed to that of a garden-pea, or even larger. These various morbid secretions may be contained in a single dilated orifice, or in a cavity formed by the union of several lacunæ. The fatty masses which are secreted by the follicles of the tonsils and pharynx, often in considerable quantity in persons in full health, have a general resemblance in colour and consistence to the granules of phthisical expectoration. From these latter, however, they may be at once distinguished by heating the substance on paper; if the secretion be derived from the follicles of the pharynx or tonsils, it is sebaceous and leaves a greasy stain on the paper, which is not the case with pulmonary or tubercular granules.

[*Follicular Pharyngitis* has not generally been described in pathological or therapeutical works, yet it is by no means uncommon. The writer has seen many cases of it; and it is very frequently presumed to be an affection of more dangerous import than it really is. Many of the cases of what has been called *Clergyman's Sore Throat*, which have fallen under his care, have been of this affection. It has been recently described by Dr. Popken, under the name *Tubercles of the Larynx and Fauces;* but he at the same time remarks, that he gives the name at the risk of its being objected to, inasmuch as the disease does not consist of true tubercles, but only of diseased mucous follicles.

Follicular pharyngitis is first indicated by huskiness of the voice, with more or less coughing and hawking, so that the disease appears to involve the respiratory, rather than the digestive organs—especially as there is often little or no pain on deglutition. Should, however, uneasiness of the throat suggest an inspection, the appearances are such as cannot be mistaken. The follicles of the isthmus of the fauces and the pharynx are observed to be unusually apparent, so that the mucous membrane seems to be studded with granulations, varying in size, from a pin's head to a pea. The larger bodies frequently have the appearance of a split pea, and of crypts or follicles distended with a semi-fluid substance.

The disease is apt to persist for a long time, even for years, and to give occasion to more or less irritation of the larynx, as indicated by coughing and hawking; but still the general health may remain unaffected, unless the affection should exist also in the larynx, when it may, by irritation, in one of tuberculous predisposition, occasion the formation or development of tubercles of the lungs. It generally occurs in young subjects, rarely before puberty, or in advanced life, and, it is affirmed by Dr. Popken, chiefly in the male sex. He remarks, that he never could trace any connection between this form of pharyngitis and any constitutional chronic disease, as syphilis, or scrofula; and that he has so rarely found it coincident with other local affections, and especially with those of the lungs, that, in a doubtful diagnosis, he rather regards the disease in the throat as a sign that there is not a vomica in the lungs. Certainly, in the cases that have fallen under the author's care, there was no chronic pulmonary disease.

The writer has always regarded the affection to consist in an accumulation of mucus in the follicles of the throat, similar to that which takes place in the congenerous sebaceous follicles of the skin in acne; and in a case, which he saw with his friend Professor R. M. Huston, the enlarged follicles presented all the appearances of acne punctata. Occasionally the follicles break, and discharge small masses of an elastic matter, which is often the source of much anxiety to the patient, causing him to apprehend serious pulmonary mischief. Sometimes ulceration succeeds, which may be defined or irregular, and is often surrounded by a vivid red inflammation. This may continue for a long time when the tone of the constitution is impaired, or some scrofulous or other *vice* exists.

The local remedies to be recommended in follicular inflammation are the same as those advised in other forms of sluggish phlegmasia of the mucous membrane of the pharynx. A solution of the nitrate of silver, or a creasote lotion, with the application of croton oil to the exterior of the throat, comprise the local means that are most beneficial. Time, however, is an element in the cure, as the disease is essentially chronic in its character. It is advisable, too, to keep the throat warm. This may be done, in the female, by wearing flannel around the throat, and in the male in the same manner, or by permitting the hair to grow around the neck. A nutritious, but not stimulating diet, and the administration of aromatic and tonic medicines, such as ammoniacum and myrrh, or myrrh, extract of bark, and sulphate of iron, has been recommended; but the

writer has not observed much effect from such agents. Like acne of the face, it is often, indeed, but little under the influence of medicine; and even change of air and the use of therapeutical agents, that essentially modify the system of nutrition, are of but limited efficacy. The parts, however, gradually become accustomed to the presence of the enlarged follicles, so that little or no irritation is ultimately induced by them. In process of time, too, they may be gradually diminished by absorption; yet in one case that was subjected for years to the treatment mentioned above, the follicles remained almost as large and prominent as at first. They had ceased, however, to excite uneasiness.

In cases of ulceration of the pharynx, it may be necessary to employ a solution of nitrate of silver, or creasote water, or a diluted mineral acid, and, if these fail, solid nitrate of silver. If any *vice*, however, exists in the constitution, it is indispensable that it should be removed by the agents that are appropriate to the particular cachexia. Usually, there is a state of defective, along with disordered, action, which demands the use of tonics, and especially of iodide of iron, for a long period.]

ROBLEY DUNGLISON.

III. VENEREAL AFFECTIONS OF THE THROAT.

The secondary or constitutional symptoms of syphilis are frequently exhibited in the throat, the interval of time between the appearance of the primary and secondary disease varying from six to twelve weeks; sometimes they are visible at a much earlier period, and even before the primary symptoms have disappeared. Indeed some writers affirm, that in some very rare instances, the constitutional symptoms of syphilis have appeared without the occurrence of the local or primary affection.

If the individual escape secondary symptoms three or at most four months after the primary symptoms have been contracted, he may, as a general rule, be considered safe, though there are occasional exceptions. Mr. Lawrence (Lectures on Surgery,) confesses his inability to point out the limit in this respect, — to say what length of time may be considered as absolutely securing a person from a recurrence of the disease. If six or twelve months may elapse between the primary and secondary symptoms, or between two particular attacks, as he had in many instances observed, he does not know why several years may not, — it is a question of experience.

The late Mr. John Pearson considered it a mistaken notion that the syphilitic poison can remain in the system several years without discovering itself; if the patient be imperfectly cured of secondary symptoms, he may have a truce for a considerable length of time, and if on a second, third, or fourth appearance of the disease, mercury be inefficiently administered, the symptoms may be indefinitely protracted. He had never, however, known the disease to lie dormant when no mercury had been used. (MS. Lectures on Syphilis.)

Mr. Bacot, in his Essays on Syphilis, observes on this point, — namely, the time which usually elapses before the secondary affections make their appearance, — that formerly much greater latitude was accorded in this respect than we are now in the habit of allowing, and that within six weeks after the occurrence of primary sores, or even before they are healed, the patient's health will often begin to fail, nocturnal pains come on, and an eruption quickly follows; but this, he believes, chiefly takes place where no mercury has been administered: if that medicine has been employed inadequately, a longer space of time will usually elapse,—from four to six months being by far the most general period.

When the constitutional or secondary symptoms of syphilis occur, they generally appear in a determinate order, the throat, skin, periosteum and bones becoming affected in succession. There is, however, in this supposed and generally-admitted regular succession of symptoms great difference, the disease frequently preying exclusively on one part, and spreading to the contiguous structures without determinate order; and though one of these several affections generally appears alone, we sometimes meet with a combination, and when this happens, there is more commonly ulceration of the throat with some form of cutaneous eruption. Ulceration of the throat may also succeed to gonorrhœa, though such cases are uncommon.

1. **Syphilitic Ulceration of the Throat.**— This form of ulceration of the throat is usually preceded by feverish indisposition, loss of flesh, and peculiar expression of the countenance. There is often considerable pain of the limbs, with lassitude, soreness of the throat, more or less pain and difficulty in swallowing. The ulceration is most frequently seated in the tonsils, of which there are three forms which have been well described by Mr. Bacot.

The first is the excavated ulcer of the tonsil, which exhibits the appearance of a deep hollow, as if a portion of its substance had been scooped out; the base is covered with a dirty ash-coloured pellicle, the margin is a litttle tumid and red, but there is little or no pain, only stiffness and uneasiness in swallowing. Mr. Bacot has found this more frequently as a solitary symptom than any other form of ulceration about the throat, though it is occasionally met with in conjunction with cutaneous eruption, as well as by iritis. He differs with Mr. Carmichael, who believes this sore to be only met with in combination with what he calls the true scaly venereal disease. It is very easily cured by mercury, which in general produces the most obvious effect upon its appearance as soon as the constitution feels its influence; nay, the local action of a mercurial gargle will often effect a rapid change in the face of the ulcer. There is seldom necessity for any local application, but if the ulceration make a rapid progress, Mr. Bacot recommends a gargle composed of the corrosive sublimate, in the proportion of one grain to six ounces of water or mucilage of quince-seed. The cure of this affection of the throat cannot be effected in less than six weeks, and if it occur in combination with a papular, or a small elevated tubercular eruption, a longer mercurial course may be required, for until desquamation has taken place in the former instance, or perfect cicatrization in the second, the patient cannot be considered safe. To ensure the full action of mercury, he advises the inunction of the strong mercurial ointment in

preference to the internal administration of the remedy. One drachm should be rubbed on the thighs night and morning for the first few days, diminishing this to one half the quantity when the gums become affected.

A more common form of syphilitic ulceration of the throat is that which is found to occur with papular eruptions on the shoulders, arms, and body, and which may occasionally occur as a solitary symptom. This form of ulcer also occurs most generally in the tonsils, but differs from the preceding in being neither large nor deep, but the edges are often irregular and indented, and lined apparently with coagulable lymph. The ulcerations sometimes appear like a mere fissure, and are generally, if not always, situated at the sides or on the posterior surface of the tonsils; in the latter case, the edge only can be seen. The tonsils are much enlarged, and of a deeper red than ordinary. In many cases the uvula partakes of the disease; it is enlarged and redder than usual, and has a stripe or two of ash-coloured appearance, as if the part had been touched with lunar caustic. The propagation of the ulceration to the uvula is to be considered, however, as by no means common. This form is attended with so little inconvenience, that the patient seldom complains of pain or difficulty of swallowing, often not until the question is put by his medical attendant.

A third form is the phagedenic ulceration of the throat, which is more formidable than either of the preceding. It is characterized by the more severe symptomatic fever, and great pain in swallowing from the beginning; in short, the general and local symptoms denote that the ulceration is accompanied by acute inflammation of the throat. It generally commences by a small aphthous spot upon the soft palate, surrounded by a deep erysipelatous redness, and proceeds rapidly to involve the neighbouring parts, until the uvula, the arch of the palate, and tonsils become involved in one slough. It is often met with in a milder degree, but the great constitutional disturbance, the acute inflammation of the throat, and the insomnolence, at once distinguish it from the preceding forms. Mr. Bacot is inclined to think that it is connected with the peculiar habit of body of the individual, and though it is generally the consequence of the small aphthous sore he has twice traced the symptoms to virulent gonorrhœa.

This form requires the early adoption of active antiphlogistic treatment to prevent the disease involving the palatine and nasal bones, and terminating in exfoliation and consequent deformity. Blood must be taken from the arm, and from the neighbourhood of the throat by leeches, the bowels freely evacuated by purgatives, and nauseating doses of the tartarized antimony exhibited. Mr. Bacot recommends as a local application to the throat, the inhalation of the steam of hot vinegar and water, or a gargle consisting of a scruple of acetate of lead dissolved in half a pint of water, By the adoption of these means, the pain, redness, and swelling of the throat generally subside in the course of two or three days, the fever abates, and the ulceration assumes a clean healthy aspect. Mercury always exasperates phagedenic ulceration, whether primary or secondary, and must therefore be suspended, until the inflammation of the throat be subdued. It may then be given, not only with safety, but is indispensably necessary to destroy the syphilitic virus; for, though in Mr. Bacot's opinion the disease may be cured without one particle of mercury, yet it is only smothered, and after the lapse of a few months will become re-established upon the very spot where it originally appeared, and will thus continue to get well and break out again, until bone becomes implicated in the disease, and then, whatever plan of treatment be adopted, the bone must come away and deformity ensue. It is therefore expedient, when the parts are healing and the system perfectly tranquillized, to have recourse to mercury in the form of the Plummer's pill, every night, with a pint of the decoction (or half an ounce of the fluid extract) of sarsaparilla during the day: if the remedy agree with the constitution, as it generally does, the quantity of mercury may be increased, so as to keep up an affection of the mouth for six or eight weeks. Mr. Bacot advises the course to be finished by mercurial inunction, and that the patient, during the exhibition of the mercury, be confined to the house, unless the process be going on at a season of the year, or under other circumstances, that will not forbid gentle exercise.

This treatment of course applies to the acute forms of sloughing phagedena of the throat occurring in young plethoric subjects. When, however, it occurs in individuals whose constitution is enfeebled by poverty, intemperance, or a dissolute mode of life, the active treatment just pointed out cannot be pursued. More benefit will be derived from the administration of sarsaparilla conjoined with quinine or nitrous acid, and liberal doses of opium, the best preparation of which is the muriate of morphia, while the sloughing of the throat is arrested by fumigation with the red sulphuret of mercury, of which half a drachm to a drachm may be employed once or twice a day, until the phagedenic ulceration be checked. If there be much pain, the vapour arising from an infusion of some of the narcotic plants—cicuta or hyoscyamus—may be advantageously combined.

2. **Syphilitic Ulceration of the Larynx.**—When syphilis affects the throat, the ulceration may spread to the epiglottis, rima glottidis, and even to the larynx, and sometimes necrosis or partial death of the cartilages is the consequence. It is fortunate, however, that the extension of the syphilitic poison to the larynx is comparatively rare: when it does occur, it is very generally ultimately fatal. The symptoms are those of laryngitis, pain at the top of the larynx, especially on deglutition, irritating cough, hoarseness or loss of voice, with emaciation. The previous history of the case will materially assist the diagnosis of this affection.

It is little under the control of treatment, but such measures as are calculated to remove chronic laryngitis give the most essential relief,—viz. local bleeding, counter-irritation, calomel and opium, with the inhalation of the vapour arising from decoctions of narcotic plants, as hyoscyamus or conium; the dyspnœa, however, is often so alarming as to threaten suffocation, so that the attempt to apply any form of inhalation is nearly impossible.

Should œdema of the glottis supervene, in consequence of the extension of the inflammation of the mucous membrane surrounding the laryngeal ulceration to the epiglottis, the patient can only be saved by making an opening into the trachea below the seat of the disease.

3. Gonorrhœal Ulceration of the Throat.—Constitutional symptoms resembling the syphilitic occasionally arise after gonorrhœa. By far the larger number of cases of gonorrhœa are not followed by any syphiloid symptoms, though it appears that in some rare instances, secondary symptoms do follow from gonorrhœal discharge. The most common form of constitutional symptoms from this source is ulceration of the tonsils; and eruptions very similar to those which are deemed syphilitic, and even nodes on the cranium and tibia, and pain in the extremities, sometimes accompany or succeed to the affection of the throat. The ulceration of the throat, when it succeeds to gonorrhœa, is not confined to the tonsils, but often extends to the velum and uvula. When mercury is administered, the symptoms often give way very speedily, but the ulceration soon reappears; and if mercury be again resorted to, caries of the bones of the palate and nose will probably take place.

The affection of the throat is to be treated by the exhibition of sarsaparilla; to which, if the powers of the patient be feeble, quinine should be added. The warm bath is decidedly useful, and may be employed every second or third night. Mercury often produces a rapid and favourable aspect in the appearance of the ulceration, which often heals under its use in three or four days, but it soon makes its appearance again, and generally in an aggravated form. Though the full action of this mineral be decidedly injurious in the gonorrhœal sore throat, alterative doses are attended with decidedly good effects. A compound calomel pill may, therefore, be given every second night, or the eighth of a grain of corrosive sublimate three times a day, in addition to the sarsaparilla.

The throat may be washed with a gargle containing the corrosive sublimate in the proportion of one grain to eight ounces of a mucilaginous vehicle. It may, also, be occasionally touched with the muriated tincture of iron, or the linimentum æruginis.

A light nourishing diet, composed partly of milk, with regulation of the bowels, should be adopted. In very mild cases the gonorrhœal sore throat heals and disappears without treatment.

4. Mercurial Ulceration of the Throat.—When mercury is first administered to persons of a feeble constitution, especially females, it sometimes induces erysipelatous inflammation of the throat, which is generally, though not invariably, accompanied with superficial ulceration of the tonsils or uvula, sometimes extending over the entire palate. When this occurs, the mercury must be immediately suspended, and the quinine with acids, and nourishment, or even wine, if the system require it, administered. The throat should be washed with a weak solution of alum, or touched with the muriated tincture of iron. It will be necessary, at the same time, to purge the patient, to administer antimonial preparations and to enjoin abstinence and confinement to the room The sarsaparilla is, in such cases, a valuable auxiliary to the other measures. The affection will generally yield to this plan of treatment in a few days; after which the mercury may be resumed without the same effects being produced; giving an illustration of another disease being induced by mercury, and when this supervenient disease is removed, of the syphilitic virus again coming into action, and being cured by the very remedy (mercury) which produced the former disease.

A. Tweedie.

TINEA.—[See Porrigo.]

TISSUE, ADVENTITIOUS.—This term, which is synonymous with *accidental tissue*, has been applied to morbid productions in general, whether they be entirely new formations, or resemble any of the natural tissues of the body. The term itself is highly objectionable, as it includes several formations which are not organized; but as it is still retained by many pathologists, we are not disposed to invent another, so long as it is generally understood. The numerous and important diseases included under this term may be conceived, when it is considered that it comprehends the whole range of morbid productions, in fact, of the science of morbid anatomy. A dissertation on this subject, therefore, ought to embrace the consideration of the most important parts of pathological anatomy, and however desirable a general article embracing the various considerations of the causes, theory of formation, progress, and termination of morbid structure might be, so much space has been already devoted to this subject in the general pathological articles in this work, that we think a more extended disquisition in this place unnecessary.

Attempts have been made to classify or arrange the various forms of adventitious or accidental productions, but hitherto with little success. This has arisen, in some measure, from the obscurity of their origin, the different characters they assume according to the tissue in which they originate, and the various appearances they exhibit in their progress.

They may be arranged, first, into such as are the effect of irritation, congestion, or inflammation: to this class belong the tissues of which callus, granulations, and cicatrices are composed; cellular, fibrous, fibro-cartilaginous, cartilaginous, and osseous tissues; serous membranes of cysts, mucous membranes of fistulous passages, and accidental synovial membranes. Another division comprehends those which are benign, such as the Colloid or Gelatiniform Matter of Laennec, melicerous, and encysted tumours, Tubercle, Cirrhose, &c. and those which are malignant, scirrhoid or hard Cancer, encephaloid or soft Cancer, and the fungoid or bleeding Cancer, and Melanosis. Some of the latter are encysted, others non-encysted.

A third class includes those morbid productions in which one tissue is metamorphosed, transformed, or converted into another. The transformations thus produced are the serous, cellular, mucous, vascular, including the erectile tissue, fibrous, cartilaginous, and osseous transformations.

For ample details on these various subjects, we beg to refer to the several pathological articles in

the work, and for information on the transformation of tissues to the article TRANSFORMATIONS.

TONICS, (τονικὰ, from τόνος, *tension, tone.*)—Tonics are medicinal agents that restore the sound and healthy elasticity, the strength and the vigour of the body when it is weakened and relaxed.

When an individual is in good health, and in vigour of body, the muscles or moving organs feel firm and tense; they act regularly and powerfully, and there is that voluntary reaction or state of extension between antagonist muscles, as Galen has justly remarked, by which they are removed from a modification of rest, and in which the one yields to the other, not from debility, but in the precise ratio of the power exercised over it; and this whether the muscles are involuntary, or those under the control of the will. This is a state of *healthful tone.* On the contrary, when the muscles feel soft and flabby, when the action of the involuntary is languid and the voluntary do not rapidly respond to the will; when there is a strong inclination for rest and indulgence; and when the movements of the body or its parts are performed with difficulty, this is a state of *deficient tone* or *debility.* That both these states are connected with the condition of the muscular fibre, may be demonstrated by detaching a muscle from the bodies of two animals, in those opposite conditions, and ascertaining its strength by appending weights to it; the muscle taken from the healthy animal, or that in a state of *tone,* will sustain a much greater weight than that which is in the opposite condition. Hence, to a certain extent, *tone* implies a difference in the mechanical condition of muscles, a greater degree of density and cohesion of their ultimate component fibrils; but this must be also joined with elasticity, that is, the power of resisting extension to a certain degree, and of restoring the previous condition, when the extending cause is removed, before the muscles can be said to be in the state of perfect tone. That this state is truly the result of vital energy is evident; for the same muscle, after a short time has elapsed, loses the power of sustaining the weight which it at first supported; and this in proportion to the distance of time from that of its separation from the living body.

Medicines, or medicinal agents which produce this state of healthful tone, and renew and maintain the tension and vigour of the muscular fibre, are thence denominated tonics. They do not act in an obvious or appreciable manner on the healthy body; but their influence is powerfully displayed in its relaxed or debilitated condition. They act on the vital principle through the medium of the nerves; and, as far as their mode of operating is understood, they may be regarded as excitants. But it is undoubted that the excitement which is the result of the action of stimulants is always followed by proportional languor or collapse: how then, it may be reasonably inquired, can those substances which produce a permanent effect on the vital energy be regarded as excitants? Are we to suppose that the difference caused by general excitants, when they produce a tonic effect, depends on a state of the parts? If not, to what are we to attribute this diversity of effect from causes which are similar? It is difficult to reply to these questions; and we can only affirm, that there appears to be something in the nature of the stimulus, which regulates both the extent and the energy of its action; and, according to the degree of its powers in these respects, the effect which it produces is more or less transitory. If the nature of the medicine or agent be such as to induce a sudden and high state of excitement, it is as quickly followed by collapse; and the changes resulting in both states are sufficiently obvious. The agent in this case is a simple excitant. But when the nature of the medicine is such that the excitement is slowly induced on the tissue to which it is applied, and very gradually extended to other parts; when the consequent exhaustion is scarcely obvious; and when the stimulus is renewed before this is complete, the impression becomes in a certain degree permanent; and consequently there is a gradual abatement of exhaustion; while at the same time the increased vigour, which is the result of the action induced, remains: then the agent which thus operates is a tonic. Still we must admit that there is merely a modification of the same action in both these cases: if the dose of the stimulant be so reduced that the effect is slight, and it be repeated at short intervals, then the ultimate effect will be tonic: on the contrary, if the administration of the tonic be carried to excess, it will exhaust the powers of the system; and, if administered in a state of excitement, its effects will be as injurious as those of a direct stimulant. We are therefore authorized in regarding tonics as excitants, permanent in their effects, because gradual and moderate in their operation.

[In the administration, however, of tonics in disease, it is very important to bear in mind the difference between them and excitants proper; inasmuch as the former may be given—if not with advantage—at least with impunity in many cases where the latter would be decidedly injurious. In all cases, perhaps, the tonic makes its impression on the nervous system, and, as the writer has said elsewhere, (*General Therapeutics and Materia Medica*, p. 17, Philad. 1843), there does not appear to be any satisfactory reason for believing, that tonics, "like every other class of medicines, are endowed with some properties peculiar and destructive, among the most conspicuous of which is their specific affinity to the muscular fibre," (Chapman, *Elements of Therapeutics and Materia Medica*, 6th edit. ii. 256, Philad. 1831.)]

Nature of Tonics.—Tonic agents are both mental and material. With regard to the first, experience has demonstrated that *confidence* and hope are powerful tonics. Every practitioner who has had many years' experience knows well the paramount importance of confidence in the treatment of diseases, and the great advantages derived by gaining ascendancy over the mind of a patient. In the same manner, *hope* operates as a powerful tonic. Deprive a patient of this solace, even after his disease is removed and debility alone remains, and there can be no solid assurance of his recovery to perfect health; inspire him with the hope that his recovery is certain, and the prognostic will seldom fail to be realized. It is much easier to demonstrate the power of these mental agents, than to explain their mode of action: the limits

of this article will not permit us to enter upon the subject.

With regard to the second set of tonic agents, or material substances, some writers* have maintained that *bitterness* is essential to all tonics, or, in other words, is the tonic principle; others (*Barbier, &c.*) that tone is the result of the influence of three distinct matters, — namely, *extractive, tannin*, and *gallic* acid; and others, that it is produced by an alkaline or azotized principle. But it does not appear that *bitterness*, or any single quality of matter, can alone be regarded as productive of tone. It is, it is true, a quality of almost all vegetable tonics; but many substances which are simple bitters, such as quassia, display less tonic influence than those which possess both an aromatic and a bitter quality. Bitters alone scarcely affect the force of the circulation; aromatics operate in too transitory a manner, and stimulate too powerfully; but in combination each aids the other, and, indeed, the most powerful vegetable tonics contain these two qualities conjoined. It is by no means, however, a tenable position that bitterness is essential even to vegetable tonics; for example — pure tannin, which possesses considerable corroborant powers, contains little or none of this principle; and it is even less tenable that nitrate of silver and some other metallic salts are indebted to their bitterness for the tonic powers which they possess, as asserted by the justly distinguished author of the Pharmacologia.

With regard to *extractive, tannic*, and *gallic acids*, the first substance, although existing in large quantity in all vegetable tonics, certainly cannot be regarded as alone capable of operating as a tonic. What is usually regarded as extractive is a brittle, brown, shining substance, soluble in water and alcohol, but insoluble in ether. When oxydized, it becomes insoluble in water and inert. Extractive certainly has a tonic influence, but it is much modified by circumstances: it is generally in combination with tannin, which also is liable to variation, both in its characters and in its powers; and although it exerts an evident tonic influence on the living solid, yet its effect is more that of an astringent than of a tonic; and the same may be affirmed of gallic acid. If it must therefore be admitted that each of these substances operates as a tonic *per se*, it must also be admitted that they cannot be regarded as tonic principles, because they are not individually or collectively present in all tonics. It is scarcely necessary to make any comment on the opinion which regards tone to be the result of an alkaline or azotized substance; the other principles already mentioned operate as undoubted tonics; and the inference is evident that no single principle can be regarded as the sole cause of tone. This opinion is confirmed by the experiments of Dr. Crawford, who ascertained this curious fact, "that the property of strengthening the intestines and of weakening the skin, is common to all the substances justly celebrated for the cure of intermittent fevers." This power, he found, belongs to ipecacuanha, tartar emetic, muriate of ammonia, gentian root, chamomile flowers, and Peruvian bark. Indeed, when we reflect on the diversity of character and the number of the medicinal agents that produce tonic effects, it is evident that tone is the result of certain impressions on the vital tissues which may be communicated by many substances, and therefore that the hypothesis which refers it to any single principle cannot be maintained.

Action of Tonics.—If a moderate dose of any tonic substance be taken into the stomach, its influence, even upon the organ into which it is introduced, is scarcely perceptible; but on repeating the dose at short intervals, its power in controlling the functions, not only of the stomach itself, but those of the other vital organs of the body, becomes gradually obvious; the appetite is improved, the powers of assimilation are augmented, the secretions altered, and a fresh energy and vigour infused into every part of the system. We proceed to examine in what manner these effects are produced, first on the digestive organs, and afterwards on each of those systems in which we can trace the influence of the agents employed.

1. *On the digestive organs.*—When a vegetable tonic is taken into the stomach, it is first partially digested, and the active matter is thus separated from the inert. This active part then exerts its influence upon the mucous membrane of the stomach, and the bundles of muscular fibres beneath it suffer contraction: the same circumstance occurs through the whole length of the intestinal canal; the coats of the intestines become firmer and more resisting, whilst their cavity is contracted. The primary action, therefore, is upon the stomach and alimentary canal; but a secondary follows it upon the rest of the system. It is scarcely possible to refer the extension of the tonic power to anything but nervous energy; although some of the metallic tonics are absorbed and carried into the circulation, and the vegetable tonics never produce their effects until their active principles are separated by the digestive function, and time is given for their absorption; but admitting that they are carried into the circulation, still the impression which produces their tonic effect must be made on the nervous centres, and it is thus extended over the entire system.

If the stomach is labouring under disease, the action of tonics produces effects which require to be noticed. When the stomach is suffering from relaxation of its coats, a salutary effect follows the administration of tonics; the appetite is awakened, and chymification is favoured. When simple irritation exists, tonics increase the evil: this is manifested by a red, dry tongue, and thirst, pain and fulness of the epigastrium, anxiety, and a strong desire for acidulous and cold fluids. If ulceration of the stomach exist, and this at the cardiac portion, little effect is produced by a tonic; but if it exist at the pylorus, or in the great curvature of the organ, the impression of the tonic is made evident by a sensation of heat and pain which cannot be mistaken. Thus, in cancer of the organ, if ulceration have commenced, tonics cause great uneasiness, morbid secretions, vomitings, heat,

* *Dr. Paris, Dr. Chapman.* [Dr. Thomson has not done these gentlemen justice. Neither of them has expressed the unqualified opinion, which he ascribes to them. Paris, *Pharmacologia*, and Chapman, op. cit.]

and severe lancinating pains. A knowledge of these facts is highly important in a practical point of view.

As appetite and digestion are promoted by the operation of tonics on the stomach itself, it may appear singular that their frequent and long-continued use is generally followed by a loss of tone; but such is really the case.

2. *Upon the Circulating and Respiratory Organs.* — Tonics act upon the heart through its sympathy with the stomach, and also by the absorption of the active principles of the substances employed, so that they can be directly applied to the moving centre and to the coats of the blood-vessels, and thus increase their muscular energy. After the administration of a full dose of a tonic medicine, the pulse is fuller and firmer, but the current of the blood is not accelerated. The tonic strengthens the organs without precipitating their action. This influence of tonics is extended to the capillary system. In a diseased condition of the heart, however, the influence of tonics is hurtful, and extends to other organs. When hypertrophy, for example, of the left ventricle of the heart is present, their employment causes cephalalgia, vertigo, ringing in the ears, and epistaxis, or congestions in the brain; when the right ventricle is the seat of this disease, the use of tonics is often followed by cough, oppressed breathing, and spitting of blood.

In a healthy state of the lungs, no appreciable effect on those organs follows the employment of tonics; but when labouring under disease, the influence of tonic substances on them is conspicuous. In an irritable condition of the lungs they excite cough, a sensation of heat in the chest, and a feeling of anxiety. In an inflammatory state either of the substance or the membranes of the lungs, the intensity of the symptoms is increased, the cough is augmented, and the expectoration suppressed. If tubercles be present, both bitters and astringents augment the cough, increase the general restlessness, and hurry on the fatal issue of the disease. On the other hand, when the lungs have suffered from previous severe disease, but all excitement is over, tonics lessen the force and frequency of the cough and promote expectoration.

3. *Upon the Secerning System.* — It is chiefly upon the renal and subcutaneous glands that tonics exert any influence; but in adding strength to those organs, they do not increase their secreting powers: the action of the glands is maintained in that state which they preserve in health. Tonics produce no marked action on the urinary organs in a state of health, but in disease they invigorate the kidneys and secure their ordinary operation. In an irritable state of these organs, tonics add to the mischief; but in a leucophlegmatic condition, tonics increase the urinary discharge; they enter the circulation and augment the vitality of the kidneys. They also increase the energy of the cutaneous capillaries, and consequently are indicated in cases of great debility accompanied with profuse sweating. In some conditions of the skin, they suppress the perspiratory function, as in some fevers, in which their administration is rapidly followed by a dry burning skin.

4. *On the Muscular System.* — It is upon the muscular system that tonics chiefly display their influence; and they are supposed to act upon it through the medium of the nerves. Every muscle is amply furnished with blood-vessels and nerves, both of motion and of sensation; the latter, it is true, do not appear, "in invisibilem pulpam deliquescere," as Blumenbach expresses himself, and then unite intimately with the muscular tissue; nevertheless any excitant, before it can produce a change in the condition of a muscle, must necessarily act at the same instant on the nerves of the part; and the discoveries of Bellingeri and Sir Charles Bell have satisfactorily demonstrated that no motion can occur in the body without the medium of at least one set of nerves. But the change effected upon muscles by tonics does not augment their contractile power; and, although it strengthens them, yet it does not render them more agile: tonics, therefore, in reference to this system, render a man stronger or more capable of active exertion, but not more active.

It is scarcely necessary to remark that the influence of tonics on the muscular system is much modified by disease.

5. *On the Nervous System.* — On the nervous system tonics operate in two ways:—1. by their direct and topical influence on the nerves of the stomach, which convey the impressions they receive to the brain and spinal cord, and through them to every part of the body: 2. by their active principles being taken into the blood, and carried to the nervous centres. The impressions made in either of these cases do not display any obvious effects on the brain in a healthy condition of the body; but in the opposite state their effects are very striking. Thus in an irritable condition of the encephalon, tonics produce symptoms approaching to those of maniacal excitement, and diffuse over the body an augmented susceptibility to external impressions. If the medullary portion of the spinal cord is morbidly excitable, tonics are apt to induce spasmodic movements; if the theca be inflamed, all the symptoms are augmented; heat, tension, and tenderness are experienced along the course of the spine; and the diseased condition of the part is confirmed.

The effects of tonics upon the general system are never rapidly displayed; but after they have been taken for some time, their influence is obvious by the increased force of the circulation, the greater energy of the digestive organs, the improvement of the secretions, the abatement of nervous susceptibility, and the augmented power in particular which is communicated to the muscular system. The effect of a tonic, when administered under proper circumstances, and when it operates favourably, is, in fact, to place the system in that state which characterizes health; and from the mode by which it produces this effect, the description of diseases in which tonics are indicated is sufficiently obvious: they are evidently those of depressed power.

The chief utility of tonics as medicinal agents is in convalescence, when there is a state of great debility after attacks of acute diseases; but in this condition, the power of tonics is required to be aided by that of moderate excitants; and a combination of bitters and aromatics is found to be more useful than simple tonics.

The view which has been taken of the opera-

tion of this class of medicines enables us to arrange the agents belonging to it into two distinct sub-classes, *material* and *immaterial;* and these again into four orders, namely,—1. *material tonics*, which produce their effects by a direct or primary action on the stomach; 2. *material tonics*, which operate through the medium of the blood; 3. *material tonics*, which influence the body solely through the nerves; 4. *immaterial tonics*, which operate through the mind.

1. The *organic products* which belong to the first of the above orders are alkaloids, resinoids, bitter extractive, tannic and gallic acids, and volatile oil.

a. The alkaloids are the active principles of the tonic barks; the first which we shall notice is,

a. Cinchonia, the active principle of pale cinchona bark, cinchona *lancifolia*, and that also of Angustura bark, cusparia *febrifuga*. In the first of these barks it is combined with kinic, in the second with igasauric acid. It can be readily separated from either; but on account of its insolubility in water, one part requiring two thousand five hundred parts of that fluid at 212° Fahr. for its solution, it is never prescribed except in combination with an acid, and the sulphuric has been found the best adapted for this purpose. It is unnecessary to describe, in this place, the method of procuring *cinchonia* in a pure state: it is a white transparent salt, in needleform crystals unalterable in the air, displaying an alkaline reaction, soluble in alcohol and volatile oils, but only slightly soluble in ether; inodorous, and bitter to the taste. It is a compound of carbon, hydrogen, oxygen, and nitrogen.* The kinic and the igasauric acids, with which it is combined in these barks, have no influence on the animal economy, but they render the cinchonia soluble, and enable this tonic principle of the barks to be taken up both by water and alcohol. There is no reason why the kinate or the igasaurate should not be employed in their separate state; but the *sulphate* is more easily procured, and answers every indication that a tonic can be expected to fulfil.

The sulphate of cinchona is formed by the direct combination of the alkaloid and sulphuric acid. It crystallizes in short, lamellar, truncated prisms, soluble in fifty-four parts of water at 65° Fahr. and six and a half parts of alcohol of sp. gr. 817. With an additional quantity of acid a bisulphate is prepared, which crystallizes in acicular octohedral prisms, soluble in half their weight of cold water, and in an equal weight of alcohol.†

The pale bark, of which cinchonia is the active principle, although designated in the Pharmacopœias as the bark of cinchona *lancifolia*, is probably obtained from several other species of cinchona.‡ That usually preferred in this country is the *bark of Lima*, which appears to consist chiefly of the bark of the cinchona *glandulifera* of Ruiz and Pavon.

[The finest specimen is the *Crown* or *Loxa-bark*, or *Crownbark of Loxa* of commerce, which is referred by the London College to *Cinchona Lancifolia*. It is the *Cinchona Coronæ* of the Edinburgh Pharmacopœia, and appears to be the bark of *Cinchona Condaminea*. Under the name *Loxa Bark*, however, in the United States, are included all the pale barks (Wood & Bache, *Dispensatory of the United States.*)]

Although it is almost inodorous in substance, its infusion and decoction are agreeably aromatic, and moderately bitter and austere, but not disagreeable, to the taste. All infusions and decoctions of astringent vegetables render its infusion, decoction, and tincture turbid, owing to the decomposition of the kinate of cinchona, and the combination of its alkaline base with tannin, (*tannic acid,*) which produces an insoluble, inert, tannate of cinchonia. On this account not only are such vegetable infusions and decoctions incompatible in prescriptions with the preparations of pale bark, but infusion of galls is employed as a test of the goodness of the bark; the quantity of cinchonia being in the direct ratio of the abundance of the precipitate thrown down in the decoction by infusion of galls. In prescribing the fluid preparations of this species of cinchona bark, it should also be remembered that precipitates are produced in them by tartar-emetic, the sulphates of iron and of zinc, the acetates of lead, hydriodate of iron, the carbonates of the alkalies, and the tinctures and salts of opium; but these precipitates do not render the cinchonia inert as the infusion of galls does, and by many of them it is not precipitated. With muriate of baryta no obvious change takes place, although that salt and also the kinate of cinchonia are decomposed; but both the muriate and the kinate of cinchonia which result are soluble salts. When sulphuric acid is added to the infusion or decoction of pale cinchona, the kinate of cinchonia is changed into the sulphate, and the alkaloid in this state being more completely separated from the other components of the bark, it is advisable to acidulate with this acid the water to be employed for making these preparations. The simple tincture of bark is an alcoholic solution of the kinate, tannin, and colouring matter, and, consequently, it is a useful preparation in cases in which alcohol is admissible: the compound tincture is more stimulant than the simple, on account of the aromatics which it contains; but the ammoniated tincture is at least of doubtful efficacy, as far as concerns the cinchonia, as much of this salt is precipitated by the volatile alkali. The best preparation of this bark is the resinous extract of the London College; it consists of the kinate in the same combination as in the simple tincture, without the alcohol, and in a more concentrated state.

The Angustura or cusparia bark, besides cinchonia in combination with igasauric acid,§ as an igasaurate, contains an acrid volatile oleoresin, gum, extractive and muriate of ammonia, and traces of brucia: thence it is more excitant than

*The proportions are 20 equiv. of carbon=122.4+12 hydrogen=12+1 nitrogen=14.15+1 oxygen=8, making the equivalent of the salt 156.55.

†The sulphate consists of 156.55 parts or 1 equivalent of cinchonia+40 1 or 1 of sulphuric acid+36 or 4 of water, making the equivalent of the salt 242.55; the composition of the bisulphate is 67.241 of cinchonia+17.241 of acid+15.518 of water,=100.

‡Cinchona *nitida*, C. *hirsuta*, C. *scrobiculata* of Humboldt, and C. *glandulifera* of Ruiz and Pavon also yield pale bark.

§This acid is characterized chiefly by affording a pea-green precipitate with ammoniated sulphate of copper; it exerts no obvious influence on the animal system.

pale bark, in whatever form it is prescribed.* Owing to the acid which it contains, and the absence of tannic and gallic acids, the infusion does not precipitate tartar-emetic and gelatine; whilst with nitric acid a precipitate of a lemon yellow colour is slowly produced, but it is affected by all the other substances that precipitate the preparation of pale cinchona bark. The dose of the cusparia bark in the form of powder is from gr. x. to ℥ss.

Quinia, another alkaloid, the active principle of the yellow cinchona bark [*Calisagabark*], the cinchona *cordifolia* of the Pharmacopœias [of London; but the precise species that yields it is unascertained,] differs from cinchonia in not being crystallizable when uncombined with an acid, and very soluble in ether. In other respects it resembles cinchonia in its chemical properties,† and, like it, combines with two distinct proportions of sulphuric acid, forming a sulphate and a bisulphate.‡ The former salt is procured in pure white silky needleform crystals, which effloresce in the air, and require seventy-four parts of water at 60° Fahr., and thirty parts of boilingwater for their solution. The bisulphate crystallizes in quadrangular compressed prisms, generally truncated, soluble in eleven parts of water at 60°, and in nearly the same proportion in diluted spirit, but scarcely soluble in strong alcohol. On account of its greater solubility, the bisulphate is preferable in composition to the neutral sulphate, which is generally imperfectly converted into it by acidulating the mixture containing it with diluted sulphuric acid. These sulphates are precipitated from their aqueous solutions by the infusions of all astringent vegetables and lime-water: with acetate of lead, an insoluble sulphate of lead is thrown down, and an acetate of quinia remains in solution, which is a less irritating preparation than the sulphate, and may, consequently, often supersede it with advantage. No change is produced on either of the sulphates by the salts, a practical advantage of considerable importance.

The yellow cinchona bark is more bitter, but less austere to the taste than the pale bark; besides an acidulous kinate of quinia, it contains a small proportion of kinate of cinchonia, kinate of lime, a fatty matter, tannin, a red insoluble colouring matter which precipitates in the decoction as it cools, a yellow colouring matter, and fecula. The same substances which affect the infusion and decoction of pale bark also cause precipitates in those of the yellow, and are consequently incompatible in prescriptions with its preparations.

In the red bark, the cinchona *oblongifolia* of the Pharmacopœias [of London and Dublin; but the botanical origin appears to be unknown,] both the kinates which we have described are contained in almost equal proportions. It is more acidulous than either the pale or the yellow bark, and it seems to contain more tannin, and probably some free gallic acid, as its secretion strikes a deep blue-black with persulphate of iron. Its astringency and stimulant properties exceed those of the two other officinal species of cinchona bark.

These alkaloids, whether in a separate state or in combination in the barks which yield them, are powerful tonics and antiperiodics. When they are received into the stomach, they operate topically upon its tissue, causing often a slight sensation of weight and uneasiness in the organ, dryness in the mouth, and an evident excitement in every part of the system; effects which differ from those caused by stimulants only in degree and in their permanency. It is to this sustained influence that we must ascribe their power of changing diseased into healthy action; and this does not seem to depend so much on the absorption of the alkaloids as on the impression which they make on the digestive organs being communicated by nervous sympathy to the rest of the system, and in part on the more perfect chymification which is the necessary result of the invigorated state of the stomach. In prescribing, therefore, either the cinchona or the cusparia bark, or the salts of their alkaloids, the topical effects which they produce point out the necessity of directing our attention to the state of the stomach and intestines before prescribing them, and of not administering them internally when these important organs are in a morbidly irritable condition. They are not, however, contraindicated on this account when they are introduced into the system either, according to M. Pointe's method, by rubbing them in fine powder upon the gums, until the whole is absorbed, cautioning the patient not to swallow the saliva; or, as Signor Broglia dal Perseco has proposed, by sprinkling them in fine powder upon blistered surfaces. The writer of this article has seen the first of these methods followed by the most beneficial results.

With respect to the question at one time much agitated respecting the period of fever in which cinchona bark ought to be prescribed, there still exists much diversity of opinion; but, notwithstanding the authority of Dr. Clarke of Newcastle, and Dr. Heberden, few practitioners in the present day venture to prescribe it at every period of the disease, or until a decided intermittent character be obvious, under which circumstances these barks and their alkaloids seldom fail to prove serviceable: indeed, this may be regarded as a general rule to guide their administration,—that whenever diseases assume an intermittent type, whatever may be their denomination, whether gout, rheumatism, eruptive fevers, catarrhs, or even phthisis, bark and its preparations seldom fail to be useful, and rarely or never are productive of injury.

* It is of importance to distinguish the true from what is denominated false cusparia bark, which is supposed to be the bark of some species of strychnos, and exerts a poisonous influence on the stomach. It is distinguished by its solidity and weight being greater than that of the true cusparia; by the epidermis being covered with distinct, rust-coloured, warty elevations; by impressing a disgusting durable bitter on the palate instead of the aromatic bitter and slight acrimony of true cusparia; and particularly by the infusion in water acidulated with muriatic acid precipitating Prussian blue when tested with ferro-cyanate of potassa, whilst none is formed in the acidulated infusion of the true bark; and, finally, by nitric acid striking a deeper crimson colour than with the true bark, owing to the presence of brucia. This bark is often mixed with the true.

† The components of quinia are 20 equiv. of carbon=122.4+12 hydrogen=12+1 nitrogen=14.15+2 oxygen=16, making the equivalent of the salt 164.55.

‡ The composition of these sulphates is—

	Neutral sulphate.	Bisulphate.
Quinia	80.9	63.5
Sulphuric acid	10.0	19.1
Water	9.1	17.4
	100.0	100.0

Even in local affections this rule holds good. Sir B. Brodie was consulted by a gentleman who had a spasmodic stricture of the urethra, which recurred in paroxysms every alternate night, and continued until five or six o'clock in the morning. The disease was cured by administering large doses of sulphate of quinia, at short intervals. In neuralgic attacks, also, which assume an intermittent type, it is equally beneficial; and in rheumatic inflammation of the sclerotic coat of the eye it may be almost regarded in the light of a specific. Circumstances nevertheless interfere to modify the influence of these barks and their preparations. When hepatic symptoms are present, they prove invariably hurtful; and, indeed, every state of the habit indicating inflammatory action should be subdued before they can be properly prescribed. Their efficacy is also modified by local and topographical circumstances. In India, says Mr. Annesley, although the bark is the grand remedy in fevers during the cold season, it fails in the rainy season, during which calomel and antimony only prove useful. With respect to the doses in intermittent affections, some physicians of deserved reputation recommend large doses;—namely, ʒiii. of the powder of bark, or gr. x. of the sulphate of cinchonia or quinia, either immediately before or after the paroxysm; but we have found that more certain benefit has followed the administration of doses of gr. ii. repeated every hour or every second hour during the interval than of large doses at long intervals.

Besides the forms of administering the alkaloids which have been described, they have been administered per anum, and have cured agues, but in this form they are apt to cause violent colic.

The *resinoids* differ from the tonic alkaloids in their chemical properties, and have not equal powers as tonic agents, although their influence is still considerable. The most energetic of this class is undoubtedly *salicin*, the active principle of the bark of the salix *alba*, and of some other barks in the same natural family of plants. It is procured in white acicular prismatic crystals, extremely bitter, and soluble in a moderate degree in water and alcohol at 60°; but not at all in ether or volatile oils. In its ultimate components it differs from cinchonia and quinia in containing no nitrogen.* It forms precipitates with infusions of astringent vegetables, acetate of lead, and tartar-emetic. The bark from which it is chiefly procured, that of the white willow, was introduced to the notice of the profession as an antiperiodic by Dr. Stone; but, as it required to be administered in very large doses, it never became a popular remedy. Salicin has set aside this objection: it operates in the same doses as the cinchonic alkaloids, and being much cheaper than them, it is likely to be soon very generally employed. Baths made with a decoction of willow bark are employed, on the continent, in weakness of the lower extremities in infants. The tincture is the best preparation of the bark; but the introduction of salicin has nearly superseded the use of the bark in any form.

*The components of salicina are 2 equiv. of carbon =12·24+2 hydrogen=2+1 oxygen=8, making the equivalent of the salt 22·24.

Piperina, another resinoid, has been still more lauded as an antiperiodic than salicina. It is obtained from black pepper, which has long been a popular remedy in intermittents, and was regarded as an alkaloid by its discoverer,† and others, until M. Pelletier demonstrated the fallacy of this opinion. It is a crystalline body; and when pure, its crystal is a flattish quadrilateral prism, with two parallel large and two small sides, terminated by an inclined plain, of a pale yellow colour and semitransparent; insoluble in cold water, and scarcely soluble in hot; soluble in alcohol and acetic acid. Piperina is seldom altogether free from a pungent, very acrid fixed oil, with which it exists in combination in the pepper; thence its tonic powers are always combined with an excitant quality which necessarily modifies their influence, and must regulate its administration. This oil gives a pungent taste to the piperina, which in its pure state is insipid. The less pure it is, the more its acrid qualities are felt in the stomach and the intestinal canal: it causes great heat in the epigastric region, purges with colic, and leaves an uneasy sensation in the lower bowels, which continues for many days. These symptoms are due to the topical impression of the acrid oil contained in the piperina on the gastric tissue, as they are not experienced when the resinoid is quite pure; and to this oil, also, may be attributed the tingling sensation and eruption of small pustules which sometimes accompany the treatment of intermittents by piperina. It is by no means yet ascertained how much of the influence of the resinoid as an antiperiodic is due to this oil. As it exists in chamomile flowers, in which it has been discovered by the author of this article, it is also combined with a fixed acrid oil distinct from the volatile oil to which the aroma of the plant is due. Long pepper contains less of this oil, and although it also operates as an antiperiodic, its influence is less energetic.

These remarks suggest the question—Is the antiperiodic influence that of tone? In reply, it must be admitted that no simple tonic, wholly or nearly devoid of stimulant power, cures intermittents; and it is well known that perturbing powers of an immaterial kind, powerful passions of the mind, violent exercise, and such like; and also strong diffusible excitants, such as alcohol, opium, and ether, applied to the system at the moment of the accession of the rigor, have not only the power of checking a paroxysm, but even of completely breaking the catenation of morbid actions which constitute the disease, and consequently of removing it. It is true that a simple tonic operating for a long time steadily on the system may gradually subdue ague, but the effect is slow and progressive: on the other hand, the sudden beneficial influence of the excitant is seldom permanent; and thence we may conclude that although both tonics and excitants may be in strictness regarded as antiperiodic, yet that it is the combination of the two on which we must chiefly rely; and, consequently, if pure piperina be a simple tonic, it is less to be depended upon as a remedy for ague than when it contains some portion of the

†M. Oerstadt, of Copenhagen. It consists of 80.95 parts of carbon+8.13 of hydrogen+10.92 of oxygen in 100 parts.

acrid fixed oil with which nature has combined it in the vegetable productions from which it is obtained. The dose of pure piperina is from four to six grains, but in its impure state it is seldom necessary to increase it beyond three or four grains, and then its acrimony should be sheathed by combining it with some bland demulcent or simple bitter extract. In prescribing it, its insolubility in aqueous fluids must always be kept in view; and this is one disadvantage attending its use, as in the form of pill, its primary effect being exerted on one portion of the stomach, causes very uneasy sensations in the gastric region, which are not experienced from the salts of cinchonia, quinia, or salicina.

[Cornus Florida was at one time stated to contain a peculiar principle, to which the name *Cornine* was given; but if such exist, it is not used. Liriodendron, Hippocastanum, Phloridzina, Cetrarina, and Narcotina, have also been used as antiperiodics. (See the writer's *New Remedies*, 4th edit. Philad. 1843.)]

Gentian, chironia, *centaurium*, lesser centaury, chirayita, and calumba, perhaps owe their tonic influence to principles closely resembling the resinoids, and consequently the above remarks are applicable to them. They can scarcely be regarded as antiperiodics, but their tonic influence is undoubted; and as simple corroborants, in convalescence from acute diseases, their freedom from irritant properties renders them more generally applicable than the antiperiodic tonics. The addition of an aromatic, when indicated, is always readily obtained by combining them with volatile oils in the form of oleo-saccharum, the doses of which can always be apportioned to the degree of stimulus required.

Bitter extractive, which is probably a compound of various vegetable products, exerts also a tonic influence on the diseased frame. We find it variously combined with other principles in Iceland liverwort, quassia, and simaruba barks, which have all been successfully employed in diseases either characterized by defective tone or debility, the sequel of acute affections which have exhausted the powers of the habit.

When a simple bitter is indicated, quassia will seldom disappoint the expectations of the practitioner, and it has the advantage of undergoing no chemical change when its infusion is combined with the salts of iron. It is particularly indicated in cases of dyspepsia connected with much irritability of stomach, in which, at the same time that it is necessary to allay this, the tone of the organ must be improved. In such cases quassia is advantageously combined, either with pure alkalies or with hydrocyanic acid. Thus combined, it fortifies the tissue, and supplies energy to the digestive organs without accelerating the pulse, or causing any increase of the animal temperature.

Bitter extractive is the tonic principle in many vegetable bodies. It is generally found in combination with gallic acid, tannin, and volatile oil, which, although when separated, or the principal components of the vegetable body, cannot be strictly regarded as tonics, yet when thus united with bitter extractive, greatly aid its tonic power. It is that solid, transparent residue which remains in combination with other principles, when a vegetable infusion is slowly evaporated, and which is oxidized, and rendered insoluble in water, when the solution containing it is long boiled in contact with the air,—an effect which explains why long decoction of some medicinal barks renders them inert; why extracts, slowly prepared even in a water bath, are seldom active medicines, or are at least much inferior to those prepared in vacuo. It is contained chiefly in roots, barks, and leaves; is inodorous, and varies in taste, according to the nature of the other components with which it is combined in different plants, for it is never obtained in a state of perfect purity.

Bitter extractive is contained in combination with a resinoid, which has been termed calumbina, in the calumba root. The aqueous infusion of this root strikes a beautiful blue with tincture of iodine;* is precipitated by infusion of galls, yellow cinchona bark, acetate of lead, bichloride of mercury, and lime-water; but not by muriate of baryta, sulphate of iron, nitrate of silver, nor tartrate of antimony and potassa. The new crystallized principle, *calumbina*, is procured from calumba by digesting the powdered root in ether, filtering, and evaporating. It possesses in an eminent degree the bitter taste of the root.

Dr. Duncan supposed that calumba root contains cinchonia, and certainly the action of re-agents on its aqueous decoction might seem to confirm his opinion; but the examination of the root, by M. Planché and M. Guibourt, has not detected this principle in calumba. The central part should be separated before making an infusion or decoction of the root. As calumba possesses no astringency, and is little stimulant, it is perhaps the best tonic in phthisical cases. It has also a considerable power in allaying the irritability of stomach accompanying pregnancy and dyspepsia, and, occasionally, dentition. Dr. Denman recommended it in the low stage of puerperal fever; and, as a tonic, in combination with rhubarb and sulphate of potassa, it is extremely useful in the mesenteric affections of infancy and childhood. Calumba root is one of a few vegetable medicines which should be given in the form of tincture, the alcohol taking up the active principles only of the root. The dose of the tincture is from f.ʒi to f.ʒiii, and even more if the patient have been accustomed to the use of ardent spirits.

The root of *avens, gei urbani radix*, also owes its properties to bitter extractive. It has been little employed as a tonic in this country; but on the continent it is much used in intermittents, and in convalescence from acute diseases. It is also regarded as a useful corroborant in chronic diarrhœa and in scurvy.

Extractive is developed in *Iceland liverwort, cetraria Islandica*, by muriate of tin; gum by subacetate of lead; and fecula by the tincture of iodine. The tonic powers of Iceland lichen certainly depend on the bitter principle; and therefore, when it is employed as a tonic in the latter

* This distinguishes it from a false calumba lately introduced, which is further known by its white colour, lighter texture, and its taste, which is at first sweetish, and not half so bitter as that of the true calumba. Its infusion also reddens the tincture of litmus; caustic potassa disengages ammonia from it; salts of iron precipitate its infusion black; and ether, digested on it, acquires a bright yellow colour; none of which effects are presented by true calumba.

stage of phthisis, the bitter should not be wholly removed. Even when it is to be employed as nutriment, there is too much anxiety to remove the bitter, a small portion of which is requisite for aiding the digestion of the fecula. But, as the bitter is very nauseous to many palates, a part of it may be removed by boiling the lichen twice, and adding to the first boiling a small quantity of any alkaline carbonate. The addition of five or six minims of diluted sulphuric acid, and f.ʒi of syrup of white poppies, to f.ʒiss of the decoction, affords an excellent tonic in phthisis, and in cases of great emaciation from acute disease. In cases of chlorosis and imperfect menstruation, the decoction may be advantageously combined with sulphate or muriate of iron, as in neither case is any precipitate produced.

Marsh trefoil, menyanthis trifoliatæ folia, after losing 75 parts in 100 of its weight in drying, consists chiefly of bitter extractive, and a peculiar substance approaching to the character of animal matter. The infusion strikes a deep black with persulphate of iron, showing the presence of gallic acid; throws down a copious precipitate with alum and muriate of tin; and also precipitates infusion of yellow cinchona bark. The extractive is rendered insoluble by solution of chlorine.

Menyanthes acts powerfully on the stomach, and in an irritable state of that organ produces a deleterious impression; it is taken into the circulation and stimulates the capillaries: nevertheless it is an admirable tonic, and would be much prized if it were less common. In large doses the infusion excites vomiting, and, under certain conditions of the body, purges or acts as a diuretic, as the surface is more or less exposed. It checks intermittents, and is peculiarly useful in rheumatism when it takes on an intermittent character. It was formerly much prized as an emmenagogue. On account of its nauseating properties, it is useful to combine it with aromatics.

Uva ursi was recommended by Dr. Bourne in phthisis pulmonalis; but the remedy has not succeeded in the hands of other practitioners. He combined ten grains of the powder of the leaves of the plant with fifteen grains of cinchona bark and half a grain of opium, and gave this mixture three times a day. The effect of this mixture was to lower the pulse without adding to its force: it palliated the symptoms, and, in some cases, appears to have effected a cure.

No adjunct to bitter extractive aids its tonic influence so effectually as volatile oil, and this combination is found in cascarilla bark, calamus aromaticus, and myrrh. The first, besides the oil and bitter extractive, contains resin and gallic acid, possesses antiperiodic powers, and has been substituted for cinchona bark in the treatment of remittent and intermittent fevers; but its influence in these diseases has been greatly overrated. As an aromatic it aids the powers of the pale cinchona bark, and those of the salts of cinchonia and quinia; but its infusion forms precipitates with infusion of the yellow cinchona bark, and is consequently incompatible with it. Neither can it be prescribed with sulphate of iron, the salts of lead, or lime-water. It is useful in all cases in which a combination of a tonic and aromatic is indicated, as in flatulent colic, the latter stages of dysentery, and old asthmatic affections; and is peculiarly suited to cases of gangrenous thrush in infants, and in that state of languor and emaciation, accompanied with tumid tense abdomen, which depends on obstruction of the mesenteric glands. It is contra-indicated, however, when there is the least tendency to inflammatory action, and it has been accused of producing a tendency to hæmorrhoids. The virtues of the acorus *calamus*, or calamus aromaticus as it is usually termed, closely resemble those of cascarilla, and even exceed them in antiperiodic powers. The writer of this article has frequently seen both cinchona bark and sulphate of quinia, after failing to cure ague, succeed in rapidly removing the disease when conjoined with calamus aromaticus. The volatile oil, which is now procured in a separate state, may be used with advantage instead of the powder or infusion of the rhizome, in the form of an oleo-saccharum; and we cannot avoid remarking here the propriety of employing the volatile oils, in this form, in combination with the alkaloids and tonic metallic salts instead of the substances which yield them, as the latter often contain matters which decompose the salts and render them inert. If sulphate of quinia is prescribed in combination with the pulvus aromaticus of the Pharmacopœia, the salt is decomposed and an inert tannate of quinia formed; but no such effect follows the combination of this salt with the volatile oils of the various aromatics composing the powder. *Myrrh*, which is now known to be the product of the balsamodendron *myrrha*, is a compound of volatile oil, resin, and gum. It is a stimulant tonic, well adapted to cases in which the powers of the constitution have been worn down by chronic disease: as, for example, humid asthma and old obstinate catarrhs, as it stops the progress of that exhaustion which accompanies profuse expectoration: on this account, also, its watery solution, in combination with nitrate of potassa, camphor, foxglove, and opium, is often prescribed in phthisis; but it is only in the entire state that it can, in any way, prove beneficial in that intractable disease. It proves useful in chlorosis, and in defective action of the uterine system in pale leucophlegmatic girls, when combined with preparations of iron, particularly the ioduret of that metal; and added to oxide of zinc, its utility in a peculiar cough which occasionally accompanies pregnancy, of which the tendency is to induce abortion, is well ascertained.

The inorganic substances which operate as tonics are *metallic oxides*, *arsenious acid*, and some *metallic salts*.

With regard to the first of these preparations, it may be remarked that, when oxygen is combined in one definite proportion with a metal, the oxide is soluble in the animal fluids, and either enters the circulation, and is there decomposed, or exerts a primary tonic influence on the stomach. It is those only of the latter description which we have now to notice.

Lime in its solution in water as lime-water, has generally been regarded as a moderate tonic of this kind; but its influence on the nerves of the stomach is rather that of a sedative than a tonic, allaying the irritability of the organ, and thereby

favouring the secretion of a more healthy gastric juice, and consequently a more perfect chymification. It is only on this account that it can prove beneficial in dyspepsia, as its antacid properties are too trifling to be beneficial as a chemical remedy. Under any circumstances it is of little value. *Oxide of zinc*, although it has not fully realized all that was anticipated by the distinguished physician who introduced it into practice, is a tonic of much value. In the decline of diseases of a spasmodic character, it has been found extremely beneficial; as, for example, in hooping-cough, when the cough is kept up by custom acting on a weakened, irritable frame of body. The most useful form of prescribing it is in combination with the pure alkalies, in an excess of which it is soluble. In this form it is especially indicated in that weakened condition of the digestive organs which induces psoriasis and some other cutaneous eruptions; the alkali allays the irritability of the stomach, whilst the oxide of zinc restores its tone. It is only the protoxide of iron that possesses active properties as a tonic; and this forms one portion of the scales from the anvil. Its action is slow, and, therefore, it is only adapted for those cases of general debility in which a permanent rather than a rapid effect is required; its efficacy is much increased by its meeting with acid in the stomach, so as to aid its solution and consequent absorption into the blood. The dose is from gr. v. to ʒss; and it is known to be in active operation by the black colour of the alvine discharges.

Arsenious acid exerts a most powerful antiperiodic influence in all affections of an intermittent character; but there are objections to its employment in this form, which would have altogether thrown it into disuse, had Dr. Fowler not suggested the combination of it with potassa, so as to form an arsenite, in the liquor arsenicalis, the arsenical solution of the pharmacopœias. In this preparation there is scarcely a sufficient quantity of potassa to saturate the whole of the arsenious acid. Each fluiddrachm of the solution contains a grain of the arsenite, or half a grain of arsenious acid; consequently, the dose of eight minims, that generally commenced with, contains nearly 1-16th of a grain. In this dose, gradually increased, if necessary, to forty or fifty minims, the arsenical solution has been advantageously administered, as a tonic, for the cure of intermittents. With respect to its mode of acting, it seems to exert a primary stimulant influence on the stomach, assisting the digestive powers of that viscus; and, both by that effect and also by the extension of its tonic influence to the whole system, to remove the debility which favours the repetition of the intermittent paroxysm. The diaphoretic power may also aid its curative influence in intermittents; as it is well known that many substances which have no other power than that of increasing perspiration, and consequently diffusing the blood equally over the system, cure agues.

The arsenical solution has been given, with benefit, in those cases of chronic rheumatism which assume an intermittent type: it has also proved occasionally useful in symptomatic epilepsy, chorea, and other spasmodic affections, as well as the tic douloureux and cephalalgia. Its efficacy in lepra and some other cutaneous diseases, when given in conjunction with large doses of the pure alkalies with conium, is well established.

In the treatment of cancer, arsenious acid has been both internally administered and externally applied; but whilst the benefit to be expected from its administration is doubtful, its deleterious agency has been manifested in many cases, even where its use has been confined to the surface. When applied to an external wound, it sometimes causes almost immediate inflammation of the stomach, accompanied with violent vomiting and purging; and death is as likely to ensue in such cases as if it were internally administered.

Sulphate of zinc as a tonic exerts a primary influence on the stomach, but a secondary, also, on the general system. It is supposed to operate with less excitement than the other metallic salts, and to be well adapted for cases of phthisis and the humid asthma of old men; in both of which disorders, besides supporting the general tone of the system, it is supposed to diminish both the quantity and the acrimony of the expectorated matter. The acetate of zinc operates nearly in the same manner, but is less frequently employed as an internal remedy.

Sulphate of copper is a powerful but hazardous tonic. It has been given in doses of a quarter to half a grain in spasmodic affections, twice or three times a day. In chronic diarrhœa, in similar doses, it has been found to check the purging, and increase tone. It was resorted to in the attack of Asiatic cholera which visited our island; but, although it seemed to aid in lessening the discharge, the benefit was not such as would recommend its general employment. It seems to influence chiefly the nerves of the intestines, and thus, by increasing the tone of the bowel, to diminish the excretion of the exhalants. The dose of this sulphate, as a tonic, may be gradually increased to two grains, which ought not to be exceeded. The subacetate possesses the same properties in every respect, but it is even more apt to cause poisonous symptoms than the sulphate. The *subnitrate of bismuth* is free from this objection. It has been found to be particularly useful, in doses of from two to six grains in combination with one grain of opium, in pyrosis, affording almost immediate relief to the pain and sense of constriction which constitute the paroxysm.

Muriate of baryta also operates by a direct action on the stomach; it was introduced as a tonic in scrofulous affections, by Dr. Crawford, but it has not been generally employed. In prescribing it, it should be recollected that it is decomposed by phosphates, sulphates, and all astringent vegetable infusions, insoluble inert compounds being the result of such combinations.

The tonics that operate through the medium of the blood are chiefly oxides, iodides, metallic salts, and the mineral acids. They all enter the circulation, and can be detected in the secretions.

One of the best preparations of iron, as a tonic, is undoubtedly the ioduret or iodide, already mentioned in the article STIMULANTS.* It possesses

* As the properties of this ioduret are still little understood, and as the specimens of it in the shops of the druggists are in many instances not what they ought to

the advantage of the iodine as an excitant and deobstruent modified by the tonic power of the protoxide of iron; so that, whilst the former is affording activity to the capillary system, the iron is sustaining its tone, and improving its general vigour and energy. It has been found highly efficacious in all cases requiring the aid of a stimulating tonic, more especially in those connected with deficient uterine action, chlorosis, and glandular obstructions, and in every instance of debility that demands a stimulant impulse to be given to the capillary system.

The ioduret, it is useful to know, is incompatible with the mineral acids; the alkalies and their carbonates; the sulphates, both alkaline and metallic; the acetates of zinc and of lead; arsenious acid and arsenite of potassa; nitrate of silver, and all the soluble salts of mercury; solution of chlorine; gallic acid; tannin and aqueous infusions of astringent vegetables; the tinctures of kino, hyoscyamus, and galls; sulphates of morphia, quinia, and muriate of morphia. On account of its deliquescent property, it cannot be prescribed in the form of pill; and in solution it becomes a hydriodate. It is contraindicated in every condition approaching to that of positive excitement.

Nitrate of silver, the first of the metallic salts belonging to this division of tonics, communicates general vigour to the body, by acting primarily on the stomach; but it is also absorbed and taken into the circulation—a fact demonstrated by the leaden hue which it sometimes communicates to the skin of those who take it. Although it operates as a powerful escharotic when applied to the surface of the body, yet the vitality of the stomach is sufficient to resist its chemical influence: its dose may be carried to the extent of even five grains three times a day. The best mode of administering it is in the form of pills, made up with crumb of bread. It is always advisable to preface its use by emptying the stomach and bowels; for when much acid, either muriatic or acetic, exists in the alimentary canal, it is decomposed and rendered inert. No salt food, nor much salt, should be used by persons taking this nitrate, as these form an inert chloride of silver in the stomach.

Nitrate of silver was early employed as a tonic in the treatment of disease; but, from want of due precaution in its administration and the harshness of its operation, it fell into disuse. It was introduced by Dr. Sims of London, who employed it in the treatment of epilepsy, and from his success it became much used. In looking at its value in this disease, truth obliges us to say that, except in protracting the return of the paroxysms in symptomatic epilepsy, little is to be expected from its employment. In chorea, however, its merits have not been too highly extolled. It has also been given with great advantage in angina pectoris.

The administration of nitrate of silver is productive of one great inconvenience, which stands in the way of its general employment as an internal medicine—it is apt, (as already hinted,) in some habits, to give an indelible leaden or saturnine hue to the whole skin. With respect to the cause of this change of colour of the skin, if we admit that the nitrate is taken into the circulation undecomposed, and arrives in that state at the capillaries of the skin, we must also admit that it may be decomposed there, converted into chloride of silver, and deposited in the rete mucosum. The chloride acquires a grey leaden colour whenever it remains in contact with animal matter; and, as it is insoluble, it is incapable of being reabsorbed, and a permanent stain is given to the skin. This effect, therefore, happens whenever a more than usual quantity of muriates is separated by the cuticular capillaries. No remedy for this inconvenient effect of nitrate of silver has yet been suggested. We imagine that, by ordering diluted nitric acid, at the time of administering this salt, its decomposition may be prevented; for, although we keep in view the difference between the living system and the laboratory of the chemist, yet it is not improbable that the employment of nitric acid may frustrate the evil by preventing the decomposition of the nitrate.

As a local tonic, the nitrate of silver has been lately successfully employed in chronic inflammation of the eyes; and to this local influence may be in great part ascribed its utility in diseases of the mucous tissues affecting the secreting surfaces, and in ulcerations, as recommended by Mr. Higginbottom. It is true that it acts in ulcerations by forming as it were an artificial cuticle of the part, which chemically unites with the nitrate; but we are inclined to believe that something is also due to its tonic power. On the same principle, it cures the inflammation of the cervix uteri dependent on increased irritability of the part.

All the salts of iron belong to the class of tonics now under consideration: the *subcarbonate* has, however, attracted the greatest attention; but owing to the nature of the preparation, it is a most uncertain medicine. The carbonate of the pharmacopœias is prepared by decomposing the protosulphate of iron in solution by subcarbonate of soda; but oxygen is so rapidly attracted from the atmosphere by the precipitate in drying, that it

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be, we shall enter a little more into detail respecting its preparation than was done in our previous notice of it. It is prepared by heating together, in a flask, equal proportions of clean, soft iron wire and iodine, with twelve or fourteen times their combined weight of distilled water; boiling the mixture until it wholly lose the colour of the iodine, and then filtering. The filtered fluid, which ought to be of a very pale greenish straw colour, should then be evaporated to dryness in a flask, terminating the process the instant the smallest appearance of the purple vapour of the iodine is perceptible. The flask should then be broken, and the ioduret, whilst it is still warm, put into a well stoppered bottle, and secured from the action of the air. Well prepared ioduret of iron is of a dark iron-grey colour, breaking with a crystalline fracture, and dissolving completely in twice its weight of distilled water. When exposed to the air, it rapidly attracts moisture and is decomposed, the iron parting with the iodine, and attracting oxygen so as to be converted into the peroxide, which, on dissolving the ioduret, falls down as an insoluble red or ochrous precipitate. This decomposition also occurs, when the filtered solution, whatever may be its degree of strength, is exposed to the air; but when a piece of clean soft iron wire is put into the solution, and permitted to remain in it for three or four days, and the fluid then filtered, it will keep limpid and undecomposed for any length of time. This solution is most convenient for medicinal use when it contains, in every fluid drachm, three grains of the ioduret; but it must be remarked that in solution it is changed to a hydriodate of the protoxide of iron, returning, however, to the state of the ioduret on evaporating the solution to dryness. In the dry state it is a compound of 28 parts of iron, and 126 of iodine, or one equivalent of each. [The last edition of the Pharmacopœia of the United States contains a formula for the preparation of the *Ferri Iodidum*, and also of a *Liquor Ferri Iodidi*. See, also, the writer's *New Remedies*, edit. cit. p. 280.]

passes into the state of peroxide, and consequently loses its carbonic acid; and no means hitherto devised have been able to prevent this change from taking place.

[Of late, the protocarbonate has been formed in a manner to be permanent; and pills, called, after their proposer, "*Vallet's Pills*," have been introduced into the last edition of the Pharmacopœia of the United States, (1842.) The addition of sugar to the protocarbonate checks the oxidation of the iron, but does not wholly prevent it. The *Pilulæ Ferri Carbonatis* of the Pharmacopœia of the United States are formed of sulphate of iron, carbonate of soda, clarified honey, syrup and barley-water. A preparation has also been introduced into the Edinburgh Pharmacopœia, under the name *Ferri Carbonas Saccharatum*, in which the precipitated protocarbonate, obtained by the decomposition of the sulphate of iron by carbonate of soda is triturated with sugar, and dried at a temperature not much exceeding 120°. Experience does not seem to show, that the protocarbonate, as a chalybeate, possesses any virtues not equally possessed by the subcarbonate or sesquioxide.]

To render this preparation [the subcarbonate] perfect, the sulphate of iron should be recently prepared, or in the state of a protosulphate, as the oxide afforded by the persulphate does not combine with carbonic acid. When it is carefully prepared, this subcarbonate, according to Mr. Phillips, should consist of —carbonate of iron 40, + peroxide of iron 60, in 100 parts. But it is generally so carelessly prepared, that it does not contain more than ten per cent. of carbonate of iron. When properly prepared, it is soluble in the juices of the stomach, and is readily taken into the circulation; and, as the carbonate is undoubtedly the active principle, it becomes a matter of great importance that the carbonate should really be the salt administered; and this can always be ensured by making it at the moment it is to be taken. An aqueous solution of eight grains of protosulphate of iron, mixed with a solution of ten grains of subcarbonate of soda, and immediately swallowed, will afford a dose of ten grains of protocarbonate of iron in its most active state; whereas, a dose of the ordinary subcarbonate contains little more than a grain only of the salt. The dose of the subcarbonate is from ten grains to four drachms.

[Of late, other preparations of iron have been introduced,—as the lactate, which has been prescribed in the same cases as the protocarbonate; but is not much used,—the citrate, which is an elegant preparation, and has been often prescribed by the writer, (*New Remedies*, 4th edit. p. 273, Philad. 1843); and iron, reduced to the metallic state by means of hydrogen, which has lately been strongly recommended by M. Raciborski, (*De la Puberté*, &c., Paris, 1844.) MM. Quevenne and Miquelard, who proposed the formula, assert, that it comprises the two grand desiderata as regards chalybeates,—great activity, with absolute insipidity. It would be strange, however, if experience were to show, that it possesses advantages over the preparations now in use.]

All the preparations of iron, whether those formed by the hand of nature in chalybeate waters, or those contrived by the artifice of man, exert a powerfully tonic effect. They increase the digestive powers of the stomach, stimulate the intestines, and, being dissolved in the gastric and intestinal juices, are taken up by the absorbents, enter the blood, and stimulate the whole system. This is demonstrated by the pulse being rendered stronger and quicker, the heat of the body and thirst being augmented, the countenance rendered more florid, and the whole powers of the system being called into action. It has been denied that iron is absorbed into the blood; but a series of experiments, detailed in the second volume of the Bologna Commentaries, places the fact of its absorption beyond a doubt.

With regard to the medicinal powers of the salts of iron, the natural chalybeates are of eminent service in all cases requiring tonics: their primary effect is displayed on the digestive organs, whence their influence is propagated, rousing the nutritive faculty in every part of the body: they augment the power of the secretory system; and, by the moderate but permanent nature of the impression which they impart to the nerves, increase the tone and general vigour of all the functions. Something is undoubtedly due, at the same time, to the circumstances connected with drinking mineral waters at their source. But tone follows the use of iron in all its forms, and therefore its preparations are employed in every disease connected with relaxation or debility, particularly of a chronic kind: dyspepsia, hysteria, amenorrhœa, leucorrhœa, scrofula, and chronic catarrh, are a few of the catalogue of those which chalybeates are calculated to benefit. When salts of iron are indicated, the doses should be large; but the propriety of giving the large doses of the carbonate which have been lately recommended, is questionable. Even in tic douloureux, we have never found it necessary, if the preparation be good, to exceed a drachm for a dose; and, in chorea, we have seen every benefit derived from the regular repetition of smaller doses at short intervals. In a weakened state of the uterine organs, causing a defective secretion of the menstrual fluid, the salts of iron are productive of the best consequences; but when amenorrhœa is accompanied with heat in the region of the uterus, pain of the loins, and plethora, they prove hurtful. In both cases, the effects are attributable solely to the tonic influence of these preparations. Reflecting on the chemical characters and medicinal powers of the carbonate, the sulphate, and the muriated tincture, it is evident that they are sufficient for every indication desired from the salts of iron; and therefore all the other preparations of this metal might be dispensed with and rejected from the pharmacopœias.

The long-continued use of preparations of iron seems to predispose to disease by causing an excess of tone; thence those who have thus employed them are liable to inflammation, active hemorrhage, and similar affections.

All the *mineral acids* are powerful tonics, especially in those cases of great debility in which petechiæ display themselves. The sulphuric, diluted and combined with wine, is the only remedy on which we can rely in the confluent small-pox, when the pustules are filled with a bloody sanies and the urine is coloured by broken-down particles

of blood. In cases of immoderate perspiration, also, as, for instance, in the hectic of phthisis pulmonalis, it is the appropriate remedy; and, in combination with aromatics, it removes many of the urgent symptoms of dyspepsia, and is altogether a tonic of the highest value when judiciously employed. In administering it, however, even in the diluted state, some anomalous effects occur which should be retained in remembrance. Thus, when given to women who are suckling, it acts powerfully on the system of the infant, causing gripings, and frequently convulsions, although it has never been detected in the milk of the mother. A case, extracted from a German Journal, appeared in the Medical Gazette of May the 10th, 1828, in which a woman poisoned herself with concentrated sulphuric acid. The last efforts of nature were exerted to give birth to a child, in whom, upon examination, sulphuric acid was detected in the cavity of the pleura and the peritoneum, and also in the heart and bladder. Its presence was also ascertained in the liquor amnii. Sulphuric acid cannot be combined in prescriptions with muriate of lime, lime-water, barytic-water, or the solution of acetate of lead, or muriate of baryta; insoluble compounds being produced by these combinations.

The tonic effects of *cold bathing* have been already noticed (see BATHING); it therefore only remains to notice the *immaterial* tonics.

When we contemplate the number and power of the moving organs of the body under the control of the will; the strength of the extensor and flexor muscles, and the facility with which, by their aid, locomotion is produced; few arguments are required to convince us that a state of constant rest is unnatural, and that motion or exercise is essential for the maintenance of health. *Exercise*, therefore, may be regarded rather as a prophylactic tonic than one actually adapted for the removal of disease. But besides the immediate influence which some tonics exert over morbid actions, the greater number of this class of medicines is employed to restore vigour to the habit debilitated by previous disease; and, in this point of view, exercise has a claim to the appellation of a direct tonic. It aids in circulating the blood more equably over the system, promoting especially the action of the capillaries and the function of the skin.

Amongst the various kinds of exercise in general use, *walking* is the best which can be taken when the strength of the body admits of a moderate degree of fatigue with impunity. It throws into action not only the muscles of the lower limbs, but those of the arms and several of the largest and most important of the trunk; particularly those which, fixed in the loins, serve as flexors to the thighs. It is probable that the motion of these contribute, in some respects, to aid the peristaltic movements of the intestines, and thus to favour that regularity of the excretory function of the abdominal viscera without which health cannot be preserved. When walking, in a convalescent, causes difficulty of breathing, palpitation, or pain in the region of the heart, it should be discontinued; but when it is performed with ease, it should be continued nearly to the point of fatigue.

Horse exercise requires greater powers of muscles than can be expected in early convalescence; but as it engages the upper part of the body, and occupies the arms and large muscles of the chest, which influence the motion of the lungs, it is most important as soon as it can be borne. In taking horse exercise also, something is due to the extent through which the person passes in the open air, and the absorption of the attention by the scenery; for experience has demonstrated that the mere exercise taken in a riding-school, or within a limited space of ground, is not so salutary as riding in the open country. As a prophylactic of phthisis, in those predisposed to that disease, riding has been justly extolled; and even when the disease has displayed itself, if, as Sydenham remarks, it be "without fever or ulcer," riding may be regarded almost as a specific. We have often witnessed the beneficial effects of horse exercise in frames of body greatly weakened by asthma, and have seen individuals who were scarcely able to mount on horseback return from a ride vigorous and alert, and by the daily renewal of this exercise rapidly regain a degree of vigour and tone which could scarcely have been anticipated. When horse exercise or walking cannot be resorted to, the next best is carriage exercise or sailing; but it must be recollected that scarcely any of the influence of these can be referred to the muscular system.

Friction may be regarded as a species of exercise, and its effects can be explained on the same principles. To produce a tonic effect it ought to be brisk, and performed in such a manner as to produce a degree of redness and warmth on the surface. The ancients judiciously employed friction after tepid bathing, and aided its influence by the administration of wine and water during the intervals of the rubbing. On this principle only can be explained the beneficial effects of the oriental custom of shampooing. In phthisis the pains of the thorax are often relieved by friction; and the influence of percussion, which may be considered a variety of friction, of chronic rheumatism, is well known.

It may be rationally inquired whether any advantage is derived from aiding the friction by stimulating embrocations or oils? If the friction be well performed, and for a sufficient time, nothing of this kind is necessary, except to prevent the skin from being fretted; in which case, dipping the hand in dry flour or hair-powder is as useful as the most celebrated embrocation. It is only when a narcotic impression is to be added to the influence of the friction that embrocations are really useful. How far friction may owe its salutary influence to electrical agency, is a subject well worthy of examination.

Mental tonics belong to this class. The tonic effects of hope and confidence have already been spoken of, and it is unnecessary to give such illustrations as no practitioner can fail to meet with in his daily duties.

Travelling is another mental tonic; but it has a closer affinity with material tonics than either hope or confidence, and in no disease is the advantage of it more conspicuous than in hypochondriasis. In this disease there are languor and torpor of the whole body, timidity and depression of the mind, and a general disordered state of the functions of the stomach and intestines. Medicines have little influence in relieving these symptoms; but by a

change of climate and of scene, the disease is mitigated, and often cured. Something undoubtedly is due to the state of the atmosphere, the temperature, and other physical properties which distinguish one climate from another; but as much more advantage is procured by moving from place to place than by remaining stationary even in the most favourable climate, the salutary effect can only be ascribed to the mental excitement produced by the constant change of scene. In prescribing travelling as a tonic, it is surely unnecessary to say that countries ought to be recommended most fertile in those objects which are likely to rouse the curiosity and arrest the attention. "Cœlum patrio pulchrius, mores festiviores, et scænæ novæ et amœnæ, mentem grate occupant, et imaginationem suavissime detinent." (*Gregory*, De Morbis Cœli Mutatione Medendis Diss. Inaug.)

To sum up these remarks on this class of medicines, we should say that in deciding upon their employment three things require to be attended to: — 1. The choice of the tonic; for although all tonics necessarily possess the same kind of powers, yet these differ in degree: some are more acrid and astringent than others; some owe their efficacy to the presence of certain alkaline or acid principles; some to bitter extractive or to volatile oil modified by combination with other vegetable constituents; and some to the conjunctions of chemical agents, forming new and active compounds. We must, therefore, determine how far these principles are likely to fulfil the indication for which the tonic is to be prescribed, before selecting it. 2. The dose. It is important to regulate the dose of the tonic employed, in order to meet the demand which is required, or not to exceed the impression which can be sustained: if it be inadequate to the effect anticipated, the therapeutical indication will remain unfulfilled, and disappointment naturally ensue; if it be too great, instead of tone, excitement and collapse may be the result. 3. The mode of administering the medicine must be duly considered. If a powerful impression is intended to be made on the stomach, the medicine selected ought to be administered uncombined with other substances, and in such a dose as will produce an impression both powerful and durable: if, on the contrary, the object is to introduce the medicine into the system, it ought to be associated with such substances as will favour its absorption, and to be administered in small and frequently-repeated doses.

With regard to the diseases particularly requiring the employment of tonics, we may remark that in none do they produce more salutary effects than in affections of the digestive organs. The efficacy of tonics in these diseases is well established: their action upon the gastric nerves is communicated to the encephalon and spinal marrow, and the reaction of these upon the stomach awakens its powers and augments the activity of the digestive function. In selecting the tonics to be employed, those which contain bitter extractive —for example, quassia, gentian, or calumba—are to be preferred: the pure bitter which these substances contain, devoid of astringency, acts in a milder manner than those which contain either gallic acid, tannin, or the alkaloids. The tonic influence which they exert on the digestive organ alters also that condition of the mucous membrane which favours the generation of intestinal worms; whilst, at the same time, some bitter substances operate as direct vermifuges or poisons to these parasites.

Although it is scarcely necessary to state that tonics are injurious in all inflammatory states of the chest, yet, when the mucous secretion is exuberant, as in chronic catarrh, tonics are decidedly indicated: in these cases the cetraria *Islandica*, the lesser centaury, and the cinchonas are to be preferred to the other bitters. In hydrothorax, and in all serous accumulations within the thorax, however, they are useless, even when these states are the sequel of asthma and similar affections, in which tonics exert an unbounded beneficial influence. In conditions of the cerebro-spinal centres producing epilepsy or hysteria, symptomatic of morbid states of the circulating system — for example, hypertrophy of the heart, or of the digestive organs, in connection with hypochondriasis or melancholia — tonics are likely to produce a salutary change; but when these diseases depend on morbid conditions of the brain and spinal marrow themselves, then no advantage can be anticipated from the use of tonics. In some convulsive affections — as, for example, chorea — tonics may be regarded as the only remedies to be relied upon. In diabetes, as they improve the condition of the digestive organs and re-establish the assimilating power of the system, they are likely to alter that state of the urinary secretion which constitutes the disease; but at the same time it must be recollected that if the symptoms can be traced to any organic affection of the lumbar portion of the spinal cord, it will be vain to anticipate advantage from the employment of this class of medicines.

In cutaneous affections not symptomatic of peculiar febrile states, tonics prove useful; and this is especially the case when these eruptions are connected with depression of the general powers, manifested by a pallid or discoloured skin, a disordered state of the stomach, emaciation of the body, and a sluggish condition of the bowels. In such a condition of the system the more active tonics, in particular arsenic and the metallic salts, are especially indicated.

But it is in fevers that the efficacy of tonics is most conspicuous. In simple fever they are rarely required; and in complicated cases the proper time to administer them is a matter which requires great judgment. As a general rule, their employment should be deferred whilst any obvious local disease exists in the bowels; although, even under such circumstances, when there is a necessity for supporting the system, they have been productive of the best results.

In typhous fever the indiscriminate use of tonics has been productive of much mischief. The appearance of languor and debility is no reason why they should be prescribed; as in these instances they have been found to increase all the symptoms without improving the strength. Ample experience has demonstrated that, in general, it is only after the febrile symptoms have been wholly subdued, when the patient does not rally, and the convalescence is slow, that tonics are beneficial. Under certain circumstances they may be required even during the continuance of the disease. Thus,

when petechiæ appear, whilst the pulse is soft and compressible, and if there be a tendency to gangrene, not only tonics but stimulants are indicated: in such cases, much advantage is obtained from a combination of volatile oil, as an oleo-saccharum, with sulphate of quinia and sulphuric acid; or, if the vegetable infusions be preferred, we should select those of serpentaria, cascarilla, or cusparia.

After what has been stated respecting the value of cinchona bark as an antiperiodic in intermittents, it might be supposed that little remains to be said regarding the employment of tonics in those fevers; but it is necessary to guard the student and the inexperienced practitioner from being misled by too general a view of this subject. If the intermissions be imperfect, and any local inflammation exist, much caution is requisite in prescribing tonics; and in every instance a complete state of apyrexia in the intervals should be secured before venturing upon their employment. It is essential, however, to discriminate between local inflammation of the viscera and those engorgements of the spleen and of other parts which exist in persons who have suffered from long-protracted agues, and which are generally aggravated by any fresh attack of the disease: the presence of these need not interfere with the use of the bark or arsenic. It has been asserted that the latter of these tonics may be administered even during the existence of inflammatory symptoms; but upon this point we must confess that we are sceptical. In some peculiar modifications of inflammatory action — such, for example, as occur in chronic rheumatism—arsenic may be administered; but the salts of quinia, the menyanthes, and other tonics, are equally safe and useful.

In remittent fevers much caution should be observed in prescribing tonics. The remission should be transformed into an intermission before they can with propriety be employed; indeed nothing is so likely to change a remittent into continued fever as their injudicious administration.

[Yet in the malignant remittents of the United States, and in yellow fever, (q. v.) very marked advantage has been obtained from the use of sulphate of quinia in very large doses. Too great a dread would seem to have been felt in regard to the admission of tonics before a decided remission takes place. Whilst excitants proper may be decidedly disadvantageous, marked benefit may result from tonic agents like the sulphate of quinia.]

In infantile remittents, notwithstanding the high authority of Dr. Clarke, of Newcastle, who, in his work on fever, recommends bark to be immediately resorted to after the operation of an emetic, we accord with those who delay the use of tonics until the advanced stage of the disease, when it proves obstinate: then the cascarilla, which in such cases is generally preferred to the other barks, maintains the tone of the stomach and bowels, and enables us to proceed with the alterative and purgative plan of treatment. In the modification of fever which constitutes hectic, it must be confessed that little reliance is to be placed upon any class of medicines.

Upon the whole, it is necessary that tonics should not be confounded with stimulants, and that we should always recollect that tone is not excitement, nor strength increased vascular action.

A. T. Thomson.

TONSILLITIS.—(See Throat, Diseases of the.)

[TOOTHACHE, *Odontalgia.*—This disease is characterized essentially by acute pain in the teeth or their involucres, and is dependent upon various pathological conditions, which may require a brief and distinct consideration.

1. **Inflammation of the Alveolo-Dental Membrane**; *Periodontitis.*—The membrane that lines the socket of the tooth is, at times, attacked with inflammation, giving rise to much suffering.

An uneasy feeling is experienced in the alveolus, or alveoli, of some part of the jaws when the teeth are pressed together; the teeth of the affected periosteum being evidently slightly forced outwards, so that they cannot be accurately brought in contact. This painful sensation, pulsative and constant, may exist for a few days and then pass off; but, at other times, the inflammation spreads outwards, so as to be perceptible on the gums; the teeth become loose; and, at times, pus is secreted in the alveolus, which makes its way outwards, between the gum and the tooth. In other cases, the parietes of the alveolus become carious, and a fistulous ulcer is kept up. When the inflammation has recurred frequently, the tooth may become permanently loose, and act as a foreign body in the socket.

Periodontitis may be induced by caries of the fang, which is not often, however, the first cause. Cold and hot fluids, taken into the mouth, and partial exposure to cold and moisture, have been looked upon as exciting causes; but, as in every other form of inflammation, the precise etiology is by no means clear.

The affection generally terminates by resolution; but, should the excitement be great, and the pain excessive, it may be necessary to apply leeches externally, to scarify the gums in the vicinity, and to give a full dose of opium, or of some of its preparations. If the tooth be loose, and no chance exist of its becoming fixed, and the maintenance or recurrence of the disease be owing to this circumstance, it will be advisable to extract it.

Periodontitis, followed by secretion of morbid matter, is a very common cause of the loss of teeth. Occasionally, it appears to be connected with some constitutional *vice*, when it has to be met by constitutional remedies. Dr. Graves gives the case of a gentleman, who had been affected by rheumatic periostitis, which was relieved by the internal use of iodide of potassium. Subsequently, he suffered greatly and repeatedly from periodontitis, which resisted every remedy until the iodide of potassium was used, which completely removed it.

2. **Inflammation of the Dental Membrane**; *Endodontitis.*—The membrane that lines the dental cavity may likewise be inflamed; but it is not easy to distinguish this from toothache dependent upon erethism of the nerve. It may be suspected, if no signs of caries be observed on examination; but it cannot be accu-

rately diagnosticated. The same intermission in the pain—the same absence of inflammation of the gum—occurs in the early stages; but, afterwards, the pain may become more constant.

If endodontitis is believed to exist, the same plan of treatment may be adopted as in periodontitis.

3. **Caries of the Teeth.**—This is one of the most common diseases of the teeth, and occurs in some countries more than in others. The traveller, in certain parts of the south of France, and of the southern regions of this country, is struck with the ravages of dental caries, whilst in other districts the inhabitants are equally characterized by the excellence of their teeth.

Pain experienced when hot or cold liquids are received into the mouth, or the supervention of the ordinary signs of toothache, attracts the attention of the patient to the condition of the teeth, and careful examination exhibits that there is either a cavity opening externally in some part of the tooth or teeth affected, or that an internal process of decay has been established, which leaves but a shell of bone between the cavity of the tooth and the open air, so that the dental nerves are readily affected through it by external agents. The precise part at which the caries or gangrene takes place varies. It is usually considered to commence immediately beneath the enamel, in the osseous substance of the corona of the tooth. A small, dark spot is observed, which gradually spreads, until there is a free communication between the external air and the dental cavity. In this mode the whole of the corona may be destroyed — the fangs alone remaining, and often continuing to excite periodontitis, as extraneous bodies, until they are removed by the punch of the dentist. At other times the gum closes over them, and they no longer excite irritation. The disease is seated in the system of nutrition of the tooth, and has been presumed by some to consist originally in inflammation.

It is a common belief that dental gangrene is universally owing to the action of external agents upon the teeth. The facts, already mentioned, that dental caries is more common in some regions than in others—that it is an evil affecting families in many cases—and that the caries is observed, first of all, beneath the enamel—would, of themselves, make us pause in admitting this belief. There is, moreover, a greater liability to the disease in some teeth than in others. The last molar tooth but one, and generally of the upper jaw, is most usually the first affected; and, after it, the corresponding tooth of the opposite side suffers, owing to their being situate anatomically alike; and, consequently, the immediate cause of caries, after having acted upon the one, will be more likely to affect the other. Often, too, the next tooth to the one that is carious becomes so likewise, and on the side nearest to the diseased portion of the first. This has been supposed to be owing to contagion, but there is no good reason for admitting it. Next to the corresponding tooth of the opposite jaw, the one in immediate proximity with the tooth primarily affected, must be most likely to be implicated, seeing that its anatomical elements—blood-vessels and nerves—can vary but little from those of its neighbour.

The upper incisors are often decayed, and, in unhealthy children, caries sometimes attacks almost the whole of the teeth of the first dentition. It is impossible to depict the kind of dyscrasy which predisposes to the affection. Some have imagined that those of a tuberculous constitution are more subject to it; but we often see the teeth largely decayed in persons who are neither tuberculous nor strumous.

The prevalent belief is, that acids are very destructive to the teeth, and, therefore, a common cause of caries. But destruction of the enamel does not necessarily give occasion to caries. We have seen many cases in which portions have been broken off the incisors, yet decay has not supervened unless the individual was predisposed to it; and the dentist is in the daily habit of filing away the enamel, under the conviction, derived from experience, that caries will not necessarily, or be likely to follow. In certain cases, too, the enamel, in the progress of life, scales off by what John Hunter called "the denuding process;" yet decay does not necessarily result. It would seem, consequently, to be improbable that any agent which acts chemically upon the enamel could induce caries, when the removal of the enamel by the file of the dentist, or by mechanical injury, does not occasion it. Besides, it is not easy to conceive how any acid substance, having a greater affinity for the lime of the tooth than the phosphoric acid,—and there are not many such,—could remain in contact with the tooth in a state sufficiently concentrated to exert any chemical agency upon it. The presence of acid in the mouth always augments the secretion from the salivary glands, so that it becomes speedily diluted.

If such be the case with acids, how unlikely is it that the free use of sugar should be directly injurious to the teeth! In sugar there is no acid, yet it has been imagined that a chemical action may be exerted upon the teeth by indulgence in it. This is probably a bugbear which has been created, in the first instance, with the view of deterring children from the use of a substance of which they are fond, and the indulgence in which is objectionable for sumptuary and other reasons. It has, indeed, been observed, that the negroes in the West India Islands, who drink the juice of the cane very freely, have unusually good teeth, and we know that the nutrition of the frame improves under its use. There cannot be a doubt, therefore, that external agents of a chemical nature are not as much concerned in the production of dental gangrene as is generally admitted; but we can easily comprehend that, in one who is predisposed to the affection, substances that disagreeably impress the nerves of the fifth pair in the mouth—as hot or very cold liquids—may act as exciting causes, by modifying the nutrition of the teeth, and producing the condition in question.

The readiest method of cure, when caries is discovered in a tooth, is to plug up the hole, where this is practicable, with a metallic or other substance. But this is only admissible when the caries communicates externally, and when the cavity in the tooth is greater than the aperture. Where plugging is impracticable, relief may be obtained by destroying the affected nerves either

by the actual cautery, or by caustics introduced into the cavity.

The pain may be palliated by substances that deaden the sensibility of the dental nerves, as the different preparations of opium; essential oils, as of cloves; mustard, alcoholic liquors, &c. One or two drops of hydrocyanic acid, put into the hollow tooth, have assuaged the pain; but it need scarcely be said, that so potent a remedy should be employed with caution. Pyroligneous acid has been used, in the same cases, dropped on cotton; and, of late years, its main energetic principle, creasote, has been more extolled, perhaps, than any other remedy. When creasote is applied in the same manner as the agents above mentioned, or by means of a pencil imbued with it, it causes instantaneously acute pain and a considerable secretion of saliva. The patient is often relieved, but the pain generally recurs, and perhaps the advantage derived from its use is not greater than that from the stronger essential oils. Creasote may be reduced by the addition of an equal quantity of alcohol. It is the opinion, however, of Dr. Cormack and others, that although creasote affords respite from pain, it hastens the destruction of the teeth. Tincture of chloride of iron, and solution of persesquinitrate of iron, have also assuaged the pain.

Revellents, which act on other nervous ramifications than those implicated, often afford relief even in dental caries, although they would seem to be more advantageous in the neuralgic form. Hence, the chewing of tobacco—to one unaccustomed to it—of pepper, pyrethrum, ginger, the bark of aralia spinosa, (*angelica tree*, or *toothache tree*, of the United States,) horseradish, calamus, mezereon, or any agent, in short, which belongs to the class of local sialagogues, may yield relief. A union of narcotics and sialagogues—extract of belladonna, extract of hyoscyamus, opium, pyrethrum, and oil of cloves, in a pilular form—has been proposed, and highly extolled by Rust.

Where the decay is extensive, and the pain cannot be controlled by any of these agents, the tooth will have to be extracted.

4. **Nervous Toothache.**—Under this term many writers describe *neuralgia of the teeth*, which may be mistaken for ordinary toothache from caries, but may generally be distinguished from it by the history of the case, as well as by the pain being more periodical, and shooting with the utmost violence along the branches of the fifth pair distributed to the affected jaw.

For the treatment of this form of neuralgia, the general rules, laid down under the head of neuralgia, will be appropriate. The reliance of the practitioner has to be placed upon narcotics in large doses, administered internally, and applied locally—and upon revellents, as blisters behind the ears. In rheumatic odontalgia, which may be regarded as a variety of nervous odontalgia, the insertion of a little cotton, imbued with creasote, in the ear of the same side, has been found serviceable. A tincture of *spilanthus oleraceus* has been much recommended in France and Germany, as a secret remedy, in toothache, and it is only of late that its composition has been known. Its virtues are probably dependent upon its acting like the sialagogues before mentioned; all of which, by the way, are indicated in nervous odontalgia. The tincture of spilanthus is said to relieve toothache instantaneously, when applied to the gums and teeth. By others, it has been esteemed very uncertain. (See the writer's *Practice of Medicine*, 2d edit. i. 96, Philad. 1844.)

The various stimulating liniments, the milder counter-irritant lotion of Granville, (see Counter-irritation,) and sinapisms, have been used with advantage, applied over the cheek or behind the ears; and the more rapid the revulsion, the more effective it is in general. It is in such cases, too, that the efforts of the animal magnetizer and the Perkinist, and the employment of the mineral magnet, may be expected to prove beneficial.

To this division of toothache belongs that of the pregnant female, which may, likewise, be relieved by the agents just indicated. It cannot often be necessary to extract the tooth, an operation which should always be avoided, where practicable, for fear the shock may induce abortion.

5. **Exostosis of the Teeth.**—Like the bony structures elsewhere, the teeth are liable to exostosis. The deposition usually occurs in the fangs, but scarcely admits of detection. Violent, deep-seated pain, not relieved by the ordinary methods, induces the patient to have the tooth extracted, when the affection is, for the first time, apparent.

6. **Tartar of the Teeth.**—From the saliva, a calcareous matter is deposited, which concretes around the base of the coronæ of the teeth, and, at times, where due attention is not paid, accumulates in considerable quantities, causing the gums to inflame, and to be absorbed, so that the support to the teeth afforded by them is lost. The main constituent of these concretions is phosphate of lime, which is cemented by means of animal matter. It has, indeed, been affirmed by M. Mandl—as the result of his microscopic observations—that they are formed of calcareous skeletons of infusoria, agglutinated by means of dried mucus.

When first deposited, the *tartar* of the teeth—for so it is termed—is soft, of a yellowish colour, and easily removable; but, as it hardens, the colour becomes of a dark brown or black, and is extremely unsightly. When it accumulates in any quantity, it is impossible to cleanse the mouth properly, so that the secretions are retained there, and, at the temperature of the mouth, 98°, readily undergo decomposition, so as to taint the breath.

Attention to cleanliness, by the daily use of the tooth-brush, will prevent the formation of this concretion. The brush itself may be sufficient, but any of the ordinary dentifrices may be used along with it. There is no better "tooth powder" than a mixture of powdered charcoal and powdered orris-root, but there is no end to the dentifrices that have been recommended. Each dentist,—nay, each druggist,—has his own, which is, of course, extolled by him as the best; and none are, perhaps, positively injurious. It may be well, however, to bear in mind, that the reiterated friction of a hard brush, employed daily and for years, may have some effect, of itself, in injuring the teeth; and, therefore, that the brush should be used no longer at a time, and with no more force, than is necessary for the removal of the secretions. Where the tartar has already formed, and does not yield to simple friction of

the kind advised, dilute acids—which, as has been already observed, are objected to by the dentist, but without sufficient reason—may be employed. Weak sulphuric acid will usually remove the concretions without much difficulty; but, should it fail, the services of the dentist are demanded to scale the teeth; after which, the re-formation of the tartar may be prevented by the tooth-brush and dentifrices.

ROBLEY DUNGLISON.]

TOXICOLOGY.—This term is derived from τόξικον, *venenum*, (itself derived from τόξον, a *bow* or *arrow*, by metonymy a *poison*,) and λόγος. In its most extended sense it would include the discussion of the natural history and chemical habitudes of all substances capable, when applied to the living body, of exerting effects injurious to or destructive of life; of their physiological action and pathologic consequences; and of the appropriate means for controlling their deleterious influence, whether by the exhibition of antidotes or other medical treatment. There are few substances of animal, vegetable, or mineral origin, which may not, under certain circumstances, prove inimical to life; so that toxicology, in its most enlarged acceptation, is a science of almost boundless extent, and would require in order to its complete development, such an extensive acquaintance with many departments of natural knowledge as rarely falls to the lot of any individual. A treatise, however, upon such a plan would include a number of topics, in a practical point of view, entirely superfluous, and answering no other end than that of uselessly loading the memory and thus embarrassing the progress of the student. For all useful purposes it is sufficient for the toxicologist to concentrate his attention upon those natural and artificial products which are distinguished by the extreme energy with which they act upon the animal economy. The range of his inquiries is thus materially narrowed, while the many advantages to society to be expected from them, such as the preservation of life and health, the protection of innocence, and the punishment of guilt, may be considered as equally well secured. Even with this limitation the subject is still sufficiently extensive, and the present article is undertaken with a deep sense of the difficulty of presenting an outline of the science of toxicology which shall at the same time be instructive, and of such dimensions as to accord with the general plan of the work of which it is to form a part.

The classification of poisons is a problem of considerable difficulty, and one which has engaged the attention of successive toxicologists. The arrangement, it is obvious, of the subject matter of a science should be regulated by, and rendered subservient to, its principal objects. In animal and vegetable anatomy, for example, parts are with propriety grouped together which possess an analogous structure and which perform similar functions; in chemistry, bodies are arranged according to their composition and properties, the great end of the science being the determination of the constitution and the affections of matter. Upon similar grounds, in toxicology, the principal aim of which is the investigation of the modus operandi of poisons with a view to the counteraction of their deleterious effects, such an arrangement should, if possible, be adopted as would bring together substances which impress the system in the same way. An attempt at the arrangement of them on this plan has accordingly been made, (Paris's Pharmacologia, vol. i. p. 242,) but the practical advantages which might be expected to flow from it have not been realized, partly because the manner of action of deleterious agents is but imperfectly known, and partly because the same substance frequently acts upon the animal body in different ways,—that is, has a *remote* as well as a *local* action.

The arrangement of poisons at present generally adopted originated with Foderé, and has been slightly modified by Orfila and Christison. It is based upon the effects which, when administered, they are observed to produce. Some corrode or inflame the parts to which they are applied; others produce delirium or coma; while others determine sometimes an irritating, sometimes a narcotic effect. All are thus reduced to three classes, (Christison,) the first of which includes the *irritants*, the second the *narcotics*, and the third the *narcotico-acrids*. This classification is adopted throughout the present article, not because it fulfils all the conditions of a philosophical division, but as being the least imperfect of those which have been hitherto proposed.

The following is a tabular view of the principal known poisons, founded on this arrangement. Those derived from each of the three great kingdoms of nature are classed separately, and the gases are placed apart from the other poisonous substances, as, from the identity of their physical constitution, and in consequence of the action of all being principally exerted through the lungs, it will be convenient to discuss them in conjunction.

I.—IRRITANTS.

1.—*Mineral.*

- Aqua chlorinii.
- Chlorides of lime and soda.
- Iodine and hydriodate of potash.
- Sulphur and alkaline hydrosulphurets.
- Phosphorus.
- Sulphuric, nitric, and muriatic acids.
- Oxalic acid.
- Potash, soda, and their carbonates.
- Nitrate of potash.
- Ammonia and its sesquicarbonate.
- Muriate of gold.
- Nitrate of silver.
- Mercury.
- Arsenic.
- Copper.
- Lead.
- Zinc.
- Antimony.
- Bismuth.
- Tin.
- Barytes.

2.—*Vegetable.*

- Euphorbia officinarum.
- Jatropha curcas.
- Momordica elaterium.
- Cucumis colocynthus.
- Bryonia alba.

Ranunculus acris, &c.
Anemone pulsatilla.
Caltha palustris.
Delphinium staphysagria.
Daphne mezereon.
Juniperus sabino.
Convolvulus jalapa.
Narcissus pseudo-narcissus.
Gratiola officinalis,
Stalagmitis cambogioides.

3.—*Animal.*

Cantharides.
Poisonous fish.
Poisonous serpents.
Animal matter rendered poisonous by disease.
Animal matter rendered poisonous by putrefaction.

II.—Narcotics.

Prussic acid.
Opium.
Hyoscyamus niger.
Lactuca virosa et sativa.
Solanum nigrum et dulcamara.

III.—Narcotico-Acrids.

Atropa belladonna.
Datura stramonium.
Nicotiana tabacum.
Conium maculatum.
Cicuta virosa.
Œnanthe crocata.
Œthusa cynapium.
Aconitum napellus.
Helleborus niger.
Digitalis purpurea.
Veratrum album.
Colchicum autumnale.
Strychnos nux vomica.
Brucea antidysenterica.
Cocculus indicus.
Upas antiar.
Camphor.
Poisonous fungi.
Ergot of rye.
Alcohol.

IV.—Poisonous Gases.

The morbid consequences of every variety of poisons are obviously twofold; — *local*, or those produced in the part of the body to which it is applied; and *remote*, or those which are observed to ensue either in some distant organ, or throughout the system generally. The local action of a poison is either to *corrode*, to *inflame*, or to *paralyse* the part with which it comes into contact. Now these effects are, *per se*, very seldom the cause of death; and indeed, they never are so unless when the organ they affect is essential to life, and that its functions have been suspended or materially deranged. The influence, in fact, of poisons in destroying life must, in almost every instance, be traced to their remote effects. As a preliminary therefore to the individual examination of the several substances included in the preceding table, it will be necessary to inquire into the manner of transmission of their remote action, or through what channel, when locally applied, their influence becomes extended to distant organs.

The earliest views which have prevailed in reference to this point were that the remote effects of deleterious agents were due to the impressions which they make upon the sentient extremities of the nerves, which impressions are transmitted to the brain, and thence, by a reflex operation, to different parts of the body. In 1811, Mr. Brodie, in a paper published by him in the Philosophical Transactions, endeavoured to establish that while some poisons, as the essential oils of almonds and tobacco, the juice of aconite and woovara, *internally exhibited*, act by nervous impression, the same substances, with several others, when applied to wounds, pass by venous absorption into the circulation, in the course of which they are carried to the brain, whose functions they suspend or destroy by actual contact. Lastly, the old theory of the general action of poisons being the result of a sympathy between the nerves with which they come in contact and the brain, has been recently revived by Dr. Addison and Mr. Morgan, who have adduced in its support several weighty arguments and some very ingenious experiments. That many substances of a noxious nature do, at least occasionally, pass into the blood, would seem established by satisfactory experiments. There are, however, numerous facts which negative the supposition of absorption being necessary to their poisonous action. Some, as strong prussic acid, kill with such rapidity that it is impossible to refer their action to absorption and cerebral contact; and, in the case of others which operate more slowly, analysis seldom enables us to detect the slightest trace of them in the blood; a fact, however, which can scarcely be considered conclusive against absorption, in consequence of the comparative defectiveness of our means for conducting such delicate investigations. A celebrated experiment of Magendie was advanced by himself, and is often quoted by others, in support of the views which we are combating here. This eminent physiologist having reduced a dog to a state of stupor by opium, amputated one of its thighs, and then re-established the circulation through the member by the intervention of quills attached by ligatures to the cut ends of the femoral artery and vein above and below. An incision was now made in the paw of the amputated leg, and a small quantity of ticunas* inserted in it: after the usual time the animal was found to labour under the influence of the poison. The symptoms, however, were arrested by pressure on the vein above the amputation, but again returned upon allowing the blood to move forward. Here it is said, the limb having no connection with the body, the hypothesis of nervous impression cannot apply, so that the action of the poison can only be referred to absorption and cerebral contact; a conclusion supported by the effects of obstructing by pressure the passage of the blood towards the heart. Such an inference, however, by no means necessarily follows. Messrs. Morgan and Addison judiciously remark that all the experiment proves is, that the ticunas had passed into the circulation,—a circumstance the possibility of which they are not disposed to contest. Having once ascended beyond the quill connecting the amputated ends of the vein, its influence

* An American poison, the nature of which has not been well ascertained.

upon the system may be due to the impression which it makes upon the nervous fibrils which are distributed upon its internal coat, an impression which by sympathy is extended to the brain. The retardation of the symptoms also upon the application of pressure to the vein, admits of explanation by supposing that the function of the nerves supplying the vessel were thus interrupted owing to a temporary paralysis.

The physiologists just quoted would really seem to have rendered it highly probable that the inner coats of the blood-vessels are extremely susceptible of morbific impressions, and that the influence of poisons, when thus applied, is developed without any cerebral contact. Ticunas, for example, introduced into the femoral artery of a dog, produced death in 108 seconds; and when inserted in the carotid artery, was not fatal until after the same lapse of time, although in this case it must have been almost immediately conveyed to the brain. But that this poison may prove rapidly fatal without entering the blood at all, and of course without being conveyed to the brain, they established by the following decisive and well-contrived experiment.

Two large bull-dogs, each weighing about 40 lbs., were the animals selected. The carotid artery of each having been laid bare on one side, and separated from its connection with surrounding parts to the extent of three inches, temporary ligatures were applied above and below, and the arteries divided between them. Brass tubes were then attached to the extremities of the vessels, and the necks of the two animals being held and closely bound together, the divided vessels were so re-connected that the lower half of the carotid in the one animal became continuous with the upper half in the other. One of the dogs was then inoculated on the back with a concentrated preparation of strychnine, which had been found in previous experiments to produce death in such animals in about three minutes and a half. In three minutes and a half exactly, the inoculated animal exhibited the usual tetanic symptoms which result from the action of this poison, and died in about four minutes after. The arteries being secured by ligatures, the living was now separated from the dead animal; but neither during the progress of the experiment, nor at any subsequent period, did the survivor exhibit the slightest symptom of the action of the poison.

It is impossible to account for these results upon the hypothesis of *absorption*. Had such taken place, both animals would obviously have suffered equally from the influence of the poison; while, on the other hand, the immunity experienced by one of them is in perfect accordance with the theory of nervous impressions and cerebral sympathy.

It may also be observed that the doctrine here advocated is supported by analogy. When, as in tetanus, the general system becomes deranged by the infliction of a local injury of a mechanical kind, the effect can obviously only be attributed to a sympathy subsisting between the sensorium and the nerves of the wounded part. Are we not, therefore, it may be fairly asked, justified, when similar effects follow the application of a poison to any particular part of the body, to conclude that the medium of its operation is the same, or that the constitution becomes generally affected by reason of the sensorium sympathizing with the nerves to whose sentient extremities the poison is applied?

From these and other considerations which it is unnecessary to adduce here, we are disposed to concur in the conclusion, that though poisons may occasionally enter into the circulation, their deleterious effects are in almost every instance, if not all, to be ascribed to the impressions which they make upon the nerves with which they come in contact, which impressions are conveyed from them to the brain, and thence, by a reflex operation, to the different organs of the body. We wish, however, particularly to guard ourselves against being understood to deny the absorption of poisons. Many such have been detected by chemical examination in the blood, but almost invariably in cases where a considerable interval has elapsed between their administration and the death of the animal; and even in such instances the experiments of Addison and Morgan furnish the strongest grounds for believing that their deleterious influence was due, not to an immediate contact with the substance of the brain, but to their application to and the consequent impressions made upon the network of nervous fibrils spread upon the serous membrane, which lines the entire vascular system.

The presence, in the excretions, of nitre, rhubarb, turpentine, and other substances, which have been introduced into the stomach, has been generally considered as establishing the theory of absorption; for such substances, it is argued, must have passed through the blood. This reasoning, however, is far from being conclusive. Wollaston (Phil. Trans. 1811) exhibited the ferro-prussiate of potash to animals, and though he was always enabled to detect it in the urine, he never could find a trace of it in the blood. Indeed, the rapidity with which certain substances introduced into the primæ viæ pass into the bladder, renders it very improbable that they should have reached their destination through the circuitous route of the circulation; and Darwin, as is well known, was hence induced to attribute the phenomenon to what he denominated a retrograde action of the absorbent system. We are far from adopting this idea, but at the same time we are convinced of the facts which it was intended to account for, and perceive in them new objections to the theory of the absorption of poisons as generally taught and understood.

Lastly, it may be observed that the action of the more energetic narcotics, which destroy life in a few seconds, must of necessity be explained by the direct influence which they exert over the nervous system, and, as it is unphilosophical to refer similar effects to dissimilar causes, strong probable grounds are laid for the universality of the principle for which Addison and Morgan contend. Should alleged exceptions be adduced, it will at all events be necessary that they be sustained by direct experimental evidence.

There is another topic closely connected with the modus operandi of poisons, to which we shall now briefly advert. The derangement which follows upon their external application or internal exhibition is seldom the same all over the body.

A poison will specially affect some particular organ or organs, while others appear to be little if at all disturbed. Thus the power of tobacco and the upas antiar, as was long since noticed by Mr. Brodie, is principally exerted upon the heart. Opium, prussic acid, and a number of other narcotic drugs, act chiefly upon the brain, while the influence of the different vegetable which include strychnia and brucia is chiefly directed to the spinal cord. The action of some, indeed, is pretty equally distributed over the entire system. Yet, even in the case of these, we may recognise a tendency to assail some in preference to other structures. The ravages, for example, of mercury and arsenic extend to every part of the body. The former, however, as is well known, acts most forcibly upon the glands, the latter upon the mucous tissues: nor are these two metals peculiar in this respect. Every substance possessing medicinal efficacy, and many such are poisonous in an over-dose, has been introduced into our pharmacopœias, chiefly in consequence of possessing this very property. The terms anodyne, purgative, diuretic, diaphoretic, sialagogue, &c., &c., owe their origin to, and at the same time attest, the knowledge which we have acquired from experience of the determination to particular organs of the virtues of medicinal agents.

A question suggests itself here, which should not be passed over unnoticed. The fatal effects of poisons we have seen reason to ascribe to the sympathy of the brain with the nerves of the part to which they are applied. When the upas antiar, however, or infusion of tobacco, is used, the heart, as has been stated, appears the organ primarily affected, while the functions of the brain are undisturbed up to the instant of death. In such case is it not, it will be asked, more probable that the mischief is not done through the medium of the brain, but is the result of a direct sympathy between the heart and the structure subjected to the action of the poison? Such would certainly seem to be the most natural inference.

There is, nevertheless, an experiment of Brodie's which points to the opposite conclusion. Having decapitated a dog, and then injected nine ounces of an infusion of tobacco into its stomach, the phenomena which were observed to follow were different from those which occurred in his previous experiments upon living animals. Thus, instead of suspending, it quickened the motions of the heart; and the voluntary muscles, instead of experiencing the usual paralysis, were affected for some time with strong convulsions. Its effects, in fact, in the living animal are of a sedative, in the decapitated animal of an exciting kind. These results, if they can be relied upon, would certainly seem to justify the conclusion that the upas and infusion of tobacco do not constitute any exception to the general rule, that the remote action of poisons is exerted through the brain.

Of the circumstances which influence the action of a poison, the nature of the structure to which it is applied is that most deserving of notice. Experiment demonstrates that deleterious substances act with an energy proportional to the absorbing power of the tissue with which they are placed in contact; and this fact has been quoted as an argument in support of a theory, as to their manner of action, which we have already seen reason to reject. This argument loses all force, if we adopt, with Morgan and Addison, the opinion that the nervous fibrils distributed to the serous lining of the arterial and venous systems, are particularly susceptible of morbific impressions. Upon this hypothesis, we can understand why poisons should be more noxious when applied to serous than to mucous membranes, and to mucous membranes than when placed in apposition with the external surface of the body, and without being driven to the necessity of supposing that when they get into the circulation they are conveyed to the organ which they appear principally to affect.

The habits of individuals, as well as certain peculiarities of constitution usually referred to the head of idiosyncrasy, will also frequently modify in an important manner the operation of substances taken into the stomach. Thus there are many persons, as is well known to every physician, who cannot partake of certain kinds of food without experiencing, shortly afterward, nausea, vomiting, and purging; in a word, without the occurrence of the ordinary consequences of poisoning by the irritants. There are also individuals affected so violently by minute doses of powerful medicines, such as arsenic, mercury and opium, that the fact is explicable only upon a similar principle. We have, on the other hand, many instances of persons who from habit had acquired the power of swallowing with impunity enormous doses of the most powerful poisons. The writer has at present under his care a girl of twenty-three years of age, affected with obstinate hysteria, who has been for some years in the habit of consuming daily four ounces of tincture of opium; and a multitude of similar cases are upon record. Alcohol, even of the strength in which it exists in Irish whiskey, is a poison of such energy that ℥iii introduced into the stomach of a rabbit produced death in a few minutes; and yet there are in this city (Dublin) hundreds of individuals, particularly amongst the porters on the quays, who could swallow a pint without suffering perceptibly from the draught. In reference to this subject, Dr. Christison lays down a distinction, of the correctness of which doubts may, we think, be entertained. The immunity conferred by habit extends, according to him, merely to vegetable poisons, those derived from the mineral kingdom being as active in their effects upon the system after being used for a length of time, as at the very commencement. This statement is, we conceive, unfounded, for without referring to the very questionable case of Monsieur Chabert, who appeared to swallow arsenic, corrosive sublimate, &c., in handfuls, before affrighted spectators, we need scarcely observe that it is the invariable rule with the physician, when exhibiting these minerals medicinally, to begin with a very small dose, which he gradually increases, until at length such a quantity is given at once, and with impunity, as would, if administered in the first instance, have undoubtedly been productive of dangerous consequences.

After what has just been observed, it must be obvious that the effects produced by a poison will, *cæteris paribus*, depend upon the quantity of it which has been taken. But not only do the symptoms vary in degree, according to the amount

of the deleterious agent which has been administered, but a variation of the dose will, in certain cases, altogether change the manner of its action. The oxalic acid furnishes a good illustration of this position. In a large dose it corrodes the mucous membrane of the stomach and alimentary tract, producing all the effects of an escharotic poison, while in a smaller one it appears to be absorbed, and to have its injurious influence propagated, in the manner already explained, to remote organs. Corrosive sublimate and arsenic, administered in small quantity, produce certain specific effects which render them valuable as therapeutic agents, and in such cases are probably absorbed: but when taken in larger quantity, their action is chiefly directed to the mucous surface of the alimentary tract, which they inflame, and even occasionally destroy.

The state of aggregation of a poison has considerable influence upon the degree of action which it exerts. When dissolved in a menstruum, it is applied to the living organs by the greatest possible extent of surface, and is also in the best predicament for being absorbed. Consistently with this it is found that solubility augments the energy of deleterious agents; and that, on the other hand, when insoluble, they act with a vastly diminished force. The state of aggregation, it is said, also affects the manner of action of a poison, and camphor has been quoted as illustrating this statement; for, in mass, it has been found to produce gastric inflammation, while, when dissolved, tetanus and coma are the results which have been observed to follow its administration.

The activity of a poisonous agent may sometimes be greatly reduced by causing it to enter into chemical combination with a substance of a different kind: thus the corrosive action of an acid is diminished, and sometimes destroyed, by uniting it with an alkali, and that of an alkali by combining it with an acid. But, as Dr. Christison observes, this is only true of those agents which exert an exclusively local action. Poisons, the injurious action of which is the result of absorption and sympathy, are not disarmed of their virulence by causing them to enter into chemical combination, unless their solubility is thus diminished. If oxalic acid, for example, be united to lime, the resulting compound will be found inert, because of its insolubility; but if united to potash, the salt thus formed will be absorbed, and produce the same train of symptoms which would be the result of the administration of dilute oxalic acid. It may be also here observed, that the common practice of introducing fluids in large quantity into the stomach is not invariably proper. If the poison act merely as a local irritant, this action will be suspended by dilution; but should it be a substance capable of entering the blood, and thus affecting remote organs, dilution, instead of counteracting, will augment its virulence, for it will render it more easy of absorption.

From the preceding considerations certain maxims of general practical application may be deduced. When a poison is externally applied or internally exhibited, the first indication is obviously to remove it from contact with the organs to which it is applied, which, in the case of external poisoning, may be accomplished by means too obvious to require description; in the case of internal poisoning, by the exhibition of emetics, and by the use, if necessary, of the stomach-pump. If, in the latter case, or when the poison has been swallowed, these means do not succeed, and indeed often in conjunction with them, it will be necessary to have recourse to antidotes. Now these are of two kinds: the chemical and the physiological, or those which chemically combine with the deleterious agent, and so alter its properties or diminish its solubility as to render it inert; and those which excite in the system an action counter to that of the poison, or, at all events, one which neutralizes or prevents its usual injurious consequences. Of the first description of antidotes we possess many of well-established efficacy. Thus, common salt is an undoubted antidote to nitrate of silver, and sulphate of soda to muriate of barytes. In antidotes, however, of the other kind, or those which enable the system generally to resist the action of a poison, we are much more deficient. A few, however, are enumerated. Ammonia and chlorine are frequently applied, and sometimes with success, as counter-stimulants to the nares in cases of poisoning by prussic acid. The antimonial preparations, particularly tartar-emetic, are supposed to counteract the specific influence of mercury; and the salts of mercury, the deleterious influence of preparations of lead. That some of these substances possess the powers ascribed to them there can be no question. The number of such antidotes, however, as has been already stated, is small, and the protecting influence which they exert such as we shall frequently fail in calling into action. Our chief reliance must, therefore, be placed upon the removal of the poisonous substance with as much despatch as possible from the structures with which it is in apposition; or upon the administration of innoxious re-agents capable, by virtue of a chemical decomposition, of neutralizing their deleterious properties. If a poison which has been taken into the stomach has once passed into the vascular system, there is obviously no mode of recalling it or determining its expulsion from the blood. When, however, the absorption is the consequence of its application to a wound, this object may, according to Dr. Barry, be accomplished by the prompt application of the cupping-glass. The blood in the vicinity of the extremities of the divided vessels is thus sucked out, and when this treatment is resorted to sufficiently soon, the further consequences of the poison are, he alleges, completely prevented. With the application of the cupping-glass, it has been proposed by Vernière to combine the ligature of the chief vein leading from the wound, and to draw off subsequently the blood of the suspected vessel by venesection. The ligature of the vein alone is a sufficient protection according to Bouillaud, who has also established the interesting fact, that if occasionally relaxed for a few instants at successive intervals, so that the poison may be gradually introduced into the system, its influence is, as it were, so diluted, as not to be productive of the injurious consequences which would otherwise follow.

Proofs of poisoning. — In investigating a case of alleged poisoning, the circumstances which

must regulate the judgment which we shall pronounce, are only the following: — 1. The symptoms which occurred previous to death; 2. the morbid appearances visible after death; 3. the results of researches instituted for the detection of some deleterious substance in food, drink, or medicine, portions of which had been swallowed by the deceased, in matters discharged by vomiting, or in the contents of the alimentary tract; 4. the presence or absence of moral grounds for suspecting suicide or murder. Upon the latter topic it is not our intention to touch at all, as it belongs rather to a treatise on juridical medicine than to one on toxicology, properly so called; and indeed we may add, falls more within the province of the civil magistrate than of the medical practitioner. It is now universally admitted that symptoms alone can seldom, if at all, enable us with certainty to declare whether poison has been administered or not. Their adequacy as data for the solution of this important practical question can scarcely be maintained; for many natural diseases, such as cholera, gastritis, ulceration, and perforation of the coats of the stomach, intus-susceptio, strangulated hernia, peritonitis, melæna, hæmatemesis, &c. are attended by a train of symptoms not to be distinguished from those which accompany poisoning by the irritants, or even the narcotico-acrids; and it would be equally unsafe, from the absence of the usual concomitants of poisoning, to infer that nothing deleterious has been administered, inasmuch as there are many cases upon record, as we shall find in the sequel, where the most powerful poisons had been swallowed, and produced death, without the previous occurrence of those functional disturbances which they in general determine.

The observations just made upon the symptoms are equally true of the post-mortem appearances. When organic lesions of the intestinal tract are present, they do not prove, and, when absent, they do not disprove the administration of poison; for, on the one hand, deleterious agents of the narcotic class destroy life without the production of any visible morbid change; and, on the other, there is scarcely a pathologic consequence of poisoning by the irritants or narcotico-acrids, which is not occasionally simulated by the effects of spontaneous disease.

The most decisive proof of a poison having been administered consists in its detection in medicine, drink, or aliments partaken of by the affected individual, in matters rejected by vomiting, or in the contents of the intestinal tube. To arrive, however, at this species of proof, the person who conducts the investigation must be possessed of a variety of knowledge. He should be acquainted with the various products of the animal, the vegetable, and the mineral kingdom; or, in other words, he should be a zoologist, botanist, and mineralogist, particularly the two former; for occasions will sometimes arise in which the nature of a vegetable or animal poison can only be deduced from the observation of its external characters. But the success of his research will chiefly depend on the extent and accuracy of his chemical knowledge. In the vast majority of cases the deleterious agent is present in a form totally different from that which it presents in nature, and frequently in quantity so minute, or in such a state of combination, as to elude the investigation of those most expert in natural history. These difficulties, however, create but little embarrassment to the accomplished chemist; for, by the resources of his art, the poison, if present, is made to pass into other states of combination, in which properties are developed so striking as to be sufficiently obvious, when the substance which is the subject of experiment is present only in an infinitesimal quantity, and so characteristic that they distinguish it from every other form of matter.

But though chemistry unquestionably affords a more complete elucidation of the question under discussion than the other sciences which have been mentioned, and even in by much the greater proportion of cases leaves us nothing to desire, it must be admitted that it is not *all-sufficient*, and that difficulties sometimes present themselves with which it is unable to contend. Poisons, in fact, have been swallowed and produced death, and expert chemists have nevertheless been unable to detect the least trace of them either in the primæ viæ, or in the matters discharged by vomiting or stool. Such failures are obviously highly interesting in a practical point of view, and it will be proper now briefly to enumerate the causes to which they may be referred.

1. Deleterious substances, as we have already seen, are occasionally taken up by the lymphatic vessels or veins, and conveyed into the sanguiferous system. A poison may, therefore, have been taken, and nevertheless be incapable of detection, in consequence of having been removed by the process of absorption.

2. When the noxious substance is derived from the vegetable or animal kingdom, it, generally speaking, admits with comparative ease of decomposition, and there is even good reason to believe that its nature may be so altered under the influence of the digestive process, as no longer to exhibit the powers and properties which characterize it in a state of integrity. Should this opinion be well founded, and that it is there can be little doubt, the failure of chemistry to discover a poison in the primæ viæ cannot be received as a positive proof that such may not have been swallowed, and have produced the observed injurious consequences.

3. The delicacy of chemical processes is extreme, and by means of them we are enabled to detect deleterious agents when present in quantities amazingly small. These processes, however, have their limit, and it is easy to conceive the subject of experiment to include a quantity of a poison so minute as to elude the ablest and most experienced experimenter.

4. The precipitation of poisons in the insoluble form by the matters they meet with in the stomach, and their occasional incorporation with the coats of that viscus, constitute another great source of embarrassment, and the only additional one to which we feel it necessary to advert. These difficulties, however, it should be recollected do not establish the inutility of chemical investigation; they only show that it is not all-sufficient, and that, in order to its conducting to a satisfactory result, the necessary experiments should be

made by a person of accurate and extensive information, and one profoundly versed in the practical operations of the science.

Some one of the causes just recounted, or several of them combined, will sometimes render the results of our experimental inquiries uncertain or ambiguous; and in such cases we are bound, as far at least as respects an inculpated individual, to act as if the allegation of poisoning was altogether unsupported by proof. The symptoms, indeed, and morbid appearances may lead to suspicions, but these it is necessary to suppress, for, as has been already seen, they may be utterly unfounded.

It would probably be going too far to assert that the phenomena which precede, and the appearances which are presented after death, may not in particular cases, especially when combined with evidence of a moral kind, constitute a degree of proof which would enable the physician to pronounce that death was the result of poison. Cases of this description may arise, and indeed are admitted by the best toxicologists. They are, however, we believe, of very rare occurrence, and we feel satisfied that in every instance the safer and the wiser course for the medical practitioner to pursue, when consulted in reference to a case of alleged poisoning, will be to abstain from the declaration of any opinion tending to criminate an individual, unless he can rest such opinion upon the basis of experimental proof. But, it may be asked, does the detection of a poison in, let us suppose, the alimentary tract, demonstrate that the individual died of the consequences of its action? This question suggests considerations of a very important description, and which do not appear to have sufficiently arrested the attention of writers upon toxicology. It may be contended that the quantity found is much too small to permit us to conclude that it was the cause of death, or it may be said that the individual died from some other cause, and that the poison discovered had been introduced subsequently to his decease with the view of criminating an innocent person.

To the first of these objections little weight should be attached, for it is impossible to assign what is the least dose of one of the active poisons capable of producing, in any given instance, a fatal effect; and, moreover, the amount of the deleterious agent detected is no measure whatever of what may have been administered, inasmuch as a good deal of it may have been lost in the dejections and matters discharged from the stomach; or it may have been removed by absorption; or, finally, when of animal or vegetable origin, decomposed in the alimentary tract.

In dealing with the other case hypothetically suggested above, it will be essential to pay special attention to the symptoms present during life, and the appearances presented on dissection. Should these be of such a description as to correspond with those which are known to be characteristic of the action of the poison whose presence has been demonstrated, the case is divested of all difficulty, and the proof of poisoning is complete. But, on the contrary, should the usual symptoms and morbid appearances not have been observed, doubts may unquestionably be entertained as to the cause of death, and it will be particularly incumbent upon us to inquire whether there be anything in the history of the case calculated to justify a suspicion of the perpetration of the diabolical act above suggested, to explain the presence of the poison. In the absence of circumstances to sustain such supposition, there are at least highly probable grounds for concluding that the deleterious substance in question was the cause of the death of the individual; for, as we have already seen, cases of decided poisoning have occurred in which the characteristic symptoms and morbid appearances were entirely wanting.

Having disposed of those preliminary observations, we shall now proceed to the examination of the various individual poisons, beginning with the irritants, and premising a brief enumeration of the symptoms and morbid appearances which are the results of their action upon the animal body.

I. — Irritant Poisons.

Symptoms and morbid appearances produced by the irritant poisons.—When a poison of this class is internally administered, the consequences which it produces are either the immediate and complete destruction of the parts with which it comes into contact, (an effect determined by the more powerful escharotics alone,) or such a degree of irritation as leads to inflammation of some part of the intestinal tract, succeeded by its usual consequences — increased vascularity, effusion of coagulable lymph and occasionally of blood, ulceration, softening, and sometimes preternatural thickening of the villous coat, and, lastly, gangrene or slough. These effects are observable in the mouth and fauces, in the œsophagus, stomach, small and great intestines; but they do not invariably occur in all these places, nor in all with the same degree of intensity. Such being the pathologic condition of the intestinal tube, the accompanying symptoms may be easily conceived. The epigastrium becomes the seat of a burning pain, and shortly after vomiting ensues, by which the contents of the stomach are first rejected, and subsequently a viscid mucus streaked with and often containing coagula of blood. The epigastrium is obviously swollen, tense, and tender, and the distress felt in this region is greatly augmented by pressure. The inflammation is sometimes confined to the stomach, but more usually it extends to the lower intestines, producing general abdominal pain and tenderness upon pressure, purging accompanied by tenesmus, and bloody dejections. When the deleterious substance belongs to the class of escharotics and is either very soluble in water, or has been administered dissolved in some chemical menstruum, the mouth, tongue, and throat are the parts which first suffer from its action, and to which the earliest symptoms are referred. These are burning pain and a sense of constriction in the fauces, preventing or materially impeding the act of deglutition, and the entrance of air into the lungs. In addition to these local symptoms it may be also observed that the constitution will be always found to have undergone serious general disturbance. The pulse will be rapid and feeble; the countenance will be flushed, or exhibit a deadly paleness; there will be excessive prostration, and the entire body will be covered with a cold and clammy sweat.

From the preceding summary it is obvious that the effects of poisoning by the irritants resemble very closely those which result from many forms of natural disease; and, such being the case, it will be proper to follow the plan of most writers on toxicology by enumerating the diseases in question, and briefly touching upon the diagnostic means which are known to be of most practical value.

The maladies which may be mistaken for the effects of poisoning are bilious cholera, gastritis, enteritis, peritonitis, perforation of the stomach and intestines, melæna and hæmatemesis, colic, iliac passion, and obstructed intestine, whether produced by entanglement, intus-susceptio, or the strangulation of hernia; to which some add complete or partial rupture of the stomach, death from over-distension, and from cold water drunk while the body is strongly heated.

The malady first mentioned,—namely, the bilious cholera, is undoubtedly that which is most liable to be confounded with the effects of irritant and escharotic poisons. Distinctions, however, do exist, and these have been very clearly pointed out by Dr. Christison.

1. Cases of poisoning by the irritants occur in which the throat is entirely unaffected, but in the bilious cholera it is, after the vomiting has begun, invariably the seat of heat, of pain, and of a peculiar sense of acridity. In poisoning, when these symptoms are experienced, they frequently precede the vomiting, but this is never the case in cholera; and indeed in this disease they are, with much probability, referable to the contact of the irritating matters rejected from the stomach with the mucous membrane of the œsophagus and fauces.

2. In poisoning, the vomiting is frequently sanguinolent; in cholera, never.

3. The irritant poisons are much more frequently destructive, and produce death in a much shorter time, than the bilious cholera. Arsenic, for example, has often destroyed life in a few hours, while there are but a very few authentic cases upon record of cholera having terminated fatally until after the third day.

Acute gastritis of the idiopathic kind is, according to many practical authorities, a disease which is never met with. Thus Dr. Abercrombie states that he "had never seen a case which he could consider as being of that nature;" and Dr. Christison, who quotes him to this effect, makes a similar statement on the part of himself and several of his medical friends, and even seems disposed to deny the existence of any such affection. This opinion, however, is by no means generally received, for there are many alleged cases upon record of inflammation of the stomach arising from natural causes, and the writer of this article, unless he is much deceived, has had recently the management of one such. It would, indeed, be very singular if the stomach alone, of all the viscera, was exempted from being the subject of acute inflammatory action spontaneously arising. The determination of the question one way or another would, as Dr. Christison observes, be practically interesting; for if it were admitted that acute idiopathic gastritis does not exist, the symptoms and morbid appearances would frequently of themselves and without any chemical investigation, be sufficient evidence of the administration of poison. While, however, the point remains undecided, the following criterion is deserving of attention. In poisoning by the irritants, the throat is frequently affected before there is any evidence of gastric disturbance; but in idiopathic gastritis the burning pain and constriction of the fauces, if present at all, are never observed until after the occurrence of vomiting.

Enteritis, or inflammation of the intestines, may be confounded with the effects of the irritant poisons. The primary seat, however, of the pain and tenderness in such an affection, the almost uniform constipation of the bowels, and the morbid appearances, are sufficient to characterize it.

In peritonitis also, the pain and tenderness are first referred to the abdomen, and are not confined to any particular region of it. The bowels are usually constipated, and, lastly, there is vascularity of the peritoneal coat, and effusion of lymph and serum visible on dissection; circumstances which leave no doubt respecting the nature of the disease. These last, however, cannot, unfortunately, be rendered available to the purposes of diagnosis during life.

Spontaneous perforation of the stomach, an event much more common than was once supposed, is often attended by symptoms very analogous to those of irritant poisoning. This perforation may be the consequence of scirrhus in the stage of ulceration, in which case it is but the termination of a chronic disease. It is sometimes, however, the result of recent morbid action, and then occurs in the centre of a superficial ulcer of variable size. Lastly, the coats of the stomach become perforated, not by ulceration, but in virtue of a softening or gelatinization which occupies the villous and even muscular coat, and finally destroys them as well as the peritoneal covering over a certain extent of surface. The opinions of pathologists do not appear to be made up respecting the nature of this latter disease, some, particularly those of the French school, referring it to a morbid action set on foot in the living body, while others, with John Hunter, ascribe it to the solvent action of the gastric juice exerted after death upon the parietes of the stomach.

When scirrhus of the stomach terminates in perforation, the nature of the malady will be pretty well determined by the history of the previous symptoms, and is completely unfolded by inspection after death.

In the second form of perforation, or that which is the result of recent disease, the diagnosis presents greater difficulty, and cannot be made to rest upon any peculiarities in the form or appearance of the ulcer, for such peculiarities are not to be recognised. When, indeed, the mischief is the result of an irritant, or, as is more usually the case, of a corrosive poison, the deleterious agent is said to be sometimes found, if of difficult solubility, adhering to the circumference of the perforation. But this is obviously a circumstance which will but rarely be found to obtain, and to which, therefore, as a characteristic mark, but little value can be attached.

In the destruction of the coats of the stomach by gelatinization or solution, the viscus, so far from exhibiting any degree of increased vascular-

ity, is unusually white, the amount of corrosion is generally extensive, and the parietes are thinned down towards the edge of the orifice; all which circumstances are the very opposite of those observed when the perforation is the consequence of an ulcer caused by some deleterious agent. In this latter case the villous coat of the stomach, particularly the part adjacent to the perforation, is preternaturally vascular, the opening is small in size, abrupt, and exhibits thickened edges; to which we may add, as has been already remarked, that adhering to its edges will occasionally be found some remnants of the poison swallowed; and, lastly, that in the colour of the circumference of the perforation we shall have indications of the nature of the agent by which it was produced, this colour being dark in the case of oil of vitriol, orange in that of iodine, yellow in that of nitric acid, &c. It is scarcely necessary to observe that in this, as well as in every other instance, where the symptoms and morbid appearances are not sufficiently characteristic, chemical analysis will be found our most valuable resource. When by means of it poison is detected in a perforated stomach, all obscurity is removed from the case; whereas, in the opposite event, still stronger grounds than any previously existing are established for tracing the injury in question to natural disease. (See the articles PERFORATION, SOFTENING OF ORGANS, STOMACH, ORGANIC DISEASES OF THE.)

Stricture of the œsophagus is a common consequence of the swallowing of corrosive poisons, but they are not known to have ever produced its perforation, though this has sometimes occurred as a consequence of natural disease.

The parietes of the great and small intestines are also sometimes penetrated by ulcers, but such are seldom, if ever, the results of the action of escharotics, for these will scarcely be permitted by the pylorus to pass into the lower intestines in such a state of concentration as to be capable of effecting the chemical corrosion of their coats. The simple irritants indeed may give rise to such perforations, and, when they do, there is no other mode than chemical analysis of determining whether they are due to such a cause or to spontaneous disease.

Colic is distinguished from poisoning by the absence of vomiting and purging, by the seat and the nature of the pain.

Hæmatemesis and melæna are sufficiently characterized by the nature of the fluids discharged.

In iliac passion stercoraceous matter is discharged by vomiting, a thing which never occurs in cases of poisoning.

In intus-susceptio the pain commences at some part in the abdomen, and there is obstinate constipation.

In strangulated hernia the same phenomena are observed, and, in addition, there is an external tumour.

As to death from drinking cold water while the body is warm, from simple distension or rupture of the stomach, enumerated by some writers, such cases will, generally speaking, be readily distinguished from the consequences of the administration of poison, by the history and accompanying symptoms, or, at all events, by the post-mortem examination. [See, on all this subject, Mr. Taylor's Report on Toxicology, in *Brit. and For. Med. Rev.* for Oct. 1844, p. 533.]

1. *Mineral Irritants.*

Aqua Chlorinii.—Water at the temperature of 60° absorbs about two volumes of chlorine, affording a solution having the yellowish-green colour and pungent odour of the gas. By keeping, it gradually loses its colour and smell, and is finally converted by the decomposition of water into a dilute muriatic acid, oxygen at the same time escaping.

There is a formula for the preparation of an "aqua chlorinii" in the Dublin Pharmacopœia, and it is pretty generally used as a tonic and antiseptic medicine in doses of from half a drachm to a drachm diluted with water. In an over-dose it would, no doubt, act as a powerful irritant, and produce inflammation and its consequences in the stomach and intestinal tube. In experiments performed by Orfila, five ounces of strong chlorine water killed a dog in twenty-four hours, and two ounces diluted with a double weight of water destroyed another in four days, the morbid appearances in the former being general redness and blackness, and in the latter ulceration of the villous coat.

Aqua chlorinii may be recognised by its smell, and by its faculty of dissolving gold and of discharging vegetable colours. In testing this latter power a diluted solution of sulphate of indigo, or paper tinged with litmus, is the best substance to employ. A solution of albumen or the white of an egg is as good an antidote to its effects as can be exhibited. It combines with the chlorine, and is coagulated by it as it would be by corrosive sublimate.

Chlorides of Lime and Soda.—The chloride of lime, as manufactured, is a white powder evolving a feeble smell of chlorine. A solution of it, however, is at present sold by the druggist for medical purposes, and this is likewise the form in which the chloride of soda is to be met with. The effects of these chlorides in large doses upon the animal economy have not been experimentally studied, but there is no doubt that, like chlorine itself, they would operate as irritants, and produce inflammation of the stomach and bowels. They are readily distinguished by evolving chlorine upon the addition of acetic acid, and thus affording solutions which exercise powerful bleaching properties. By a solution of green vitriol they are immediately brought to the state of muriates, a form in which they may be considered as comparatively inert. This salt would, therefore, seem an advisable antidote.

Iodine and Hydriodate of Potash [*Iodide of Potassium*].—Iodine is a simple substance of a steel grey colour and metallic lustre, usually occurring in tabular prismatic plates, friable, evolving an odour analogous to that of chlorine, and converted by the application of heat into a violet vapour. When exhibited in an over-dose to the extent, for example, of ten or twenty grains, it operates as an irritant poison, producing a sense of constriction in the fauces, nausea, epigastric pain augmented upon pressure, vomiting, and colic. These symptoms, however, do not invariably occur, and, indeed, there is reason to believe that its in-

jurious action upon the economy has been overrated. When administered for a considerable time in medicinal doses, effects have sometimes been observed finally to ensue analogous to those just described, and in addition, diarrhœa, pain and tenderness in the region of the liver, cramps, general emaciation, and, in particular, a wasting of the larger glands, as the mammæ and the testicles. In other cases complete anorexia, tremours, palpitation, and repeated syncope have been noted amongst the effects of its long-continued use. The morbid appearances which presented themselves in a case of slow poisoning by iodine recorded by Link, were redness of the mucous membrane of the stomach and intestines at several points, adhesion of the intestines by their peritoneal covering, together with effusion into the abdominal cavity, distension of the intestinal tube with gases, and enlargement, accompanied by a slight redness, of the liver. Effusion into the sac of the pleura was also observed by him.

The hydriodate of potash is also an irritant poison, producing all the symptoms and morbid changes which result from the use of iodine. The latter, according to Orfila, given to the extent of two drachms, killed a dog in seven days. The former, in a similar dose, caused death in three days in an experiment performed by Devergie. Notwithstanding these experiments, however, there can be no doubt that the action of the hydriodate on the human subject is much less energetic than that of iodine.

In the solid form iodine is easily recognised by the application of heat, which converts it into a violet vapour. In the fluid form its presence may be demonstrated in a similar manner, or by the addition of a cold aqueous solution of starch, which affords with it a beautiful blue precipitate. The hydriodate of potash affords with the proto-salts of mercury a yellowish green, with the per-salts of mercury a scarlet precipitate, and with the soluble salts of lead a yellow precipitate very similar to chromate of lead. The hydriodate of potash may also be tested for by developing the iodine by the addition of a drop of nitric acid or chlorine water, and subsequently adding the solution of starch. Should the chlorine water be employed, care should be taken not to add an excess of it, for this would prevent the formation of the blue precipitate.

To detect iodine in a coloured fluid containing organic matters, the following process, the outline of which is given by Christison, should be pursued.

Supersaturate with caustic potash, evaporate to dryness, and ignite the residuum, taking care to apply but a low red heat, otherwise the iodide of potassium would sublime. Alcohol digested upon the residuum will take up the iodide of potassium, which, after the removal of the alcohol, and the addition of water, may be tested for with nitric acid and solution of starch, as already described. The conversion of any free iodine into hydriodic acid by sulphuretted hydrogen, directed by Christison in the commencement of the process before adding the potash, is unnecessary; for any iodate formed by the action of the alkali on the iodine is converted by the heat applied into iodide of potassium. Iodine is readily detected in the urine of patients using it as a medicine. It exists in the form of a hydriodate.

In a case of poisoning by a large dose of iodine, starch, or what amounts nearly to the same thing, wheaten flour, would probably be an advisable antidote to exhibit.

Sulphur and the Alkaline Hydrosulphurets.—Sulphur in medicinal doses operates as a laxative, and in larger ones irritates and inflames the intestinal tract. Its action, however, is not sufficiently energetic to entitle it to a detailed notice among the irritant poisons.

Hydrosulphuret of Ammonia.—This compound, a solution of which is prepared for medicinal purposes by passing sulphuretted hydrogen into water of ammonia, proves an irritant to the different parts with which it is brought in contact, and, like arsenic, inflames the stomach, whether introduced into this viscus, or applied externally to a wound. When internally administered to dogs and rabbits, Arnold found it to produce palpitation, excessive debility, slow breathing, and tetanic spasms. Its poisonous action has hitherto been witnessed only in the lower animals.

A good antidote to exhibit would be a solution of green vitriol or some other soluble chalybeate salt.

The other alkaline hydrosulphurets possess similar poisonous powers.

Phosphorus.—This remarkable substance has been prescribed by some physicians as a general tonic and corroborant, and, in particular, to stimulate the genital organs. Experiments made on the lower animals by Orfila prove it to be a powerful poison, producing irritation and inflammation of the different parts of the intestinal tract; and there are two cases upon record in which, in very small doses, it has proved fatal even to man. In the primæ viæ it is converted into phosphoric acid, and partly into phosphuretted hydrogen, as may be collected from the alliaceous odour of the matters discharged by vomiting. The symptoms and morbid appearances are analogous to those produced by the mineral acids, and which will be presently described.

Phosphorus in the pure state possesses properties so peculiar as to prevent it from being confounded with any other known substance. In the form of phosphoric acid it may be distinguished by its fixity at a low red heat, by precipitating albumen after it has been ignited, but not before, and by producing, when neutralized with an alkali, in the latter case a yellow, in the former a white precipitate with nitrate of silver, both of which are soluble in ammonia and nitric acid.

[A case of poisoning by phosphorus has been described lately in the journals. (*London Lancet*, Dec. 1843.)]

Sulphuric, Nitric, and Muriatic Acid.—These acids offer examples of purely corrosive poisons, or of such as give rise to no other effects upon the system than what are the results of the disorganization they produce, and of the consequent impressions made by them upon the nervous system. They may be conveniently discussed in conjunction, inasmuch as the symptoms they excite are very similar, and, as has just been observed, their manner of action is the same. Tartra, who has studied this subject with great

attention, describes two distinct varieties of fatal poisoning by the mineral varieties.

The symptoms of the severer form are excessive debility, feeble and irregular pulse, general coldness and clamminess of the body, particularly of the extremities, repeated vomiting, the matters discharged being highly acid, and containing shreds of a coagulated mucus, occasionally portions of the villous lining of the œsophagus and stomach; a sense of burning heat in the throat and stomach, epigastric pain augmented by pressure, constipation of bowels, scanty urine, and, very generally, distressing tenesmus. [The difficulty of respiration is, at times, so great as to render tracheotomy necessary, especially in young subjects. (*Lond. Med. Gaz.* xii. 220.)] Death relieves the patient from his sufferings sometimes in a few hours, but more generally not for two or three days; and there are even cases upon record which did not prove fatal until the fifteenth.

In the second variety we have, at first, all the symptoms which have been just enumerated, but these after a short time subside, and are succeeded by others of scarcely a less formidable description. The belly becomes distended, the respiration quick and embarrassed, the limbs are affected with pains and also with spasms. Profuse salivation sets in, and this after a little time is accompanied by a peculiarly offensive smell. The skin is dry and hot, the tongue parched, the pulse quick and strong; in a word, there is general fever: the vomiting also recurs at intervals, membranous flakes being discharged in quantity; digestion appears almost suspended, and the individual finally sinks into a state of extreme emaciation.

Where the poisoning does not terminate fatally, the recovery, nevertheless, is not always perfect. The stomach, in certain cases, ever after continues irritable, is often affected with pain, and frequently rejects its contents, particularly if the food employed be of a stimulating nature, or such as the individual has not been in the habit of using.

The morbid appearances are easily given, being such as might be anticipated from the symptoms just detailed, and from the corrosive nature of the poisonous agents in question.

In the more rapidly fatal cases there is no wasting, and the body exhibits its usual appearance. Spots or stains are observed on the lips, and occasionally upon the adjacent parts of the face, of a dark brown colour when due to the sulphuric, and of a yellowish tinge when to the nitric acid. The teeth are similarly discoloured. The mucous membrane lining the mouth presents a hardened and glazed appearance. It is white or brownish from oil of vitriol, and yellowish or orange from aquafortis. The appearance of the pharynx is sometimes the same with that of the mouth; sometimes it is red and highly vascular, and the inflammation will also occasionally be found to have extended to the glottis and top of the larynx. The œsophagus is sometimes entirely destitute of its inner coat, (the same may be said of the mouth and pharynx,) and lined with an adventitious membrane of a yellow colour, and which adheres firmly to the subjacent parts. The stomach is in a state of distension from gases, its pyloric orifice is contracted, and it contains a quantity of semi-fluid matter of a dark colour, apparently composed of blood, mucus, and decomposed animal structures.

The mucous membrane itself is either in a state of high inflammation and vascular injection, the blood in the vessels being of a dark colour; or its rugæ are removed, as it were, by a process of solution at several points; or studded with ulcers discharging pus; or, lastly, in a condition resembling a charred or half-burned towel. The walls of the viscus are sometimes traversed by a circular perforation of variable size, the edges of which are thin at the margin, of a dark or yellow colour and invested more externally with a highly vascular ring or corona. Cases have occurred in which the œsophagus exhibited no morbid appearance whatever, and the only lesion to be observed in the stomach was a single perforation. The jejunum and lower intestines are often unaffected, an exemption which is probably due, as Christison has suggested, to the spasmodic closing of the pylorus. In cases of perforation, peritonitis and its consequences, namely, the effusion of serum and lymph, are, of course, observed, unless death should very rapidly supervene.

The blood has been found in large coagula or clots in the heart and great vessels, and these are described as exhibiting a particularly dark appearance.

In the more protracted variety the body is in a state of extreme marasmus, the stomach is contracted enormously in size, and the calibre of the intestine so much reduced as to permit with difficulty the passage of a quill at particular parts. The pyloric orifice of the stomach is also in a state of stricture or inordinate contraction.

[Cases are on record in which two ounces of sulphuric acid have been taken without fatal results. The smallest fatal dose which Dr. Christison (*Treatise on Poisons*, 3d edit. Edinb. 1836) has recorded, is one drachm. It was taken by mistake by a stout young man, and killed him in seven days. Mr. A. Taylor (*Manual of Medical Jurisprudence*, p. 90, Lond. 1844) says the smallest quantity which he has been able to meet with as seeming to have proved fatal, was in the following case: Half a teaspoonful of concentrated sulphuric acid was given to a child about a year old by mistake for castor oil. The usual symptoms came on, with great disturbance of the respiratory functions, and the child died in twenty-four hours. The quantity taken could not have exceeded forty drops. (*Lond. Med. Gaz.* xxix. 147.)

The smallest quantity of nitric acid, which Mr. Taylor finds reported to have destroyed life, is about two drachms.

The smallest fatal dose of muriatic acid was about an ounce. The patients died in fifteen hours.]

Tests for Sulphuric Acid. — The oily consistence, soapy feel between the fingers, power of charring bits of paper, slips of wood, &c., and of evolving considerable heat when mixed with water, are so many familiar characters by which the concentrated acid may be recognised. To apply to it chemical tests, it will be convenient to reduce its strength by the addition of seven or eight times its weight of water. Upon adding to it, in this diluted state, muriate of barytes, it will afford a

white precipitate insoluble in water or any other menstruum but boiling-hot oil of vitriol. This precipitate also, if mixed with an equal bulk of lamp-black and heated (rolled up in platina foil) to redness over the spirit-lamp, will yield to water a solution which will give, with acetate of lead, a black, and with tartar emetic, an orange precipitate. To this process it may be objected that the barytic precipitate is due, not to free sulphuric acid, but to a soluble sulphate existing in the acid solution. To obviate this objection, the acid should be boiled upon carbonate of barytes until it is neutralized, and any excess of carbonate removed by the action of muriatic acid. The residual powder, if any, should be now subjected to the tests above described, for the purpose of proving it to be sulphate of barytes. In practising this method, it is indispensable to attend to the following precautions:—

1. To wash the mixed sulphate and carbonate of barytes diligently with distilled water, for the purpose of removing the soluble sulphates before adding an acid to dissolve the carbonate. 2. To remove, before the addition of the carbonate of barytes, any free muriatic, nitric, or acetic acid; for these would form, with the carbonate of barytes, barytic salts, which would be decomposed by any soluble sulphate present, and afford a sulphate of barytes even though there were no free sulphuric acid. To remove the acids which have been mentioned, it will be sufficient to evaporate the solution, at a temperature of about 300 degrees, in a porcelain capsule, as long as acid vapours continue to be evolved.

The chemical evidence in support of poisoning by oil of vitriol, is supposed not to be complete unless the acid be detected in the free state. This, however, cannot always be accomplished, even in cases where it has been swallowed in the uncombined form. Should antidotes, such as the carbonates of lime and magnesia, have been exhibited, they will neutralize it, and there are even cases on record in which this has been achieved by the spontaneous development, in the stomach, of ammonia, the result of incipient putrefaction.

For these reasons, and because the normal secretions and usual contents of the stomach contain soluble sulphates, the detection of the acid in a state of combination can by no means be considered, *per se*, as a proof that sulphuric acid was swallowed. But when the amount of these sulphates is unusually large, (and their amount may be easily ascertained by the addition of muriate of barytes, to the washings of the precipitate got by neutralizing the sulphuric acid with carbonate of barytes, as already explained,) strong grounds are undoubtedly laid for suspecting the administration of oil of vitriol, and these will, of course, be strengthened by the occurrence of any circumstances in the history of the case which may account for its neutralization.

The existence of stains upon the clothes frequently affords important collateral evidence in cases of suspected poisoning by the mineral acids. From the stained parts also, by digestion with distilled water, a sufficiency of free acid may often be extracted to subject to the operation of tests. A portion of it, however, is always in a state of combination, usually with ammonia.

Tests for Nitric Acid.—Nitric acid, when pure, is a colourless fluid, but, as usually met with, it presents an orange tinge, owing to the presence of nitrous acid. When strong, it emits white vapours in the air, stains the cuticle of a permanent yellow, which is heightened by contact with ammonia, and dissolves silver, copper, zinc, iron, &c., with the copious evolution of orange vapours.

In the pure state, or when merely diluted with water, it is identified by the following properties:—1. When brought into contact with copper, a colourless gas (the nitric oxide) is given off, which, by contact with the oxygen of the air, becomes an orange vapour, and when passed into a solution of green vitriol, communicates to it a dark colour. 2. With an aqueous solution of urea it affords a precipitate composed of crystalline pearly scales. 3. It discharges the colour of sulphate of indigo, or rather changes it to an orange. 4. By the addition of muriatic acid it acquires the power of dissolving gold. 5. When touched by a crystal of morphia the latter acquires a deep red or orange colour.

The first test is quite decisive, but it can scarcely be applied in a satisfactory manner where the quantity of acid is but small. In such a case the better mode of proceeding will be to saturate the acid with potash, and, having evaporated the solution nearly to dryness, to add sulphuric acid and a couple of crystals of green vitriol. The sulphuric acid will liberate the nitric acid, and this, by contact with the protosulphate of iron, will be resolved into oxygen and nitric oxide, the latter of which produces a dark annulus about the crystals, in consequence of being absorbed by such portion of them as has been dissolved, while the former converts more of the solution into a persalt. The second method given above is open to the objection of urea affording with oxalic acid a similar precipitate. The characters of the oxalic, however, are so distinct from those of the nitric acid, that no difficulty can occur in distinguishing them from each other.

The accuracy of the sulphate of indigo test, first proposed by Liebeig, has been called in question by Dr. O'Shaughnessy, who states that a similar discoloration is produced by several other agents besides the nitric acid. This would, undoubtedly, be effected by the chloric, iodic, and bromic acids, which resemble the nitric acid so closely in composition, also by sulphurous acid, protomuriate of tin, and, according to Dr. O'Shaughnessy, by permuriate of iron. We cannot, however, subscribe to the statement that pure sulphuric or muriatic acids are capable of discharging the blue colour of sulphate of indigo. Should muriatic acid include, as it frequently does, permuriate of iron, sulphurous acid gas, or a trace of chlorine, iodine, or bromium, it will no doubt act as a decolorizing agent; but, when entirely free from such impurities, we find it to exert no action whatever on the sulphate of indigo. Dilute sulphuric acid we consider as equally inert, but, in the concentrated state and at the temperature of ebullition, sulphurous acid is developed, to which any bleaching powers exerted are, we believe, to be ascribed. If these views be correct, the solution of indigo in sulphuric acid may with proper precautions be

employed as a valuable auxiliary test in searching for nitric acid.

The fourth method of conducting the investigation was first suggested by Dr. Marcet, and is founded on the fact that when nitric and muriatic acids are mixed, chlorine is set free, an agent which possesses the power of dissolving gold. A similar power, and one due to the same element, is developed upon adding muriatic acid to the chloric, iodic, bromic, or chromic acids. From the rarity, however, of these acids, (they do not, in fact, exist as natural products,) the process cannot, on such account, be considered as practically impugned. In practising the last of the methods noticed above, it is essential that the morphia be not perfectly pure, for in this state its colour is not affected by the nitric acid. The sulphuric and muriatic acids communicate, not a red, but a dark colour to crystals of morphia with which they are heated.

When the quantity of acid is small, (which indeed will be always the case where it is sought for in stains made on the skin or clothes, after being extracted from these by repeated digestions with distilled water,) the solution should be saturated with potash, and the residuum obtained by evaporation to dryness introduced into a glass tube, and heated with a few drops of oil of vitriol so as to liberate the nitric acid. If the latter be present, it will communicate a deep orange colour to a crystal of morphia dropped into the tube. This method, which is susceptible of great delicacy, was first proposed by Dr. O'Shaughnessy.

When the nitric acid is sought for in the intestinal tract, where it is necessarily mixed with animal fluids, it should, as before, be neutralized by potash and crystals of nitre, if possible, obtained by filtration and evaporation, from which the nitric acid is subsequently to be liberated by means of oil of vitriol. The animal matter will sometimes prevent in this process the crystallization of the nitre; and if the filtered solution be merely evaporated to dryness, it will, in consequence of the presence of chloride of sodium, frequently evolve, upon being heated with the oil of vitriol, chlorine, and no nitric acid. The evolution of the chlorine, however, may, upon the principle of Marcet's method, be looked upon as proving the presence of a nitrate, so that further investigation becomes unnecessary. To apply, indeed, the test by morphia, it will be necessary to develop the nitric acid itself; and when this is deemed essential, we must resort to the following method laid down by Christison. Saturate the fluid with potash, filter, and then add acetate of silver as long as there is any precipitate. This will throw down the chlorine of the common salt in the form of chloride of silver, and will also determine the coagulation of the animal matters present and the clarification of the fluid. Upon now filtering a second time, evaporating to dryness, and acting with oil of vitriol upon the residuum introduced into a glass tube, nitric acid will be set free and may be tested by the introduction of a crystal of morphia into the tube.

[In the Annual Report of Berzelius, cited by Dr. T. R. Beck, (*Amer. Journ. of the Med. Sciences*, Oct. 1843, p. 498, from the *Pharmaceutical Transactions*, March, 1843,) an easy method of determining the presence of nitric acid is given on the authority of M. Berthemot. About a drachm of concentrated sulphuric acid, free from nitric acid, is to be placed in a glass, and to this are added a few drops of the liquid suspected to contain nitric acid. These are mixed together with a glass rod, and then, with the moist extremity of the rod, a small piece of brucia is introduced into the mixture, and the whole stirred together. If nitric acid be present, a red colour will be immediately developed, which will afterwards pass to yellow. If there be no nitric acid, the brucia will not dissolve. By this means, the presence of $\frac{1}{100000}$th part of nitric acid may be detected in a liquid.]

Tests for muriatic acid.—The action of this acid when concentrated is analogous to, but less intense than that of the sulphuric acid, and the same may be said of the symptoms and morbid changes it produces. In the pure state, or when merely combined with water, it is at once detected by the addition of nitrate, or, what is better, sulphate of silver, which affords with it a precipitate, the chloride of silver, possessing the following characters: — it is white, but blackens upon exposure to light, particularly the most refrangible rays; it is insoluble in nitric acid, but dissolves readily in aqua ammoniæ and the solutions of the alkaline hypo-sulphites; lastly, it fuses into a sectile horny mass at a temperature considerably below a red heat. Should the acid be sought for in the contents of the stomach, the formation of a precipitate on the addition of the soluble salts of silver will take place, even though no muriatic acid has been swallowed, in consequence of the presence in this viscus of the chlorides of potassium and sodium, and the muriate of ammonia. In such case it will be necessary to begin by distilling off the free acid, which may be accomplished by means of a gas-bottle furnished with a tube bent twice at right angles, and dipping into a bottle of distilled water to within a short distance of the surface of the fluid. By this process the free muriatic acid is distilled over, and a solution obtained which may be treated in the manner already described when speaking of the pure acid.

In investigations of this description, it should be recollected that pure muriatic acid exists in the stomach during digestion in association with the acetic, as has been amply proved by the experiments of Prout, Gmelin, and Lassaigne. The quantity, however, is so small, not exceeding in an experiment of Prout's, in which the gastric secretion was morbidly acid, a quarter of a grain in the ounce, that this natural source of the acid can scarcely create any serious embarrassment to the toxicologist.

Treatment of poisoning by the mineral acids.—This must of course consist either in removing the acids from contact with the animal structure on which they are acting, or in depriving them, by the exhibition of proper antidotes, of their injurious powers. The latter is much more easy of execution than the former, and is therefore that usually attempted. Their escharotic action may be suspended by copious dilution, or by combining them with bases so as to convert them into innoxious saline compounds. It should, however, be recollected that the strong acids, particularly

the nitric and sulphuric, are very rapid in their action on animal textures, and that we can, therefore, never expect to accomplish, by the administration of either variety of antidote, any thing further than the suspension of the corrosive influence which they have been exerting. A certain amount of mischief is always necessarily inflicted, the effects of which can only be combated by general medical treatment. Water being always at hand should be repeatedly and copiously exhibited. The poison thus diluted is no longer a corrosive, but, in consequence of the injury already done to the mucous membrane, it operates upon it as a powerful irritant. To annihilate this effect we must combine the acid with some base, and that most likely to be at hand, and which at the same time answers the purpose well, is powdered chalk, limestone, or old mortar. If carbonate of magnesia be within reach, it is preferable; but the magnesia usta, which is frequently recommended by toxicologists, should on no account be employed. The heat, in fact, which results from its union with an acid is such as would of itself produce inflammation, or even disorganization of the stomach. In the absence of these bases a solution of soap may be advantageously exhibited; but the alkaline carbonates, if administered at all, should be given with caution, inasmuch as they are themselves poisonous substances. The after treatment must be antiphlogistic, and conducted upon general principles.

[**Sulphate of Indigo** has been taken accidentally, and has proved fatal. It is a solution of indigo in sulphuric acid, and produces the same effect as the latter. It may be suspected when, along with the symptoms of poisoning by sulphuric acid, the lining membrane of the mouth has a blue colour. The vomited matters will, likewise, be tinged blue; and, in the case of a girl, who swallowed an ounce, and died eleven hours afterwards, it was remarked, that the urine which she passed was tinged blue. After death, the mucous membrane of the lower part of the intestinal canal presented patches of a blue colour. In another case, observed by Orfila, a child which died in seven hours and a half, the urine was also tinged blue. (Taylor, *Manual of Medical Jurisprudence*, p. 97, Lond. 1844.)]

Oxalic acid. [*Binoxalate of potash, Salt of sorrel.*]—There is no poison more interesting to the toxicologist than the oxalic acid. It has been very frequently taken in mistake for Epsom salt, to which it bears a close resemblance; and from the certainty and rapidity with which it destroys life, and the facility with which it can be procured, it is very likely to be, and actually has been, employed as an instrument of murder.

[In the return of the coroners of England for 1837-8, there were nineteen cases of poisoning by this substance, of which number fourteen were the result of suicide. (Taylor, *Op. cit.* p. 117.)]

When injected in small quantity into a vein, it proves almost immediately fatal, and it is scarcely less energetic in its action when applied to a wound or introduced into the sac of the peritoneum or pleura. It is a powerful poison also when taken into the stomach. The structure through which it acts with most slowness is the subcutaneous cellular tissue. The entire subject of poisoning by oxalic acid has been investigated with much success by Drs. Christison and Coindet, in a joint paper published by them in the nineteenth volume of the Edinburgh Medical and Surgical Journal.

The symptoms consequent upon swallowing a solution of the acid vary with the strength of the solution and the quantity of it which has been administered. When the solution is strong, and a considerable quantity of it has been swallowed, a very severe pain is almost always immediately felt in the stomach, and sometimes in the fauces, which after a little time is followed by violent vomiting,* cold clammy skin, and feeble or even imperceptible pulse. A drowsy or torpid state next ensues, characterized by great languor and debility, during which death takes place without being preceded by any other remarkable phenomena. The symptoms, in fact, first observed are those which belong to a powerfully irritant or corrosive agent, while those subsequently developed are such as one would expect to result from the exhibition of a narcotic poison. The former class are those which have been most prominent in individuals of the human species poisoned by the acid.

When oxalic acid is diluted with about twenty times its weight of water, like the mineral acids it loses its irritant action, but, unlike them, is still poisonous in a high degree. According to the researches of Coindet and Christison, it attacks in this form the heart, the brain, and the spinal cord, producing, when swallowed in quantity, paralysis of the first-mentioned organ, and in smaller doses a fatal coma, which is usually preceded by tetanic spasms, particularly of the respiratory muscles, fixing the chest, and thus determining asphyxia or suffocation. These results have been arrived at by means of experiments on the lower animals, and, in all probability, correctly represent those effects which, under similar circumstances, would be witnessed in the human species. Opportunities, however, of studying these seldom present themselves, for when the acid is taken accidentally, or designedly administered as a poison, the solution is usually strong and swallowed in considerable quantity.

From this enumeration of symptoms it is obvious that oxalic acid exercises on the economy an influence independent of its irritating action, and which is principally directed to the nervous system. We shall not revive here a topic which has been already sufficiently discussed, by inquiring into the precise medium through which its action is exerted; but it would be improper to omit mentioning that chemical experiment has failed in demonstrating its presence in the blood, even in a case where eight grains of it were injected into the femoral vein of a dog, although it is very easily detected in blood drawn from the arm, and into which it is introduced subsequent to venesection. Dr. Christison concludes that when introduced into the vascular system it is decomposed in virtue of some unknown vital action; and it must be admitted that the fact just referred to,

* Cases have been recorded in which vomiting did not occur; [and one is related by Mr. Taylor, where about two ounces of the poison had been swallowed in which there was no pain.]

combined with the facility with which it is resolved into carbonic acid by any thing which will supply it with oxygen, gives countenance to this opinion.

[It has been a question how much oxalic acid is necessary to occasion fatal results; but this cannot be positively assumed. Anomalous cases are occasionally witnessed in which considerable quantities have been taken, been rapidly rejected by vomiting, and the patient has recovered. When the dose is upwards of half an ounce, death has usually resulted; but Mr. Taylor (*Op. cit.* p. 118,) refers to the case of a man who recovered after having taken an ounce of the crystallized acid.

The period at which death takes place varies. Of two cases, where about two ounces were taken, one man died in twenty minutes, the other in three-quarters of an hour. One case is recorded in which death resulted in ten minutes. On the other hand, fatal results have not occurred until thirteen hours and more.]

The post-mortem appearances closely resemble those presented after poisoning by the mineral acids. Marks of inflammation are to be seen in the œsophagus, the stomach, and sometimes the small intestines, such as unusual vascularity of those parts, softening and extreme pulpiness of the villous coat, portions of which are sometimes quite destroyed, and the presence in the stomach of a dark fluid resembling coffee-grounds, and obviously including a considerable quantity of blood. Cases, however, have occurred in which these morbid changes were altogether wanting, but it is worthy of remark that in such death occurred very soon after the administration of the poison.

[*Tests for oxalic acid.*—Oxalic acid reddens litmus, and is volatilized by heat. Nitrate of silver, added to a solution of it, yields a white precipitate of oxalate of silver, which is soluble in nitric acid, and, when dried and heated on the point of a knife by the flame of a candle or spirit-lamp, becomes brown on the edge, detonates very feebly, and is completely dissipated. With lime-water, or a solution of chloride of calcium, it yields a white precipitate of oxalate of lime, insoluble or nearly so in excess of oxalic acid, readily soluble in nitric acid, and slightly so in chlorohydric acid. If the precipitate be collected, dried, and calcined, it yields quicklime. With sulphate of copper, oxalic acid yields a bluish-white precipitate of oxalate of copper.

To detect oxalic acid in oxalate of lime, boil the oxalate with a solution of carbonate of potassa for two hours, and filter. The liquid will contain oxalate and carbonate of potassa. Add acetate of lead, collect the precipitate of oxalate and carbonate of lead, suspend it in water, through which sulpho-hydric acid is to be passed; filter, to get rid of the dark sulphuret of lead; boil the clear liquor, which is a solution of oxalic acid, and test, as above, for the free acid.

If the oxalate of lime be mixed with organic matters, the filtered liquor must be feebly acidulated with nitric acid before adding the acetate of lead. The acidulated liquor must be filtered, rendered faintly alkaline by carbonate of potassa, again filtered, then mixed with acetate of lead, and the precipitate treated as above. (Pereira, *Elements of Mat. Med. and Therap.*, Amer. edit. by Dr. Carson, i. 307. Philad. 1843.)]

Treatment of poisoning by oxalic acid.—The indications are, to remove the poison by emetics or the stomach-pump, and to neutralize what may not have been removed by the exhibition of appropriate antidotes.

With respect to the *removal* of the poison, it should be borne in mind that its action is extremely rapid, and that it will be inexpedient to exhibit drinks with the view of washing it out of the stomach, for these, by diluting the acid, will promote its absorption. In fact it will, generally speaking, be the better plan to lose no time in attempting its expulsion, but proceed at once to the exhibition of *chalk*, or the *carbonate* of magnesia, both of which have been proved by direct experiment adequate to the perfect counteraction of its injurious action. The alkaline carbonates will not answer, for Christison and Coindet have found the soluble oxalates nearly as destructive as the acid itself, and moreover, if administered in excess, these carbonates themselves operate as poisons.

[Where the usual antidote is not at hand, Sir Geo. Lefevre (*London Lancet*, June, 1844,) has recommended the administration of old mortar, finely powdered, or even the plaster scraped from a wall.]

Potash, Soda, Lime, &c. and their Carbonates.—The modus operandi of the alkalies and their carbonates [*Pearlash, Soap-lees,*] is the same, both acting, in small doses or diluted solution, as simple irritants, but in larger quantity or more concentrated form as escharotic poisons. Such being the case, the symptoms they produce may easily be conceived. Great irritation, or even burning pain, is felt in the mouth, œsophagus, and stomach, accompanied by difficulty of deglutition. These are succeeded by bloody vomiting, epigastric and abdominal pain and tenderness, cold sweats, excessive prostration of strength, bloody dejections, subsultus, &c. Such are the symptoms which have been observed to follow upon the administration of three ounces of the carbonate of potash. When the quantity swallowed is smaller, the effects are less severe, and are by Christison compared to those which characterize an attack of acute gastritis: in this latter case the recovery is sometimes rapid and complete. This, however, does not always occur. A train of phenomena indicative of a chronic inflammation and serious derangement of the intestinal mucous membrane, such as incessant vomiting and purging, pains in the entire abdominal region, occasionally set in, and the patient ultimately dies in a state of extreme emaciation, the inner coat of the alimentary canal having been disorganized to such an extent as to be incapable of subserving the purposes of digestion or assimilation. There is, it should be observed, an instance of poisoning by carbonate of potash upon record, in which the injury sustained was limited to the œsophagus, where stricture was produced, and the patient ultimately perished of starvation. This summary of symptoms has, in strictness, reference only to poisoning by the carbonate of potash, for instances of *its* effects upon the human subject have alone been recorded. There can, however, be no doubt

that the carbonate of soda would operate in a similar manner, and experiments upon dogs, many of which were instituted on this subject by Orfila, justify us in concluding that the caustic fixed alkalies differ from their carbonates, not in the kind but the degree of action which they exert upon animal textures.

[The quantity of any of these poisons required to destroy life is not known.]

Upon dissection, the alterations of texture which have been observed are softening, and occasionally destruction, of the membrane which lines the mouth, fauces, and œsophagus, together with high vascularity and partial removal of the villous tunic of the stomach.

The parietes of this latter organ are also sometimes the seat of perforations, and in these cases peritonitis and its consequences, the effusion of serum and lymph, and extensive adhesions, are invariably witnessed. The calibre of the œsophagus, too, is often greatly reduced in size, and, as has been already observed, the diminution is such, in some instances, as to amount to stricture.

Treatment.—The first curative step consists in neutralizing the poison, whether it be alkali or alkaline carbonate, by causing the patient to swallow a quantity of vinegar, or, what will answer well, dilute sulphuric or muriatic acid. Oil also has been recommended, but that can evidently not operate as an antidote in the case of the carbonates. After the neutralization of the alkali has been achieved, the subsequent treatment must be conducted upon general antiphlogistic principles. Febrile action must be restrained by venesection or the repeated application of leeches. Cool and mucilaginous drinks must be exhibited, and jelly, milk, and such other nutritious matters as are easily swallowed and digested, alone permitted.

Lime possesses strong corrosive qualities, and may be considered as exercising on the system powers similar to those exerted by caustic potash. The symptoms, however, to which it gives rise are more exclusively those of an irritant poison. Two cases are on record, in which, internally administered, it has proved fatal to the human subject.

The alkalies and their carbonates have a peculiarly acrid taste. They change turmeric to a reddish brown, the infusion of blue cabbage to a green, and restore the colour of reddened litmus. The former may be distinguished from the latter by their greater degree of causticity, and by dissolving in acids without effervescence. Potash affords, with an excess of tartaric acid, a white crystalline precipitate, but this does not occur with soda. As additional distinctions, it may be mentioned, that potash is precipitated by bichloride of platinum as a yellow crystalline powder, by carbazotic acid in crystalline scales, and by hydrofluosilicio acid in a gelatinous form, re-agents which have no such effect upon the mineral alkali. The only direct mode of testing for the latter consists in heating the substance under examination on the end of a platina wire before the blowpipe, when, if soda be present, the cone of flame beyond the wire is tinged of a deep yellow. These tests are equally applicable to all the neutral salts of both bases.

Nitrate of Potash.—This salt influences the system in a double manner. Its principal action is that of a local irritant, but it also occasionally produces secondary effects upon remote parts, disturbing in a remarkable manner the brain and nervous system. The symptoms which first present themselves, when from half an ounce to an ounce has been swallowed, are such as are produced by other powerful irritants, namely, acute epigastric and abdominal pain, and violent vomiting and purging, the matter discharged being frequently mixed with blood. These, however, are very generally followed by indications of cerebral irritation, such as great debility, tendency to faint, tremours, and convulsions.

The morbid appearances are inflammation of the stomach and intestines, which, though principally affecting the villous coat, is not confined to it, but extends also to the other tunics of the alimentary tube.

Upon the subject of *treatment* it is sufficient to observe that the poison is to be removed from the stomach by emetics or the stomach-pump, and the patient is to be made to drink largely of mucilaginous fluids, which will dilute the salt, and thus, at the same time, render it innoxious and contribute to its more easy and perfect elimination. The subsequent treatment must be regulated by general principles.

Nitre may be recognised by its crystalline form, which is a six-sided prism terminated by a dihedral summit, unalterable by exposure to the air. Thrown upon a red-hot coal, it enlivens its combustion, and when treated with sulphuric acid, nitric acid vapour is evolved upon the application of heat. The nature of the base may be demonstrated by the application of the tests mentioned in the preceding article.

[**Bitartrate of Potassa, Cream of Tartar, Argol.**—Cream of Tartar is not generally regarded as a poison, yet it has proved fatal in at least one instance, which occurred in London, in 1837. A man, aged 37, took four or five teaspoonfuls of cream of tartar. He was seized with violent vomiting and purging, with pain in the abdomen, thirst, feeble pulse; and the thighs and legs appeared to be paralyzed. The fluid vomited was of a dark green colour, and the evacuations were of the colour of coffee-grounds. Death took place in about 48 hours. On inspection, the mucous membrane of the stomach and duodenum was found highly inflamed, the cardiac portion of the former being of a deep red colour, with some spots of black extravasation. The stomach contained a thick brown fluid, coloured by bile. The whole of the intestinal canal was more or less inflamed. (Taylor, *op. cit.* p. 130.)

Sulphate of Potassa.—It is only of late that any question has arisen in regard to the poisonous character of this salt. A lady, about a week after delivery, took, by the prescription of a physician, about ten drachms of the sulphate of potassa, in divided doses, as a laxative. After the first dose, she was seized with severe pain in the stomach, nausea, vomiting, purging, and cramps in the extremities. These symptoms became more and more aggravated, and she died in two hours. On inspection, the mucous membrane of the stomach and intestines was found pale, except the valvulæ conniventes, which were reddened. The stomach

contained a large quantity of reddish coloured liquid, which, on analysis, was found to contain only sulphate of potassa, and no trace of any known irritant poison. The experts ascribed death to the sulphate of potassa given in an unusually large dose, whereby it acted as an irritant poison on a person whose constitution was already much debilitated. (*Annales d'Hygiène Publique*, Avril, 1842.)

Since then, a case has occurred in England, in which a question arose as to this salt having acted as an irritant poison. It was that of the Queen v. Hayes, and was tried at the Central Criminal Court, in October, 1843. The prisoner had given to the deceased, the night before her death, two ounces of sulphate of potassa, dissolved in water; and it was affirmed, that a fortnight previously to this, she had taken as much as a quarter of a pound of the salt. The woman supposed herself to be pregnant, but she was not, as was shown on dissection; and the prisoner was charged with having given her the salt with the intention of causing a miscarriage. She died with the symptoms of irritant poisoning complicated with lesion of the nervous centres. (Taylor, Report on Toxicology, *Brit. & For. Med. Rev.* Oct. 1844, p 556.) MM. Mérat and De Lens (*Dict. Univers. de Matière Médicale*, art. Potassium,) state that in 1821, an ounce of the salt, taken by mistake in a glass of *tisane*, instead of the salt of Seidlitz, caused a sense of burning and pain in the epigastrium, vomiting, &c.; and they refer to another case, in which half a drachm caused hypercatharsis and death in a patient affected with fever. Other similar cases have been recorded. (Taylor, *loc. cit.*)]

Ammonia and its Sesquicarbonate.—The volatile alkali, as is well known, possesses caustic powers when applied to animal structures, but the experiments of Orfila upon dogs establish that its action is not exclusively of this kind. When given in a poisonous dose, effects indicative of disturbance of the spinal system, such as tetanic spasms and convulsions, invariably supervened, and, unless when death very speedily took place, the stomach was found extensively inflamed. The subcarbonate of the shops (sesquicarbonate) acts precisely in a similar manner.

The *treatment*, as far at least as antidotes are concerned, should consist of the copious administration of mucilaginous drinks containing a dilute acid.

Solutions of ammonia and its carbonate have both a very pungent smell, strike an azure blue with a small quantity of a dilute solution of sulphate of copper, and give yellow precipitates with muriate of platina. They may be distinguished from each other by the addition of an acid, which causes the carbonate alone to effervesce, or by a drop of a solution of muriate of lime, which is unaffected by the ammonia, but affords with its carbonate a white precipitate.

We shall have to return to ammonia when we speak of the gaseous poisons.

Gold.—The only preparation of gold which requires notice here is that usually known under the name of muriate. This salt was once employed by the physician in the treatment of syphilis and other affections, and an attempt has recently been made to revive its use. It is also occasionally manufactured in quantity, or at least an acid solution of it, in one process for purifying the standard gold. When this solution is concentrated and permitted to cool, it affords prisms of a ruby colour, which are deliquescent and very soluble in water, and, when added to a proper proportion of chloride of sodium, form a beautiful double salt, which crystallizes in prisms or tables, and is permanent in the air. Both these preparations, the simple and the double salt, are powerful escharotics, undergoing decomposition, almost immediately upon contact with the animal structures to which they are applied. The symptoms, therefore, which they produce are exclusively local, or such as result from the action of the simple irritants.

Nitrate of silver added to these preparations will detect their muriatic acid, and protomuriate of tin their base, which it precipitates in the form of a purple powder, the purple of Cassius. As another distinguishing character of these preparations, it may be mentioned that they stain the cuticle of a beautiful purple colour.

Green vitriol, which throws down from their solutions the gold in the metallic state, is the best antidote to administer where any of it is supposed to remain undecomposed in the stomach.

Nitrate of Silver.—This salt ranks with the local irritants, for though it is in all probability partially absorbed,* its injurious effects are, undoubtedly, the results of the disorganization which, as a powerful caustic, it produces in the textures to which it is applied. When any animal tissue is touched by it, it produces an eschar, being at the same time itself decomposed, and to such an extent that some of the silver is reduced to the metallic state. Its corrosive action may, therefore, be safely referred to its oxygen and acid, both of which are set free.

It is not necessary to detail the symptoms of poisoning by lunar caustic, as they do not differ materially from those which are the consequence of the introduction into the stomach of other escharotic substances. Nor, for the same reason, will it be necessary to say of the morbid appearances any thing further than that, when swallowed, it corrodes the mucous membrane of the œsophagus and stomach, and produces ulcers analogous to those caused by it when externally applied in surgical practice. In doses of from half a grain to three grains, it is often exhibited in the treatment of epilepsy and other spasmodic diseases. In the latter quantity there can be little doubt that it would give rise to very dangerous consequences, were it not that the salts and free muriatic acid of the stomach decompose the greater part of it, and bring it to an inert or much less active state of combination.

Nitrate of silver may be known by crystallizing in colourless tabular prisms, which deflagrate like nitre when thrown upon a red coal, coating it with a perfectly white lamina of silver. They dissolve also readily in water, and the solution affords, with muriatic acid or any soluble muriate, a white curdy precipitate insoluble in water, the acids and fixed alkalies, soluble in ammonia or its

* That it, or at least its base, is taken into the blood would appear proved by the leaden hue of those who have used it medicinally for some time; it is worthy of remark that this change of colour is limited to the parts habitually exposed to the light, as the face and hands.

carbonates, and also in the alkaline hyposulphites. Lastly, when treated with the arsenical solution, or with a solution of arsenic first and subsequently a drop of ammonia, a beautiful yellow precipitate (the arsenite of silver) subsides.

We possess in common salt an antidote for nitrate of silver, simple, effectual, and easily obtained. If swallowed subsequently to the introduction of the nitrate into the stomach, the nitrate is converted into the chloride of silver, a preparation which is perfectly innoxious.

Mercury.—The only mercurial preparations which are interesting to the toxicologist are the bichloride, the peroxide, the subsulphate or turbith mineral, calomel, and the nitrates.

Of these the first is that which is most entitled to his attention, both by reason of its activity, and because it is that most frequently employed for the purpose of destroying life. It is also that, the action of which on the animal system has been studied with most attention and success.

Corrosive Sublimate.—[*Corrosive chloride of mercury, bichloride of mercury*], operates as a powerful poison, whether introduced into the stomach, applied to the cellular substance, or injected into the blood; and the morbid changes it produces, as well as the symptoms which it determines, would appear in all three cases nearly the same. The stomach is sometimes corroded, and it and the rectum are often inflamed and ulcerated. In cases in which death quickly supervened, Brodie found, in experiments on dogs, the heart to be paralysed; and this organ always presents (according to Smith and Orfila) signs of inflammation when the poison is introduced into the subcutaneous cellular tissue, and more particularly when injected into the current of the blood.

Besides the vomiting, purging, gastric and abdominal pain, cold and clammy surface, feeble pulse, and general prostration, which are the symptoms that might naturally be expected to result from the lesions just described, another and a peculiar class, of a secondary and more chronic kind, usually manifest themselves, unless the case should prove very rapidly fatal. The assemblage of these latter is usually known under the name of salivation, and is understood to consist of a peculiar fetor emanating from all parts of the body, and which is usually preceded by a brassy taste in the mouth, of ulceration of the gums, sometimes extending to the tongue and tonsils; and, lastly, of profuse ptyalism, [which may commence in a few hours, where a large quantity of the poison has been taken.

In the report of the coroners of England, for 1837–8, there were about fifteen cases of mercurial poisoning, in twelve of which corrosive sublimate was the poison taken. (Taylor, *op. cit.* p. 161.)]

The other mercurials enumerated above do not possess irritant and escharotic powers as energetic as those of corrosive sublimate, but produce precisely the same train of secondary effects.

When the poison of mercury is very gradually introduced into the system, as in persons who work in quicksilver mines, gilders, looking-glass makers, and those who manufacture barometers and thermometers, a special disease is established, usually known under the name of the shaking palsy, a designation suggested by the tremours and convulsive movements by which the malady is distinguished.

The mercurial poisons are amongst those which when externally applied by inunction make their way into the blood. This has been established by chemical experiment, and we may add that they have also been found under similar circumstances in the urine. Mercury, there is good evidence for believing, has been passed through the urethra in the metallic state by persons labouring under salivation; and many cases are recorded upon respectable authority, in which it was found after death in the brain, periosteum, and bones of syphilitic patients. Facts such as these leave no room for doubting that the poisonous action of the mercurials is exerted, at least partly, through the medium of absorption. Corrosive sublimate is the only one of the mercurial preparations whose immediate action is that of a corrosive poison. The local action of the rest is irritant. All, however, produce the same train of secondary effects. Mercury in the metallic state is generally considered innoxious, and so it probably is when applied in mass. In a state of minute division, however, it is far from being inert. To finely divided quicksilver, for example, the unguentum hydrargyri and blue pill owe their efficacy; and there are upon record several instances of profuse and even fatal salivation determined by mercury in the vaporous form. In connection with this latter topic it is important to remark that mercury is not, as is the common opinion, fixed at all ordinary temperatures, but that, as shown by Mr. Faraday, it emits an appreciable vapour at all heats above 60° Fahrenheit.

[It is difficult to say what is the precise quantity of corrosive sublimate required to destroy life. It would seem that the smallest dose which has proved fatal was three grains. The subject was a child, and it has been presumed that from three to five grains would kill an adult. Yet cases have occurred in which large quantities have not destroyed, in consequence of their having been rejected by vomiting. Death has usually taken place, in an acute case, in from one to five days; but it has been known to prove fatal in eleven hours; and in one case, recorded by Mr. Ellingworth, (*Lond. Med. Gaz.* xxxi. 557,) the duration of the case would not seem to have been more than two hours from the time the poison was taken, (Taylor, *Op. cit.* p. 168.)]

Dr. Christison seems to think that poisoning by corrosive sublimate, or some soluble mercurial preparation, may be inferred from the symptoms alone. This, however, may be doubted, seeing that the most characteristic of them, those, for example, which constitute salivation, may, as he himself admits, be produced by certain preparations of gold, copper, and antimony, by croton oil and digitalis, and occasionally also arise either spontaneously, or as the consequence of a cynanche. The symptoms combined with the morbid appearances will, undoubtedly, often lead to a probable conclusion; but certainty is scarcely attainable in such a research without the aid of chemical experiment.

Corrosive sublimate is sufficiently characterized by the following properties. It occurs in crystal-

line cakes, or small irregular prisms of considerable density, which are soluble in water, and, more copiously, in alcohol and ether. Heated in a glass tube it sublimes unaltered, and its solution in water affords a yellow precipitate with caustic potash or lime-water, and a scarlet one with the hydriodate of potash. The latter, however, must not be added in too large or too small a proportion, for the new compound formed (biniodide of mercury) is soluble both in corrosive sublimate and hydriodate of potash. The chlorine of the corrosive sublimate may be detected by adding to its solution a little nitrate of silver, which will throw down the well-known chloride of this metal, and its mercury may be directly separated in the metallic state by boiling it with an acid solution of protomuriate of tin, or subjecting it in the usual manner to the action of a galvanic couple. Gold and iron, which are easily had, form a very efficacious combination for this purpose, and are best used, as Paris first suggested, by touching with an iron key a sovereign, or other piece of gold, through a drop of the solution. The sovereign may be advantageously replaced by a slip of gold leaf or platina foil, from which the adhering mercury may be separated by heating it over the spirit-lamp in a small glass tube, when the quicksilver will rise and condense in globules in its upper and cooler portion.

In many cases, however, the corrosive sublimate will have to be sought among the contents of the stomach or intestinal tube, and in such the difficulty of the search is greatly increased, and for a double reason. In the first place, the operation of the tests which have been enumerated is obstructed and screened by the presence of a variety of organic and alimentary matters; and in the second place, these substances, as well as the coats of the intestines, frequently decompose the poison, reducing it from the soluble to the insoluble state. Should any of it remain undecomposed, it is best obtained separately by agitating the entire of the materials to be experimented upon with one-fourth their volume of ether, as first recommended by Christison. This will remove the corrosive sublimate, and afford it upon evaporation sufficiently pure for the application of the tests already described. Should the result of this process be of a negative kind, the residue insoluble in the ether should be digested for some time with protomuriate of tin, and the precipitate, after being collected on a filter and drained, should be boiled with a considerable excess of caustic potash. This will dissolve both the animal matters present and the oxides of tin, and leave quicksilver (should any corrosive sublimate have been originally present,) in the form of a greyish powder, which by sublimation in a small glass tube may be converted into metallic globules. By this method very minute quantities of corrosive sublimate may be detected, even when rendered insoluble by the action of the mucous lining of the stomach, or of its organic contents. An affirmative result, however, in such an investigation, may obviously lead to an erroneous conclusion should calomel or any other insoluble mercurial have been administered medicinally previous to death, and without the knowledge of the experimenter.

The search for corrosive sublimate, when rendered insoluble by combination with organic matters, may be conducted in many other ways. Thus if the whole of the suspected mixture be dissolved in nitro-muriatic acid, rendered neutral by evaporation to dryness and re-dissolved in water, the mercury, if any such be present, will be thrown down in the metallic state upon the application, in the manner already specified, of the protomuriate of tin; or, by introducing into the aqueous solution a galvanic couple composed of iron and gold, the mercury will amalgamate with the latter, and may be sublimed by heating the bit of gold in a narrow glass tube.

[The relative delicacy of some of the tests is thus stated by M. Devergie (*Médecine légale*, 2de édit. vol. 2, Paris, 1840).

	Degree of Dilution.
Ferrocyamuret of potassium stops at	1500
Lime-water, "	4000
Potassa or its carbonate, "	7000
Iodide of Potassium, "	8000
Ammonia, "	36000
Sulpho-hydric acid or sulpho-hydrate of ammonia stops at	60000
Protochloride of tin or galvanic pile stops at	80000]

Treatment of poisoning by corrosive sublimate.—The immediate action of corrosive sublimate is, as we have seen, to irritate and even corrode the textures with which it is brought in contact; the remote, to produce the shaking palsy, or the train of morbid phenomena which are comprehended under the term salivation. When effects of the latter kind are established, they can only be gradually removed by withdrawing the individual from all contact with the poison under the effects of which he is labouring, and making him the object of judicious medical treatment conducted upon general principles. The escharotic and irritant action, however, of corrosive sublimate may be, as is well known, at present obviated by the timely administration of appropriate antidotes; amongst which the white of egg, first recommended by Professor Orfila, holds the most prominent rank. By contact with this substance the corrosive sublimate is deprived of half its chlorine, and thus reduced to the state of calomel, which precipitates in admixture, or, according to some, in combination with altered albumen. That this precipitate is inert, Orfila has proved by direct experiments upon dogs; and he has also established that a fatal dose of corrosive sublimate may be swallowed by these animals with impunity, provided that white of egg or any other kind of fluid albumen, be introduced shortly before or after into the stomach. Cases are also upon record which establish that it possesses an equal efficacy in the case of the human subject.

[In employing albumen as an antidote to corrosive sublimate, it must be borne in mind, that it may be given in too great quantity, as the compound formed is soluble in an excess of albumen, and in the deleterious combination, which enters the blood, producing the remote influence of the poison. So long as the vomited matters contain a white opaque material admixed, the antidote should not be withheld; when the *ejecta*, on the contrary, becomes transparent, the farther employment of the remedy is generally useless, and

may be injurious. *Dublin Medical Journal*, cited by Dr. T. R. Beck, in *Journ. of the Med. Sciences*, Oct. 1844, p. 533.]

The changes produced in corrosive sublimate by the white of egg admit of being also effected by other organic substances, in particular by the gluten of wheat and the casein of milk. The efficacy, however, of these principles as antidotes is not so well made out as that of albumen, and they should therefore not be resorted to unless in the absence of the latter substance, the powers of which have been amply confirmed.

The only other antidotes deserving of mention here are iron filings and meconic acid. The former was recommended by Dumas, and must obviously operate by bringing the mercury to the metallic state. The meconic acid, particularly when combined with an alkaline base, affords, with corrosive sublimate, an insoluble and inert permeconate of mercury. The meconates of the ordinary alkalies, however, can scarcely be obtained in sufficient quantity to be applied to such a purpose; and from the smallness of the saturating power of meconic acid, it would be hazardous to administer the quantity of opium which would be adequate to the decomposition of a few grains of corrosive sublimate, inasmuch as the muriate of morphia, which would be cotemporaneously formed, is a narcotic medicine of very considerable energy.*

[Dr. T. Buckler, of Baltimore, (*Maryland Med. and Surg. Journ.* Jan. 1840, p. 52,) has recommended a galvanic antidote, consisting of a mixture of gold dust and iron filings diffused in water containing gum, and slightly acidulated. He found that corrosive sublimate in solution is wholly precipitated in the form of mercury, when gold dust and iron filings are added to it; yet Orfila (*Annales d'Hygiène*, Oct. 1842,) reports unfavourably of it as an antidote. He found, that when given in large quantity, it did not prevent animals from dying within the usual time from the effects of the poison.

Recently, M. Mialhe, (Proceedings of the Royal Academy of Medicine, of Paris, for Aug. 16, 1842, cited in *American Journ. of the Med. Sciences*, for Jan. 1843,) has strongly recommended the hydrated protosulphuret of iron, which, whilst it is inert, produces with corrosive sublimate protochloride of iron, and bisulphuret of mercury. The protosulphuret may be made by adding hydrosulphuret of ammonia to a solution of protosulphate of iron, and washing the black precipitate without exposure to air. Orfila (cited by Dr. T. R. Beck, in *Amer. Journ. of the Med. Sciences*, Oct. 1843, p. 500,) has made experiments with it on animals, and has found, that when it was exhibited speedily after the poison had been taken, it possessed even greater powers as an antidote than albumen. Farther experiments are, however, needed. (See Mr. Barry, in *Pharmaceutical Transactions*, No. 6, p. 306, or Braithewaite's *Retrospect*, No. 5.)]

Arsenic.—White arsenic, which is the oxide of a peculiar metal, is the most active, the cheapest, the most easily obtained, and hence the most generally employed, of the mineral poisons. All its combinations are, though in different degrees, destructive of life, and its noxious influence is exerted through almost every tissue of the animal body, but not through all with the same energy or rapidity. According to Jaeger, it is most energetic in its action when injected into a vein, introduced into a wound, or applied to the peritoneal sac; less so when brought into contact with the stomach; and least of all when passed into the rectum. It is a curious fact that in his experiments it proved quite inert when applied to the substance of the nerves. The symptoms also which it produces would appear little influenced by the manner of its application, or the nature of the texture with which it is primarily brought into contact.

Systematic writers on toxicology distinguish three varieties of poisoning by arsenic; and, though satisfied that this division is far from being perfect, we shall provisionally adopt it, as, by so doing, the history of the symptoms can be more readily and clearly given.

In the first class of cases the symptoms are those indicative of irritation and inflammation in the intestinal tract and other mucous passages, the nervous system being more or less depressed, but not in other respects materially deranged. The duration of such cases is from one to three days. In the second class there are no indications of irritation from the commencement, but the patients sink within the space of five or six hours, as if under the influence of a powerful narcotic. In the third variety we have, in the first stage, the usual symptoms of irritation of the mucous passages; but these after some days intermit, and are succeeded by some form of imperfect paralysis or by epilepsy which terminates the sufferings of the patient usually about the sixth or seventh day.

1. The detail of the symptoms which belong to the first variety is as follows. In half an hour, sometimes sooner sometimes later, nausea and faintness are experienced, and are shortly succeeded by a burning pain in the stomach and by obstinate vomiting, which, should it for a moment cease, is immediately excited by the swallowing of any kind of drink. The matters discharged after some time exhibit a yellowish-green or bilious colour, and after the lapse of twenty-four hours are frequently tinged with blood. After the vomiting has set in, a sensation of dryness, heat, and tightness is experienced in the throat, accompanied by unextinguishable thirst. The voice also is hoarse, and the articulation of words is effected with considerable difficulty. Diarrhœa now usually sets in, (not always,) accompanied by considerable anal irritation, often with tenesmus. The abdomen becomes tense and painful, and the irritation extending to the urinary system produces deep-seated pain in the region of the bladder, and swelling and even gangrene of the genital organs. The pulse is small, quick, and feeble, the heart flutters, the surface is cold and clammy, the extremities are livid, the countenance is collapsed and expressive of pain. The tongue and mouth are furred, the papillæ on the back of the former become unusually prominent, and aphthæ are seen on the uvula and fauces. Finally

* Hahnemann states that four grains of corrosive sublimate will kill an adult within twenty-four hours; but there is reason to think that a much smaller dose would, under certain circumstances, prove fatal.

towards the close of the scene, there are delirium and convulsions, which are quickly followed by death. As an appendix to this enumeration it may be proper to observe that in some rare cases the entire body has become swollen, particularly in the vicinity of the eyes, and covered by miliary or petechial eruptions, which appear and disappear at intervals.

2. In the second variety the signs of irritation are either entirely wanting or unusually mild, but death nevertheless occurs, and with great rapidity, accompanied by all the circumstances characteristic of narcotism. The particular affections most uniformly present are extreme faintness, sometimes amounting to syncope, a state of coma or stupor, and slight convulsions. This kind of case is rather uncommon, and it has been observed to occur only where the poison was swallowed in unusually large quantity, in solid lumps, or, lastly, in a soluble form.

3. The symptoms which characterize the third variety are, in the first stage, those of irritation already described, but in the second, such as are alone referable to nervous disturbance. The most formidable of the latter are coma, imperfect paralysis of the arms, epilepsy, tetanic convulsions resembling those of hysteria, and, lastly, mania, which, however, has been but once observed.

In cases which belong to the second variety no morbid changes whatsoever are observed. In the first and third varieties the throat and œsophagus are injected with blood, though this does not invariably occur. The villous coat of the stomach is red and dappled with livid spots, in consequence of the extravasation of blood into its texture. The same tunic is also frequently softened to such a degree as to admit of being readily scraped off with the nail, and not only it but the other tunics are studded with ulcers at several points. Nor are ulcers confined to the stomach alone; they occur also in the duodenum and inferior part of the intestinal tube, and are particularly abundant and constant in the rectum. Coagulable lymph is also infused upon the inner membrane of the stomach, and the interior of this organ is occupied by a dense and consistent mucus blended with clots of extravasated blood. The trachea, pleura, and inner surface of the heart exhibit frequently a reddened aspect indicative of inflammation, and genuine peripneumony has also been observed. Under the head of symptoms we have already alluded to the lesions of the urinary and genital organs, and to the swollen and erupted state of the surface. The blood, according to Brodie and others, is of a dark colour and does not coagulate; but this statement, or rather its latter half, though generally true, is liable to exceptions.

The preceding summary of symptoms and morbid changes has been collected from cases in which the poison was internally administered. The description is applicable, however, with little modification, through whatever channel it is introduced into the system. When arsenic is applied to a wound or serous surface, or injected into the blood, the mucous passages appear to suffer less, while the derangement and depression of the nervous system is more decided than when taken, as is the more common case, into the stomach.

[In the case of Mina, tried in Pennsylvania for the murder of Mr. Chapman, it was stated by several medical witnesses, that when the stomach was opened a peculiar smell resembling that of pickled herring was perceived; and Dr. J. K. Mitchell states, that a stomach, which he placed in some Fowler's solution, for two or three months, acquired the same odour. (Beck's *Med. Jurisprudence*, ii. 410, Philad. 1838.)

Dr. Griffith, (Taylor's *Med. Jurisprudence*, Amer. edit. p. 138, Philad. 1844,) states, that he tried a similar experiment, using a solution of arsenious acid, with the same result.]

From what has been said of the effects of arsenic on the human subject, it will probably be considered obvious that it is one of the poisons which exercise a double action, one immediate upon the part to which it is applied, the other remote or directed to distant organs. Such is the opinion usually entertained. When, however, we recollect that arsenic possesses no escharotic powers, and that, upon application to a wound, it produces those very symptoms and morbid changes characteristic of mucous irritation which follow upon its introduction into the stomach, we cannot but entertain doubts as to the justice of the views which would refer any of its consequences to local action. But supposing, as indeed can scarcely be doubted, that its noxious influence upon any particular texture or organ is the result of a remote action, the question arises, through what channel is this influence conveyed? Is it through the medium of the nervous sympathy? Or does the poison enter the current of the circulation, and reach through it the parts which are found to suffer from its ravages? Having already discussed, at the commencement of this article, the general question of which the present is but a part, we shall not return to it here, further than to observe that we are not acquainted with any experiments establishing unequivocally the presence of arsenic in the blood of individuals who have died of the administration of such poison. Some, indeed, have been put forward, but they appear to us unsatisfactory.

It has been already observed, more than once, that the symptoms and morbid appearances, though conjoined, will seldom afford satisfactory proof of poison having been administered or taken in any particular case, much less enable us to infer the precise nature of that employed. Arsenic is unquestionably no exception to this statement.

As an auxiliary in such a research, the alleged antiseptic powers of the poison have been summoned into use, and when the body of the deceased resists for a longer time than usual the process of decay, it is by many considered as a strong corroboration of death having been produced by arsenic. This substance undoubtedly exercises, as is well known to the collector of specimens in zoology, a preservative power in reference to the parts to which it is topically applied, and there can be no doubt that the alimentary canal of individuals who have perished by swallowing arsenic continues for a considerable time without exhibiting any symptoms of decay. This preservative influence, however, though the contrary has been alleged, does probably not extend further than the parts which have been impregnated with the poison.

The most unequivocal proof of poisoning by arsenic is, it is scarcely necessary to observe, to be derived from chemical investigation; and this brings us to the consideration of those properties which best characterize the poison, and the detail of the processes by means of which its insulation from the matters it may be mixed with is most readily and perfectly effected.

White arsenic, as this poison is commonly denominated, is the oxide of a peculiar metal of a steel grey colour, friable, and having a specific gravity of about 8.3. By exposure to air and moisture it rapidly oxidizes, combining with about one-third of its weight of oxygen, and being thus converted into the common oxide. This change, however, is never perfect, the result being always a mixture of oxide and metal. When heated in a close vessel to 356°, it sublimes unaltered, emitting a strong alliaceous odour. But if heated with contact of air, it absorbs oxygen, and passes to the state of white arsenic.

The oxide of arsenic is a white powder, or occurs in lumps, usually opaque, sometimes translucent, and having the specific gravity of 3.7. Heated to 380° it sublimes, without, however, the production of any alliaceous smell; and if the process be conducted slowly, it will concrete into octohedral crystals exhibiting an adamantine lustre. These crystals are at first transparent, but, upon exposure for some time to the air, finally become opaque: 1000 parts of boiling water dissolve about 80 of the oxide, and after cooling to 60° retain 30. The same amount of water, however, will take up at the temperature of 60 but about three parts. Guibourt has found a difference between its solubility in the opaque and transparent states, the former being more soluble than the latter.

[The observations of Dr. J. K. Mitchell and Mr. Durand show, that the power of the solvent is modified by the fineness of the powder, the time the fluid is in contact with the arsenic, and even the shape of the vessel in which the solution is made. They found, that 1000 parts of temperate water will take up from 12 to 16 of the acid, whilst the same proportion of boiling water will dissolve 148, and retain on cooling from 25 to 40, according to the time the boiling fluid is in contact with the arsenic.

The smallest fatal dose on record is stated to have been thirty grains of powdered white arsenic. The man died in six days. A much smaller quantity than this, however, would doubtless kill. The smallest fatal quantity of arsenic, in a state of solution, is stated to have been four grains and a half. The child who took it died in six hours. In a case that fell under Mr. Taylor's notice, (*Manual of Med. Jurisprudence*, p. 141, Lond. 1844,) he had reason to think a young lady was killed by eating a portion of cake which could not have contained more than four grains of arsenic, and probably less than three grains. A fifth of a grain of arsenic, given in divided doses, in three days, occasioned, in one case, symptoms of inflammation of the stomach, and alarming hemorrhage of a serious character, which rendered a discontinuance of the medicine absolutely necessary. Mr. Taylor considers we are warranted in affirming, that a dose of three grains and upwards is likely to prove fatal to an adult; and a much smaller dose to a child. Persons, however, have recovered after having taken very large doses of the poison, which has been rejected immediately by vomiting. Dr. Christison (*Op. cit.* 321) refers to one where an ounce was taken, and the patient recovered under no other treatment than the exhibition of magnesia and sulphate of zinc.

Large doses generally prove fatal in from eighteen hours to three days. In some cases, the fatal event supervenes much earlier—in from three to six hours. Mr. Taylor has referred to many such, and to one or two where death occurred in less than two hours. (See Dr. T. R. Beck, in *Amer. Journ. of the Medical Sciences*, for Jan. 1841, p. 59.) In the cases of poisoning by arsenic recorded by the coroner of the city and county of New York during the years 1841, 1842, and 1843, (J. B. Beck, *Transactions of the New York State Medical Society*, vol. vi. Pt. I., p. 72, Albany, 1844,) the smallest quantity taken was one drachm; the largest two drachms. The shortest time intervening between the taking of the poison and the death was four hours;—the longest two days.]

Oxide of arsenic is soluble in the fixed oils, and also, though sparingly, in alcohol. Its solubility is much diminished by the presence of organic substances, such as milk, tea, animal mucus, &c. It reddens, though faintly, vegetable colours, and forms with bases saline combinations, properties which have acquired for it the title of arsenious *acid*.

Arsenic may become the subject of experiment to the toxicological chemist in the solid form, in a state of aqueous solution, and, lastly, when mixed with the contents of the stomach or intestinal canal.

Should a solid lump or powder of a white colour, suspected to be arsenic, be presented to him, the necessary chemical inquiry may be conducted in the following manner. Let a small particle, previously rendered perfectly dry, be heated gently over a spirit-lamp in a clean glass tube of small diameter sealed hermetically at one end. If it be arsenic it will sublime and be condensed, when the process is conducted slowly, into shining octohedral crystals in the cooler part of the tube. If these phenomena should be distinctly observed, there can be little use in pushing the inquiry further. To satisfy, however, every scruple, let a little of the suspected substance be mixed with twice its weight of black flux, and let the mixture be heated to redness over the spirit-lamp in a very narrow tube, similar to that used in the previous experiment. All doubt as to its real nature will now be removed by the reduction of the oxide, and the formation in a cool part of the tube of a metallic crust, exhibiting externally the lustre and polish of burnished steel, and which, when removed and again heated in a tube open at both ends, the upper extremity of which is held near the nose, will strongly affect the olfactory nerves, as would be done by a bit of garlic.

Dr. Turner has proposed a further test, which may be here resorted to as a corroboration of the evidence already obtained, and which consists in subliming, from one part to another of a tube closed at one end, a particle of the crust. By this treatment, when arsenical, it gradually becomes

oxidized, and is finally deposited on the sides of the tube in the octohedral crystals already described.

In practising the reduction of arsenious acid, the only points to be attended to are to employ a tube whose diameter shall not much exceed the eighth of an inch, to introduce the materials without soiling the tube, and to remove, with a wire surrounded with cotton wick, the moisture which sublimes at the commencement of the process; for, if left in the tube, it would interfere with the distinct and regular formation of the metallic crust. The production, by the process above explained, of a shining ferule of metal; the volatility of this metal with the emission of an alliaceous odour; and the conversion, by Dr. Turner's method, of a particle of it into octohedral crystals, possessing an adamantine lustre; are properties which establish beyond all question that arsenic, or some combination of it, has been the subject of experiment, and enable us to dispense altogether with the liquid tests so frequently resorted to in researches of this description.

Should the arsenic be suspected to exist in solution, the initial steps of the process to be pursued will be somewhat different. Our first object must be to convert it into the sesqui-sulphuret, or orpiment, by passing sulphuretted hydrogen through the solution. Before, however, doing this, it will be necessary to be assured that the arsenious acid does not exist in the solution combined with any base, for in such form the experiment would not succeed. To accomplish this, the solution should be acidulated with a few drops of muriatic or acetic acid. The hepatic gas is then made to traverse the solution for some time, as a consequence of which, if arsenic has been present, an orange precipitate forms and gradually deposits. When the quantity of arsenic present is small, the solution merely acquires an orange colour, but there is no deposition. The formation, however, of a precipitate may, in such case, be invariably determined by *boiling*, which seems to act by expelling the excess of gas with which the solution is charged, and which probably prevents the subsidence of the orpiment. The matter thus obtained should be washed by decantation, and collected on a small filter, from which it is to be transferred while still moist to a watch-glass. Here it is to be mixed with twice its weight of black flux, and the mixture when perfectly dried at 212° is to be introduced into a glass tube, and reduced with the heat of a spirit-lamp, as already minutely described. The subsequent manipulations to be resorted to, in the event of a metallic crust being obtained, it is unnecessary to repeat.

In the great majority of cases, and these by much the most important, arsenic will have to be sought for in the stomach or intestines, where it is necessarily mingled with a variety of animal secretions and alimentary matters. The poison may often, by minute examination, be recognised among these in little lumps, or the form of powder, particularly if sought for at the bottom of a tall cylindric jar, in which they have been agitated, mixed with an equal bulk of water. Should such a search prove fruitless, the process by sulphuretted hydrogen must be resorted to; but it will, as is obvious, be in the first instance necessary to remove the organic matters present in the solution. These would obstruct, if not prevent, the precipitation of the orpiment, and materially interfere with and obscure the subsequent reduction. The following is the outline of the method of clarification first recommended by Christison, and which we have frequently found to succeed perfectly.

Let the matters among which the poison is to be sought be boiled for half an hour with an equal bulk of water, and to the filtered solution, first slightly acidulated with nitric acid, let nitrate of silver be added as long as it affords a precipitate. The animal matters are thus thrown down in combination with oxide of silver, while any arsenic of silver formed is kept in solution by the free nitric acid. Filtration is again resorted to, and to the clear solution so obtained muriate of soda is next added, so as to remove, in the form of chloride, any silver which it may include. After another filtration, potash is added to neutralize the free nitric and arsenious acids, and the solution being then acidulated with a few drops of acetic acid, it is in a state for treatment with sulphuretted hydrogen, in order to obtain orpiment, which, if procured, is to be reduced, as already fully explained. The only explanatory observations which it is necessary to add are, that, prior to the use of the sulphuretted hydrogen, the nitric acid is directed to be neutralized, as otherwise it would decompose the hepatic gas, precipitating its sulphur; and that the acetic acid is subsequently added, in order to liberate the arsenious acid, if present, from the alkali previously employed; as, while in a state of combination, the sulphuretted hydrogen would not affect it. The acetic acid is also ordered rather than the muriatic or sulphuric, as the latter would liberate nitric acid, the former chlorine, both of which are incompatible with sulphuretted hydrogen.

This process we have upon four different occasions practised with success in searching for arsenic in the human stomach; and we cannot assent to the justice of the statements which would appear to have influenced its author in giving it up. Arsenite of silver is extremely soluble in nitric acid; and if, therefore, the details just given be faithfully followed, the arsenic cannot, as has been alleged, subside in combination with oxide of silver.

As a substitute for the method the particulars of which have been just given, Dr. Christison, in the last edition of his work, directs the solution obtained by filtering the boiled contents of the stomach to be simply evaporated to dryness, and the residue to be treated with successive portions of boiling water, to dissolve out any arsenic which it may include. A solution is thus obtained not perfectly free, like that which is the result of the first process, from organic matters, but, nevertheless, sufficiently so to allow the precipitation of any arsenic which it may contain, by the sulphuretted hydrogen gas to be subsequently employed. The orpiment, however, procured by this process invariably contains organic matter, which in the reduction is decomposed, and renders it difficult to distinguish any metallic crust which may happen to be formed, particularly if its quantity should be small.

[If arsenious acid be subjected to the action of nascent hydrogen obtained by the action of diluted sulphuric acid on zinc, it is deoxidized; and the metallic arsenic, thereby obtained, combining with hydrogen, forms arsenuretted hydrogen gas. This is *Marsh's test*. It is considered to be one of great delicacy, and it has been asserted that metallic deposits may be procured when the arsenic forms only the 2,000,000th part of the liquid examined. M. Signoret affirms that he has procured metallic deposits with only the 200,000,000th part of arsenic in the liquid: this being in the proportion of one grain of arsenic dissolved in about 400,000 ounces or 3000 gallons of water. (Taylor, *Op. cit.* p. 152.) The mode of employing this test is given in chemical works. (Graham, *Op. cit.* p. 438; see, also, Pereira, *Op. cit.* i. 538; and Mr. Ellis, in Taylor's Report on Toxicology, in *Brit. & For. Med. Rev.* for Oct. 1844.)

The fallacies of this test arise from the presence of either antimony or imperfectly charred organic matter in the suspected liquid, or from the employment of either zinc or sulphuric acid contaminated with arsenic. (Pereira, *Op. cit.* i. 530; and Taylor, *Op. cit.* p. 154, and his report just cited, for the views of Fresenius, as contained in the *London Lancet*, June and July, 1844.)

Of late, a simple method has been proposed by Reinsch for determining the presence of arsenic in liquids, which has been called, after its proposer, *Reinsch's test*. (See *British and Foreign Medical Review*, July, 1843, p. 275.) To the suspected solution a few drops of pure muriatic acid is added, and a slip of bright copper is placed in it. There is no change until the liquid is brought to the boiling point, when, if arsenic be present, even in small quantity, the copper acquires an iron-grey coating from the deposit of that metal. This is apt to scale off, if the arsenic be in large quantity. The slip of copper is then removed, washed in water, dried, and gradually heated in a reduction tube, when arsenious acid will be sublimed in minute octohedral crystals. If these should not be apparent from one piece of copper, several may be introduced successively. The test succeeds perfectly with powdered arsenic, the arsenites, arsenic acid, the arseniates, and orpiment. It will even separate the arsenic from the arsenite of copper, and from common lead-shot. When the quantity of arsenic is small, the copper acquires a faint violet or blue coat, and the deposit is materially affected by the quantity of water present, or, in other words, the degree of dilution. This test failed to detect the 4000th part of a grain of arsenic in thirty drops of water, the dilution being equal to 120,000 times the weight of the arsenic. The deposit on copper commenced with a violet-coloured film, when the quantity of arsenious acid was equal to the 3000th part of a grain in thirty drops of water, or under a dilution of 90,000 times its weight.

An objection to Reinsch's test is, that other metals are liable to be deposited on copper under similar circumstances. This is the case with antimony, whether in the state of chloride, or of tartar-emetic; and it is not always possible to distinguish, by the appearance, the antimonial from the arsenical deposit. Tin and lead become tarnished under the same circumstances, but there is no decided metallic deposit. Bismuth produces a deposit closely resembling that of arsenic. The arsenical deposit may, however, be discriminated by the circumstance, that octohedral crystals of arsenious acid may be procured by slowly heating the slip of copper in a reduction-tube. If, while heat is applied to the copper in a long piece of tube drawn out at one end, a current of air be gently blown through it, a ring of white arsenious acid will be obtained: this may be filed off, boiled in water, and tested by the ammonio-nitrate of silver and sulphuretted hydrogen.

Of all the methods of detecting arsenic, this is regarded as the most simple and easy of execution; and, according to Mr. Taylor, (*Op. cit.* p. 156,) it will probably, in a short time, supersede most of the other more complex processes of testing for arsenic.

In a recent case of alleged poisoning, Dr. Christison employed this test, and readily detected arsenic in the substance of the stomach in its contents, as well as in the substance of the liver. At one time, Orfila affirmed that he had discovered arsenic as a normal constituent of the body; and Dr. Christison was examined in a court of justice on this point. His answer was, that "Arsenic is not a constituent part of the human body, and is not formed in it. It was once alleged that it was, but that was disproved. The individual (Orfila) who first promulgated this theory, only argues now that small quantities are found in the bones; but in three several experiments before the Academy of Paris, he was unable to show it. Arsenic could only have come into the liver by absorption." Elaborate experiments were made by MM. Danger and Flandin, which demonstrate that there must have been some fallacy attending the original experiments of Orfila; as in no instance in operating on the largest quantities of animal matter, and employing the most delicate tests, could they detect the smallest trace of arsenic as a natural constituent of the human body. (Taylor's *Report*, loc. cit.)]

There are many other arsenical preparations in common use capable of destroying life in small doses, and which are therefore interesting to the toxicologist. The presence, however, of metallic arsenic in them all may be detected with certainty without deviating from the methods which have been recommended for the oxide. Thus, those of them that are insoluble, namely, the German *fly-powder* — a mixture of metallic arsenic with the oxide — the native and artificial sulphurets, and the arsenite of copper or Scheele's green, may all be reduced in a glass tube with a little black flux. And the same process is applicable to the soluble arsenical preparations, such as the arsenite and arseniate of potash, when orpiment is formed from them, by first dissolving them in water acidulated with acetic acid, and passing through the solution sulphuretted hydrogen. In the case of the arsenite of potash, a salt which not long since held a place in the Dublin Pharmacopœia, it will be better to decompose its solution by nitrate of silver, and subject the insoluble arseniate thus procured to the usual process of reduction; for the arsenic acid, in a disengaged state, is but slowly converted by sulphuretted hydrogen into a sulphuret.

[Arsenuretted hydrogen has occasioned death by being respired accidentally.]

In the *treatment* of poisoning by arsenic, antidotes of a chemical nature, to neutralize its malignancy, are entirely out of the question. There are, indeed, several reagents, such as lime-water, sulphuretted hydrogen, and the ammoniaco-nitrates of silver and copper, which are capable of converting arsenic into compounds insoluble in water; but many of these reagents are poisonous themselves, and there are none of the compounds which they form that are not appreciably taken up by the secretions of the stomach and intestines. Neither are we acquainted with any substance which may be viewed as an antidote, acting through the medium of the constitution by exciting an action contrary to that of the poison. Such being the case, it is obvious that we must rely upon expelling the poison, with as much despatch as possible, from the stomach by an emetic, or the application of the stomach-pump, and obviating by appropriate treatment the symptoms of inflammation, and those of nervous irritation and occasional depression, which may manifest themselves in the progress of the case. The experienced physician will not require any suggestion as to the course which he should take on such an occasion, and the student we must refer to hospital practice, or to works which expressly treat of clinical medicine.

[Since the above observations were written, much evidence has been brought forward in favour of the antidotal effects of the hydrated oxide of iron, which must be given as speedily as possible; and, if practicable, the recent oxide should always be administered, especially where the amount of poison taken has been large. (W. Procter, Jun., *American Journal of Pharmacy*, April, 1842, p. 37.) In another work, (*New Remedies*, 4th edit. p. 297, Philad. 1843,) the writer has adduced various cases of successful results from its exhibition. It is necessary to administer it largely, especially as uncertainty must exist in regard to the quantity of poison taken. It has been recommended, that to an adult a tablespoonful, and to a child a dessert-spoonful, should be given every five or ten minutes, until relief from the urgent symptoms is obtained. (T. R. Beck, *American Journal of the Medical Sciences*, July, 1841, p. 90.) A commission of the Royal Academy of Medicine of Paris recommend, that four ounces of the dry hydrated oxide, the subcarbonate or sesquioxids of iron of the shops, should be suspended in twenty-four fluidounces of water, and a good glassful of the mixture be given every ten minutes. After four ounces have been consumed, fresh doses of the same mixture may be administered in like manner, and the patient should not be considered out of danger, until he has taken at least half an ounce of the oxide for each grain of arsenious acid supposed to have remained in the stomach. (*Revue Médicale*, Mai et Juin, 1839.)

The oxide forms with the arsenious acid a proto-arseniate of iron. (Graham's *Elements of Chemistry*, Amer. edit. p. 439, Philad. 1843.) It would seem, however, from some experiments by Mr. Taylor, (*Medical Jurisprudence*, p. 145,) that the oxide of iron does not possess the power of combining with powdered arsenious acid, the form in which arsenious acid is generally administered as a poison; and where recoveries have taken place from its use, there must have been some other mode of operation. (Taylor's Report in *Op. cit.* p. 540.)

It has been objected to the use of the oxide of iron, that it is liable to contain arsenic, and might thereby give rise to embarrassment in the analysis. The objection was urged in the case of Madame Lafarge; but Mr. Taylor states, that he has examined several specimens of oxide of iron by Reinsch's test, but has not found any arsenic in them.

Instead of the pure hydrated oxide, Van Specs, (*Med. Jahrbüch. des k. k. öst. st.* xix. 621, Wien, 1836; and *Brit. and For. Med. Rev.* July, 1837,) employed substances in which the peroxide is known to exist in considerable quantity, and which require no previous preparation, as rust of iron, and hæmatite (red iron); and, from his experiments, he was led to conclude, that although these substances do not prevent all the bad effects of arsenic on the system, they may, in the absence of the hydrated oxide, be employed as antidotes to that poison. The rust of iron has the advantage of being readily procurable.

A case has been published (Batilliat, *Journ. de Chimie Médicale*, Janvier, 1840,) which led to the inference that the hydrated oxide, dried in the air, is as efficacious as that which is kept moist. It certainly would seem, that the dry hydrated oxide—*Ferri-Subcarbonas* of the Pharmacopœia of the United States, (1842,)—possesses the power, to a considerable extent, of neutralizing arsenious acid (Dr. Beck, *loc. cit.*); and hence it ought to be used in the absence of the fresh moist preparation—the *Ferri Oxidum hydratum*. The latter, however, may be obtained in a condition fit for use, in ten or fifteen minutes, by using a solution of the persulphate of iron, (W. Procter, Jun., *op. cit.*) The experiments of M. Guibert (*Bullet. Général de Thérap.*, Dec. 1841,) would seem to show, that the subcarbonate of iron, as ordinarily prepared, is about three times less active in neutralizing arsenic, than the dry hydrate prepared with ammonia, and six times less active than the same hydrate in the moist state. Still, when the hydrated oxide is employed, the practitioner should use every means to evacuate the poison.]

Cobalt.—The salts of cobalt are poisonous. Thirty grains of the chloride killed a rabbit within a day. When applied to the subcutaneous cellular tissue, they were found by M. C. G. Gmelin to act in the manner of irritant poisons. According to Mérat and De Lens, (*Dict. Universel de Mat. Méd.* &c. Art. Cobalt,) the *fly-powder*, known in French commerce under the names *mine de cobalt*, and *poudre aux mouches*, is native arsenic. Cases have been recently referred to in which it proved fatal. (Lewis Hurd, *Boston Med. and Surg. Journ.*, Nov. 20, 1844, p. 316.)]

Copper.—The only combinations of copper deserving of attention in a toxicological point of view are the sulphate, natural and artificial verdigris, and certain pigments, which, like verditer, include the hydrated peroxide of the metal. These preparations are seldom or never employed

for the purpose of destroying life, but some of them, particularly the carbonate and acetate, occasionally make their way into food, pickles, and preserves, &c. cooked in copper or brass vessels. The circumstances under which such an impregnation is or is not possible are deserving of attention.

When vinegar is boiled in a perfectly clean copper vessel, not a particle of the metal is dissolved. If, however, cold vinegar be kept in such vessel for some time, the metal becomes oxidized by the absorption of atmospherical oxygen contained in the vinegar, and, of course, immediately after converted into the cupreous binacetate. These facts were first experimentally determined and explained by the celebrated Proust. Now, what is true of pure vinegar, may, one would be led to anticipate, be predicated of the various articles of food and drink which owe their acidity to free acetic acid. The conclusion thus deduced from analogy is found to be in perfect accordance with experiment. Acid preserves of every description may be boiled with impunity in clean copper vessels; but if kept in them for any time at the common temperature of the atmosphere, a sufficient quantity of copper is taken up to render them strongly poisonous. The relation of copper to the animal fats and fixed oils is nearly the same. In the cold they corrode it with the assistance of the oxygen of the atmosphere; but, at a high heat, their action, though probably not null, is considerably less energetic.

[Mr. Warington has lately shown, that copper vessels, saucepans, taps, and other articles, which have been covered with a surface of silver by the electrotype process, are liable to be acted on by weak acids, such as lemon-juice and vinegar, when these are permitted to remain in contact with them for a short time. It seems, that the metallic silver with which they are covered is porous, and that the acid liquor can penetrate the silver, and reach the surface of the copper. A kind of galvanic action is thus established, which augments the chemical action; so that such vessels, whilst appearing to give security, are really rendered more dangerous. The presence of copper in acid liquids kept in electrotyped vessels, was clearly demonstrated by the usual tests for that metal. (Taylor's Report on Toxicology, in *Brit. and For. Med. Rev.*, Oct. 1844, p. 552.)

The symptoms which characterize poisoning by verdigris are, headach, cutting pains of the intestines, followed by vomiting and purging, coppery taste in the mouth, and strong aversion to the taste of the metal, cramps in the legs, pains in the thighs, and jaundice, a symptom never produced by mercury or arsenic. In fatal cases, shortly before death there are coma, paralysis, and violent tetanic convulsions. The pulse, almost from the commencement, is small, quick, and feeble; and, in some few cases, a slight salivation has been observed.

The morbid changes which have been noticed, are yellowness of the entire body, and inflammation, and even ulceration and gangrene of the mucous lining of the stomach and intestines, at several points. This membrane, also, along the entire tract of the alimentary tube, usually exhibits a decided greenish colour, a circumstance which occurs in no other variety of poisoning.

From what precedes, particularly the summary given of the symptoms, it is obvious that some of the most remarkable of the effects of copper are witnessed in its action on the nervous system. It is not, however, as yet clearly ascertained whether they are the result of sympathy, or of the transmission through the blood to the brain and spinal cord of some portion of the poison. It is asserted by some that copper has been found in the blood, and by others in the liver, of individuals labouring under its influence. These statements, however, require confirmation. If verified, they would seem to establish, at least in one case, the doctrine of absorption and transfer.

There are none of the symptoms or morbid appearances produced by the preparations of copper sufficiently characteristic to enable us to infer from them alone that such preparations, or any of them, have been employed in any particular case of poisoning. The jaundiced colour, indeed, of the surface, and the greenish tinge of the mucous lining of the alimentary tract, furnish, though not convincing evidence, yet strong probable grounds for believing that copper, in some form, has been administered. The suspicions thus raised will require for their confirmation or rejection the co-operation of chemistry; and this brings us to a brief description of the experiments by which the presence of copper may be detected in any of its ordinary forms.

Should the suspected substance be soluble in water, as is the case with the sulphate and binacetate, let it be acted upon with a minimum of this solvent, and then tested, in distinct portions, with the following re-agents, namely, ammonia, a polished iron wire, and a drop of ferro-prussiate of potash. If copper be present, the portion treated with ammonia will require, if the alkali be added in sufficient quantity, a beautiful sapphire blue colour; that in which the wire is immersed will, after the application of heat, if necessary, deposit upon it a coating of metallic copper; and that treated with the ferro-prussiate of potash will give a bulky precipitate of a deep red colour.

If insoluble in water, as is the case with the carbonate, and the acetate or artificial verdigris, and also with the pigment known under the name of verditer, which is a mixture of chalk, carbonate, and hydrate of the peroxide of copper, it is to be taken up with the smallest possible quantity of muriatic acid, and then tested with the substances used in the preceding case, when, should copper be present, the phenomena already specified will be manifested.

The preceding experiments, as will be seen, are calculated only for demonstrating that copper is present in some form or other, but they afford no information respecting the nature of the acid with which it is combined. This latter point, however, can be ascertained by resorting to the tests for the acids explained in a former part of this article.

When copper is sought for in the contents of the stomach, or in mixtures including animal or vegetable matters, such as albumen, milk, tea, and coffee, the first step to be taken is to digest such mixture with an excess of acetic acid. Any copper swallowed in an insoluble form, or rendered

insoluble by the decomposing action* of the fluids just enumerated, will be thus taken up, and, upon filtration, a solution will be obtained, from which the copper will be thrown down by sulphuretted hydrogen. This precipitate, heated on a watch-glass, with a few drops of nitric acid, the excess of which is to be expelled by evaporation to dryness, will be converted into the persulphate, which, when treated with ammonia, polished iron, or the ferro-prussiate of potash, will comport itself as already described.

Should the search thus conducted not lead to the detection of copper, before pronouncing that it is absent, the insoluble matters, separated by the filter from the acetic solution, should be ignited in an earthen crucible. By this treatment any of the metal which may have existed in such matters will be reduced; and when the incinerated residue is treated as before with nitric acid, and filtration performed, a solution will be obtained to which the usual tests may be applied.

In certain cases the preceding investigation may be much abridged. Thus persulphate of copper, which is sometimes used by the baker, particularly in Germany, for the purpose of promoting the fermentation of the dough and contributing to the whiteness of the bread, objects which it is said to accomplish when used in a proportion not exceeding one part in 2000, may be at once detected by the light carnation tint produced by dropping a dilute solution of the ferro-prussiate of potash on the soft part of the loaf. Unless, however, the tint be very decided and characteristic, the washings of a considerable quantity of the bread with distilled water acidulated with acetic acid should be concentrated, and subjected, for the purpose of verification, to the different tests already more than once described.

Different antidotes have been proposed for the cupreous poisons. Sulphuretted hydrogen and the alkaline hydrosulphurets have been particularly recommended; but experience has shown that they cannot be relied upon, and indeed this might have been inferred from the fact of their being themselves preparations highly inimical to life. Duval recommended sugar, probably because, when boiled with salts of copper, it effects their reduction, but this action is not exerted at ordinary temperatures; and Orfila, though first a convert to the opinion of Duval, has since found that the antidote suggested by him does not possess any real efficacy. Orfila has himself since recommended the white of eggs, and his experiments on dogs would really appear to prove that it neutralizes the influence of the acetate. Lastly, two French physicians have tried iron filings, in consequence of the power possessed by this metal of reducing the salts of copper, and the results they obtained, in some experiments performed by them on animals, are such as to justify considerable confidence in the antidote which they recommend.

To the preceding remarks it is scarcely necessary to add that no time should be lost, and none of the ordinary means omitted in expelling the poison from the stomach, and that the inflammatory or other symptoms which may arise in the progress of the case should be treated on general principles.

Lead.—[A case has been reported by Dr. Bryce (*London Lancet*, Dec. 31, 1842,) which would seem to show that lead, in the metallic state, may be poisonous. A man, aged 23, swallowed three ounces of No. 4 small shot in three days. On the third day, there was great anxiety with depression, sunken features, coldness of surface, vertigo and numbness in the arms and legs. He continued getting worse in spite of treatment; the bowels were obstinately torpid, and there was increased numbness in the arms, and dizziness. Cathartics were exhibited; the alvine discharges were examined; but only one pellet was found; so that if the shot were discharged it must have been in the three days before he was seen by Dr. Bryce. The man perfectly recovered in a fortnight.

A case is related in the *Annales d'Hygiène*, &c., for April, 1844, which shows that serious results may follow from the shot used in cleaning bottles being left in them, and afterwards becoming acted upon chemically by wine or other liquid put into the bottles. (Taylor, Report on Toxicology in *Brit. and For. Med. Rev.* Oct. 1844, p. 546.)]

The preparations of lead most used in medicine and the arts are litharge, red lead, the carbonate, or white lead, the acetate or sugar of lead, and the subacetate, commonly known under the name of Goulard's extract. The two last alone are soluble in water, and hence are the most active in their effects upon the animal economy. The others are, in a greater or less degree, acted upon by the acid secretions of the stomach, and thus acquire the poisonous properties they are known to exert.

Before proceeding to examine, according to our usual plan, the subject of poisoning by lead, it will be proper to premise some remarks upon the different means by which lead may be introduced into articles of food and drink. This is, from the extended use of the metal, a subject of much practical interest, and one which has been studied with considerable attention.

If lead be kept any length of time in contact with distilled water deprived of the atmospherical air which water under ordinary circumstances always includes, not the slightest corrosion is observed to take place. If, however, the access of air be permitted, its oxygen gradually combines with the metal, and the oxide thus formed attracting carbonic acid from the same source, is gradually converted into the white carbonate. The water in which this change has been effected may, if drunk, prove poisonous in one or other of two ways; first, should particles of carbonate of lead be suspended mechanically in it, and secondly, should it abound in free carbonic acid; for this gas possesses the power of dissolving carbonate of lead. If pure water in which lead has been corroded be boiled and filtered, it is deprived of all traces of the metal, and may then be used with perfect safety.

Should water contain a minute quantity of saline matter, as is the case with almost all natural waters, though kept in contact for any length

* Albumen, milk, tea, coffee, afford upon the addition of the persulphate of copper, insoluble combinations of animal or vegetable matter with the peroxide of the metal.

of time with lead, the metal will scarcely undergo a perceptible corrosion, for a minute film of insoluble salts is gradually deposited on it, which protects the subjacent metal from further oxidation. In the case of ordinary water, the contained salts of which are almost invariably sulphates and muriates, the protecting film is composed of sulphate of lead, intermixed, however, with traces of chloride and carbonate. All salts are not equally efficacious in protecting lead from oxidation, the general rule being that those answer the purpose best whose acids afford with oxide of lead the salts most difficult of solution in water. Experiments, for example, conducted by Dr. Christison, demonstrate that complete protection is afforded by $\frac{1}{2000}$th of muriate of soda, $\frac{1}{4000}$th of sulphate of soda, $\frac{1}{12000}$th of arsenic, and $\frac{1}{27000}$th of phosphate of soda. [See a second paper by Dr. Christison, in *Transactions of the Royal Society of Edinburgh*, vol. xv.; or *Lond. Edinb. and Dublin Philos. Mag.* Aug. 1842.]

The difference of the corrosive powers, in reference to lead, of perfectly pure water and that which is slightly impregnated with the ordinary salts, is well illustrated by the greater amount of oxidation experienced by the lid of a leaden cistern than by its bottom and sides. The latter are in contact with common water, while the former is subjected to the action of its vapour, or of water in a perfectly pure or distilled state. From the facts just stated, and which have been fully established, it would seem to follow that when a leaden cistern undergoes a rapid corrosion, it must be traced to an unusually small amount of its saline constituents. But though present in sufficient quantity, their preservative influence is, as has been already observed, sometimes counteracted by the agency of a large quantity of carbonic acid. When lead exists dissolved in water, it is held in solution chiefly by this latter substance; but when alkaline muriates alone occur in the water, and in quantity insufficient for the protection of the metal, a little chloride of lead is also generally taken up, and this cannot, like the supercarbonate, be removed by ebullition.

Lead has been intentionally administered in large doses, in the form of acetate, for the purpose of destroying life; but it is more frequently gradually introduced into the system in consequence of its occurring in small quantity in different articles of food or drink. It occurs, as we have seen, in water, and also occasionally in milk, pickles, preserves, &c. The vegetable acids existing in these corrode, with the assistance of the oxygen of the atmosphere, the leaden vessels in which they may happen to be made or preserved, and thus invest them with poisonous properties. Acescent fluids also, such as sour milk, have been known to become impregnated with lead when kept for some time in earthenware glazed by means of litharge, a circumstance which has in a great measure led to its disuse by the potter. The acetic acid is that the action of which is most energetic. Next to it come the citric and the malic, and, lastly, the tartaric, which though it combines with lead previously oxidized, will scarcely take it up, as the tartrate is nearly insoluble in an excess of its own acid. Acescent wines are sometimes treated with litharge, which neutralizes their free acid and confers upon them a sweetish taste; and this pernicious practice, which once prevailed in France to a frightful extent, is, we believe, not as yet entirely laid aside. In the cider counties of England, also, at one time a similar impregnation frequently occurred, not, however, in consequence of lead intentionally introduced, but because of this metal being used in the construction of the press and other implements employed in the cider-house.

Lastly, in the case of miners, smelters, painters, glaziers, litharge and white lead manufacturers, &c. lead enters the system either accidentally during meals, or by pulmonary or cutaneous absorption, and thus gives rise to the different symptoms so characteristic of its action. The nature and order of these symptoms we shall now describe.

The symptoms vary according to the nature of the preparation employed, and the amount of it administered. The insoluble preparations of lead do not produce in the intestinal tract any symptoms of irritation or inflammation, and the same may be said of the soluble salts when given in small doses. When, however, a soluble salt of lead, such as the acetate, is taken into the stomach in doses of from one to two drachms, morbid phenomena ensue, analogous to those produced by the ordinary irritant poisons. Pain after some time is felt in the throat, œsophagus, and stomach; nausea and vomiting ensue, and these are succeeded by all the symptoms of common colic. Finally, when the case proves fatal, convulsions, together with a general sensation of numbness, are experienced a short time previous to death.

But if some one of the insoluble preparations, or even a soluble one in a small dose, be administered sufficiently often, the results are very different. From the commencement there are either none or but very slight symptoms of irritation of the alimentary tract. A colic, however, of a very decided and distressing nature is after some time developed. This sometimes begins suddenly, more frequently it is preceded by gastric derangement, such as nausea and vomiting; cramps of the stomach next set in, and these gradually extend over the abdomen, and at length degenerate into a colic scarcely to be distinguished from the idiopathic disease of the same name. The belly is unusually tense and is greatly drawn in at the navel; the pain, which is subject to intermissions of greater duration than those which belong to common colic, is relieved by pressure; the bowels are generally costive, though in some cases the opposite condition of a diarrhœa prevails; the urine is scanty; the saliva is copiously secreted and of bluish colour; the limbs are the seat of aching pains; the skin exhibits a dull and cadaverous aspect, and is bathed in a cold and clammy sweat; the countenance is gloomy and desponding, and the pulse, though in some few cases accelerated, is, generally speaking, considerably retarded. This combination of symptoms, which constitutes the lead or painters' colic properly so called, if not cut short by apoplexy, an event which has been but once observed, usually ceases of itself within the space of seven or eight days. In such event, however, it is often followed by a general and extreme debility, and by a wasting and partial

paralysis of the muscles which supply the wrist, thumb, and fingers, particularly those which serve for the purposes of extension. These symptoms are frequently the only ones which are observed to follow from gradual poisoning by lead, those of colic being wanting. The painters' colic and its sequelæ are, it may be observed, produced by lead in all its ordinary forms, and whether these be internally exhibited or externally applied.

In a case in which Goulard's solution was swallowed, and which proved fatal on the third day, the stomach, duodenum, upper part of jejunum, and ascending and transverse colon, were considerably inflamed, and the villous coat of the stomach was, in addition, found in a soft or pulpy state.

In cases which have commenced with symptoms of colic alone, and which have proved fatal, the most minute examination has failed to detect any morbid change save a preternatural contraction of the intestinal tube, particularly that part of it which constitutes the large intestine. Even when death has been preceded by well-marked symptoms of cerebral derangement, such as paralysis, coma, and convulsions, the brain and spinal marrow have been found perfectly healthy. We should not omit to mention that in individuals long under the influence of the partial paralysis produced by lead, the affected muscles are invariably wasted, flaccid, and of an exanguious pale appearance. See Colic.

The soluble forms of lead in large doses often irritate, as we have seen, and inflame the alimentary tract, and such effect, from the rapidity with which in certain cases it has been determined, is no doubt the result of a local action, or the immediate application of the poison to the parts affected. The consequences, however, of its administration upon the large intestines and the nervous system must be referred to an agency exerted through the medium of nervous sympathy or absorption. That its effects are, at least partly, produced in the latter way, would appear pretty well established by the experiments of Wibnier, which detected lead in the liver, spinal cord, and lumbar muscles of a dog thrown into painters' colic by repeated small doses of sugar of lead; and it may be added that this conclusion, as far at least as respects the lumbar muscles, has been confirmed by the more recent researches of Christison. If entitled to look upon this point as established beyond controversy, we shall henceforward be able to ascend at least one step higher than before in our search after the cause of the paralysis which characterizes slow poisoning by lead.

When an individual dies of a large dose of some soluble preparation of lead, there is nothing in the symptoms or morbid appearances sufficiently characteristic to distinguish the case from one of poisoning by any other irritant. But in those cases which are by much the most numerous, where the poison gradually insinuates itself into the system, the symptoms of colic during life, combined with the contracted state of parts of the intestinal canal, and the absence of all other lesions, will, generally speaking, enable us to decide respecting its real nature. It will seldom, however, occur that a certain conclusion can be drawn without the aid of chemical research, and this brings us to the description of the experiments by which lead in its various ordinary forms may be detected.

If our search be directed to an aqueous solution, it will be only necessary to add to separate portions of it a little sulphate of soda and hydriodate of potash. If lead be present, the former will afford a white precipitate, which is blackened by sulphuretted hydrogen; and the latter, one of a bright yellow colour, and soluble in a large quantity of hot water, from which, as the solution cools, it subsides in scales of a beautiful orange hue.

Should the suspected substance be insoluble in water, let it be heated on charcoal with the blowpipe, by which treatment, if it be a preparation of lead, a malleable metallic button of a blue colour will be obtained; and the solution obtained by acting upon this with nitric acid will, when rendered neutral by evaporation or otherwise, afford, with sulphate of soda and hydriodate of potash, the precipitates already described.

When a mixture containing organic substances, such as milk, albumen, or the contents of the stomach, is the subject of experiment, it is to be acidulated with acetic acid and then boiled for some time, in order that the vinegar may take up any oxide precipitated by the organic matters. Filtration is now to be practised, and sulphuretted hydrogen passed through the filtered solution as long as a black precipitate is formed. This, if sulphuret of lead, will afford with nitric acid a nitrate of the protoxide, which, when rendered neutral by evaporation, re-dissolved in water, and separated from any insoluble residue by filtration, will be affected as before by the sulphate of soda and hydriodate of potash. One or other of these methods is applicable to any of the preparations enumerated at the commencement of this section.

When a soluble salt of lead, such as the acetate, is swallowed, next to the adoption of such means as may effect its expulsion from the stomach, the most judicious course will be to introduce after it such re-agents as will convert it into compounds insoluble in the gastric juices. This object may be accomplished by solutions of the sulphates of soda or magnesia, for experiment proves that the sulphate of lead which is formed in virtue of the decomposition which ensues, is entirely destitute of poisonous action. The phosphate of soda is equally efficacious, and the alkaline carbonates, though themselves injurious in large doses, may, when cautiously used, be exhibited with advantage, as the carbonate of lead is much less active than the acetate or any other soluble salt of the same base.

[Dr. C. G. Mitscherlich has lately shown, that the acetate of lead is a poisonous salt; and that when mixed with acetic acid, it is more energetic than when given in the neutral state. (*Brit. & For. Med. Rev.*, No. vii., p. 208.)]

Dr. A. T. Thomson has given publicity to the very paradoxical opinion, that the carbonate is not only the most poisonous of the preparations of lead, but that it alone is possessed of any injurious properties. It would be interesting to learn the ground of such a position.

In recounting the chemical antidotes, the sulphate of zinc should not be forgotten. This will not only favour the ejection of the poison by exciting vomiting, but will also convert any portion

of it which exists dissolved in the contents of the stomach into the inert and insoluble sulphate.

[Albumen precipitates the oxide of lead when added in large quantity, and Mitscherlich has found, that casein is a very effectual precipitate of the oxide. It would, consequently, be advisable to administer, in cases of poisoning by the soluble salts of lead, milk or albumen in large quantity. The compounds, thus formed, if not inert, are far less active than the acetate.]

The consequences of slow poisoning by lead, namely, colic and partial paralysis, are to be treated upon general medical principles. The former is most readily subdued by the exhibition of alternate doses of purgative and anodyne medicines, while the latter can only be benefited, and finally overcome, by means which restore the general health. It may, however, be observed that this latter line of treatment seems considerably assisted by the use of splints or other mechanical means, for sustaining in the extended position the wrists and fingers, which are the seat of the paralysis.

These symptoms are very apt to recur or repeatedly attack the same individual, whenever he is exposed sufficiently long to the influence of the poison. To prevent, in some cases, such a recurrence, a total change of occupation is indispensable, and in all instances of inevitable exposure to the poison, the strictest measures of cleanliness and precaution should be adopted, so as to prevent as much as possible its ingress, through any channel, into the system.

Zinc.—The sulphate of zinc is the only preparation of this metal which claims notice here. From its extensive use as an emetic in the different varieties of poisoning, if for no other reason, it deserves the attention of the toxicologist.

When white vitriol is administered to the human subject, vomiting is shortly excited, and this being an almost invariable effect, it has been concluded that in no dose can it prove dangerous, as after a little time it is necessarily expelled from the stomach. Cases, however, have occurred in which it has caused very violent irritation, and there are even two instances on record in which it produced death.

The symptoms which are witnessed when a large dose of sulphate of zinc has been administered, are violent vomiting, which, for the most part, ceases after the stomach has been completely emptied, the individual shortly recovering his natural state. In some cases, however, the vomiting is succeeded by a diarrhœa, tenderness in the epigastrium, and abdominal pains; symptoms which, though very rarely, have terminated fatally.

In a fatal case recorded by Mertzdorf, the stomach and intestines, particularly the latter, were found contracted, and the inner membrane of both studded with several spots of effused blood. Their contents also were fluid, and of a greenish grey colour. In other respects the body was natural.

The preceding details are confirmed by the symptoms and morbid appearances witnessed by Orfila in dogs made to swallow large doses of sulphate of zinc, the salt being detained in the stomach by ligature on the œsophagus.

When introduced into the stomach, sulphate of zinc operates obviously as an irritant poison, and even inflames the part to which it is applied. The nausea and vomiting, however, are also produced when the salt is applied to other mucous surfaces, as, for example, the rectum; and it has hence been concluded that the greater portion of the phenomena it produces are the result of its operation upon remote organs. But the precise channel through which this action is conveyed has not been determined.

It is scarcely necessary to say that the exhibition of sulphate of zinc cannot be inferred from the symptoms or morbid appearances which it produces. In suspected cases, the aid of chemistry must be invoked, and indeed there is no metallic preparation the presence of which in a given solution or mixture can be determined by more decisive experiments than white vitriol.

If the suspected substance be a white pulverulent or prismatic powder, if it dissolve in water, and if the solution afford with hydro-sulphuret of ammonia a white precipitate, but none with sulphuretted hydrogen if previously acidulated with sulphuric acid, it may be pronounced, with much probability, to be a salt of zinc. This conclusion is confirmed, if, upon the addition of a drop of water of ammonia to a separate portion of it, a white precipitate is obtained, which disappears, affording a colourless solution, when more of the alkali is added. Should it be sought for in the contents of the stomach, it is necessarily mixed with organic matters. In such case the whole should be agitated for some time in a warm place, in a bottle, with an excess of the water of ammonia, and the insoluble matters separated by filtration.

The solution thus obtained will contain the oxide of zinc dissolved by the volatile alkali, from which it may be recovered, in the form of the white sulphuret, by a stream of sulphuretted hydrogen. If this precipitate be digested with nitric acid, a mixed sulphate and nitrate of zinc are formed, which, when rendered neutral by evaporation to dryness, dissolved in water, and filtered, may be subjected to the tests already mentioned.

The process for organic mixtures given by Christison is defective, for it assumes what is erroneous,—namely, that the oxide may be thrown down from sulphuric acid by sulphuretted hydrogen. This only occurs, to a very limited extent, when the solution is neutral, but not at all in one acidulated by a mineral acid.

The preceding process will merely prove the presence or absence of oxide of zinc from any solution or mixture submitted to examination. The search for sulphuric acid will require the application of other tests, which have, however, been detailed in their proper place.

Upon the subject of *treatment* it is not necessary to make any remarks. From its peculiar action on the stomach, it will generally be quickly discharged, so that the only point which can require attention will be the allaying, by appropriate means, the irritation or inflammation which it may have excited.

Antimony.—There are at least four preparations of antimony employed as therapeutic agents by the physician and surgeon, namely, the prepared sulphuret, kermes mineral, tartar-emetic,

and the chloride or butter of antimony. The two first possess too little activity to become objects of interest to the toxicologist, and as to the last, though a powerful corrosive, we have, owing to its rarity, very few instances of poisoning by it. It will therefore be nearly sufficient for us to confine our attention to the tartar-emetic. A few incidental remarks at least will suffice in reference to the other preparations.

When tartar emetic is swallowed by man, it very generally happens that, whatever may have been the amount of dose, it, like the sulphate of zinc, is rejected by vomiting; and after these effects are over, the individual is found to have sustained no injury whatsoever. This, however, does not invariably occur; for sometimes when the dose is large, or when the medicine is retained for a considerable time, the vomiting which finally sets in becomes obstinate, the stomach is the seat of a burning pain; and purging accompanied with violent colicky spasms, shortly follows. A sense of constriction in the throat is also experienced, and the limbs are seized with the most distressing cramps. In case of a fatal termination, a thing very seldom witnessed, death is preceded by delirium and convulsions.

In two cases recorded in the French journals in which death was produced by tartar-emetic, inflammation of the villous coat of the stomach, duodenum, and small intestines, constituted the only lesion which was observed. Magendie, in experimenting upon dogs, found that the lungs were always highly congested and inflamed, but the dissections hitherto made do not enable us to extend this observation to the human subject.

[Professor Hamilton of Edinburgh was in the habit of referring in his lectures to fatal cases resulting, in infants, from the administration of the tartrate of antimony and potassa. He was led to believe that the fatal lesions were induced when no fluid was contained in the stomach, and hence urged the necessity of care on this point. Attention has been recently drawn to the subject of poisoning by this salt in the case of the young by Mr. Goodlad and Mr. Noble, when given even in small doses. Four cases have been recorded by Mr. Wilton in which prostration and collapse followed the administration of ordinary doses of the tartrate to young children. Two of these were fatal. (Mr. Taylor's Report on Toxicology, *Brit. and For. Med. Rev.* for Oct. 1844, p. 552.)]

It is scarcely necessary to observe that tartar-emetic exercises a local action, whether introduced into the stomach or applied by inunction to the external surface of the body. In the former case, redness, thickness, and spots of extravasation are produced upon the mucous lining of the alimentary tube; in the latter, a pustular eruption, as is well known to the physician and surgeon. It may, however, be doubted whether the effects it produces on the stomach are not partly the result of a remote action directed to the nervous system, particularly when we recollect that nausea, vomiting, and marks of gastric inflammation are also produced when the poison is introduced into the urethra or rectum, applied to a wound, or injected into a vein. The medium through which this action is exerted has not been ascertained, but it is probably nervous sympathy.

No assistance can be derived from either the symptoms or morbid appearances in deciding upon a suspected case of poisoning by tartar-emetic. This is too obvious to require enforcement. The solution of the question as to whether antimony has been administered or not must be drawn from chemistry alone.

The substance suspected to be an antimonial preparation is either soluble in water, or it is not. If soluble, let the solution be treated with sulphuretted hydrogen, and if an orange precipitate is formed, it furnishes probable, though not convincing evidence of the presence of the metal. Let the precipitate be collected on a filter, washed, dried, then dissolved in a minimum of concentrated muriatic acid, and, finally poured into water. Should a white precipitate be thus produced, all doubt as to the presence of antimony is removed.

When the metal is sought for in organic mixtures, the whole should be digested with tartaric acid for the purpose of dissolving any oxide of antimony which may have been precipitated. It is now filtered, and through the solution thus obtained the sulphuretted hydrogen is passed as before, the temperature of 212° being subsequently applied in order to determine the subsidence of the precipitate. In consequence of the organic matters present, this precipitate, though it be sulphuret of antimony, will seldom exhibit its characteristic orange colour; but if upon treatment, as already described, with muriatic acid and water, a white precipitate be obtained, which is changed to orange by contact with sulphuretted hydrogen, the proof of the presence of antimony is complete.

The preceding processes suppose the antimonial preparation to be either soluble in water or tartaric acid, and are therefore applicable to tartar-emetic and butter of antimony.* Should the native or artificial sulphuret be the subject of examination, they will dissolve with the evolution of sulphuretted hydrogen in strong muriatic acid, and the solution poured into water will deposit the pulvis Algarotti, or white powder already described. The processes for the reduction of the metal recommended by Orfila and Christison are altogether omitted, as they are rather difficult of execution unless by the experienced chemist, and when successfully performed, afford, in reality, less satisfactory evidence than those with the description of which we have contented ourselves.

Treatment.—The poison should be expelled as speedily as possible, but this will, generally speaking, be accomplished without assistance when the tartar-emetic has been taken. To neutralize any of it which may remain, draughts containing infusion or tincture of yellow bark, or in the absence of these, tincture or infusion of galls, should be repeatedly given.† The bark in powder has also been advantageously administered. After a sufficiency of cinchona has been given, if the stomach still continue disturbed, opium may be exhibited. Should gastric inflammation be developed, it is to be treated upon general principles.

* This preparation, if swallowed, immediately deposits, upon contact with the fluids of the stomach, the pulvis Algarotti, which dissolves in tartaric acid.

† The gallate and tannate of antimony are insoluble, and, as far as experiments go, would appear to be inert. It is by the formation of these that cinchona acts as an antidote to tartar-emetic.

Bismuth.—When a solution of bismuth in nitric acid is rendered as neutral as possible by evaporation, and then poured into water, a beautifully white precipitate immediately falls down. This, which is a subnitrate, is a good deal used by some practitioners in the treatment of the different forms of dyspepsia. But, when exhibited in an over-dose, it is an irritant poison, and has occasionally produced fatal effects.

In a case quoted by Christison from a French journal, in which two drachms were swallowed mixed with a little bitartrate of potash, the symptoms were, shortly after swallowing the poison, burning in the throat, brown vomiting, watery purging, cramps, coldness of the limbs, and intermitting pulse; then inflammation of the throat, difficult deglutition, dryness of the membrane of the nose, and a constant nauseous metallic taste. On the third day, hiccup, laborious breathing, and swelling of the hands and face; on the fourth day, swelling and tension of the belly; on the fifth day, salivation; on the sixth day, delirium; on the seventh day, swelling of the tongue and enormous enlargement of the belly; on the ninth, death. The urine also was suppressed until the eighth day. It was ascertained after death, that from the fauces to the rectum there were but few points free from disease. The tonsils, uvula, pharynx, epiglottis, and larynx were gangrenous, the gullet was livid, and the stomach very red, with numerous purple pimples, the whole intestinal canal red, and here and there gangrenous, especially at the rectum. The inner surface of the heart was red. The kidneys and brain were healthy.

The subnitrate of bismuth may be distinguished from other white powders insoluble in water, by being taken up by nitric acid of a density not less than 1280., and by the solution thus obtained affording, when poured into water, a white precipitate, (the original subnitrate,) which is blackened by sulphuretted hydrogen. If sought for in a mixture containing organic matters, the insoluble portion should be separated by filtration and charred in an earthen crucible at a red heat. In this way the subnitrate, if present, is reduced, and may be subsequently dissolved by digesting the residue with nitric acid of specific gravity 1280. The solution thus obtained is of course to be tested in the manner above explained.

Under the head of *treatment* it is sufficient to say that the poison should be expelled as rapidly as possible, and any subsequent inflammation encountered by the usual antiphlogistic means. There is no chemical antidote for this poison.

Barytes.—There are but two barytic preparations which deserve any notice here, the carbonate and the muriate, [*chloride of barium*,] for these are the only ones which are prepared in quantity for medicinal or other purposes. The former is a native product, and has, in the districts in which it abounds, been employed as a poison for rats; the latter is artificially prepared with a view to its exhibition in the treatment of strumous affections.

But few opportunities have occurred of studying the symptoms it gives rise to in the human subject. In a case recorded in Brande's Journal, vol. iv. p. 382, in which an ounce of the muriate was taken in mistake for Glauber's salt, a sensation of burning was felt in the stomach immediately after swallowing the poison; vomiting, convulsions, and headach ensued, and death took place within an hour. There is a case in the Medical Commentaries referred to by Christison, of a gentleman, who shortly after having swallowed by accident about thirty drops of the same preparation, was attacked with profuse purging and vomiting, and in half an hour with a degree of muscular debility of the lower limbs, nearly amounting to paraplegia. In twenty-four hours, however, he recovered his natural state.

The morbid changes produced by barytic preparations in man have not as yet been described. In the lower animals, when swallowed they produce, unless death ensue with great rapidity, inflammation of the stomach and lower intestines; and Dr. Campbell observed that when dogs were poisoned by the application of the muriate to an external wound, the brain and its membranes were so injected with blood as to exhibit appearances analogous to those of congestive apoplexy.

The barytic salts obviously exert a local action, for they irritate and inflame the parts to which they are applied. The most remarkable effects, however, which they produce, are the result of a remote action directed to the brain and spinal marrow, and producing paralysis and convulsions. This second variety of action is established not only by the symptoms which have been observed in man, but also more completely by the experiments of Brodie, Orfila, and Gmelin, upon the lower animals. We do not know through what channel the morbific influence of barytes is conveyed to the nervous system. It is important, however, in reference to this point, to observe that the muriate and other soluble salts of barytes operate as poisons, whether introduced into the stomach, applied to a wound, or injected into the blood. The carbonate of barytes, though insoluble in water, is a poison in the stomach, being dissolved by the acid juices which it encounters there; and Dr. Campbell even found it to produce alarming effects when applied to a wound. Introduced into a vein, it would probably act merely in a mechanical manner: for, from the alkalinity of the blood, it could not undergo any solution.

The muriate of barytes may be distinguished from all other poisons by affording, with nitrate of silver, the well-known chloride of that metal, and, with sulphate of soda, a white precipitate quite insoluble in water, acids, or alkalies, and not blackened by sulphuretted hydrogen. These latter experiments, indeed, do not sufficiently distinguish it from the muriate of lime and strontites, for the sulphate of these earths, particularly the latter, are very sparingly soluble, and are equally unaffected by sulphuretted hydrogen. To remove all doubt, let the suspected solution be treated with less sulphate of soda than is necessary for its perfect decomposition, and let the precipitate be collected on a filter and washed with distilled water. If the washing, upon the addition of a drop of muriate of barytes, afford no precipitate, the salt must have been a barytic one. If there be a precipitate, it is one including lime or strontites. Should the poison be sought for in the contents of the stomach, these should be boiled with water, filtered, and the solution thus obtained should be evaporated to dryness, and ignited

in a platina crucible to destroy organic matter. The residue is next to be digested with a small quantity of water, and to the solution thus obtained, when filtered, the tests already described may be applied. If, in the treatment of a case of poisoning by barytes, the proper antidotes be administered with sufficient promptness, the earth can only be found in the stomach in the form of sulphate. To form from it the muriate, with the application of the proper tests, the following method must be pursued. Let the contents of the stomach be thrown upon a filter, and let the matters detained thereby, when dried, be mixed with one-sixth of their weight of lamp-black, and exposed in a platina crucible, or, should the mixture be very small, rolled up in a little platina foil, to a strong red heat for ten or fifteen minutes. The sulphate of barytes is thus converted into a sulphuret of barium, which is changed by the action of muriatic acid into muriate of barytes, sulphuretted hydrogen being at the same time given off. The mode of testing this muriate need not be repeated.

In case of poisoning by the muriate, a solution of sulphate of soda or magnesia should be introduced into the stomach. This also should be done without loss of time, for the poison sometimes acts with extraordinary rapidity. The barytes is thus immediately converted into the insoluble sulphate, which experiment proves to be altogether inert. Should the carbonate have been the preparation swallowed, the soluble sulphates should be replaced by copious draughts of dilute sulphuric acid.

Tin.—Metallic tin in a finely granulated state is employed in medicine as a vermifuge. Its action is considered purely mechanical, and, though given in large doses, it has not given rise to any poisonous symptoms. The peroxide of tin also, though not inert, possesses but little activity. If the experiments of Schubarth can be relied upon, in drachm doses it exerted no action whatever upon a dog. The proto- and per-muriates, however, which are prepared in quantity in consequence of their uses in dying, are active irritants, whether exhibited to man or the inferior animals.

The only description of the symptoms produced by these preparations published is that given by Orfila, in the case of several persons who partook of food seasoned with muriate of tin, accidentally used by the cook instead of common salt. All had colic; some diarrhœa; and all recovered in a few days.

The morbid appearances are exclusively such as result from violent irritation. In dogs, the stomach, according to Orfila, always looks as if it had been partially tanned.

The symptoms observed after the exhibition of the muriate to dogs, combined with the morbid changes it effects, justify the belief of its action being simply that of a local irritant. Tin, in the form of protomuriate, is easily detected by its affording with the muriate of gold the purple powder of Cassius, with corrosive sublimate a white precipitate, which presently assumes a leaden hue, and by communicating a red colour to a very dilute solution of the muriate of platinum.

As a permuriate, it does not yield to any very characteristic precipitates with re-agents, so that it will be necessary to heat the suspected substance to redness with black flux in a Hessian crucible, by which means, if tin be present, a metallic button will be obtained. This will dissolve with the evolution of hydrogen in muriatic acid, and the solution thus formed will comport itself as protomuriate of tin.

In cases of the ingestion of tin, the first therapeutic step to take is to expel as much as possible of the poison from the stomach by emetics or the stomach-pump; the next to decompose whatever may remain by the introduction of fluid albumen. Should inflammatory symptoms be developed, the usual antiphlogistic measures must be resorted to.

To the irritant poisons of organic origin the term *acrid* has been usually applied. Some are the products of the vegetable, and some of the animal kingdom.

[**Chrome.**—The only salt of this metal which has been productive of poisoning is the *Bichromate of Potassa.* This salt is much used in the art of dyeing, and is extensively manufactured in Baltimore, where several cases of poisoning with the saturated solution have occurred. The following instance was communicated by Dr. Baer to Professor Ducatel, (*Manual of Practical Toxicology*, p. 144, Baltimore, 1833.) A labourer, aged 35 years, on attempting to draw off from a reservoir a solution of the bichromate of potassa, in the effort to exhaust the syphon by suction, received a small quantity of the solution in his mouth. His first impression was, that he had spitten it out; but only a few minutes elapsed when he was seized with great heat in the throat and stomach, and violent vomiting of blood and mucus. The vomiting continued until shortly before his death, which took place about five hours after the accident. No medical treatment was attempted, Dr. B. having been called in too late. In the examination after death, the mucous coat of the stomach, duodenum, and about one-fifth of the jejunum was found destroyed in patches. The remaining parts could be readily removed by the handle of the scalpel. The lower part of the intestinal tube appeared to be healthy.

The bichromate of potassa seems to be an irritant poison, affecting principally the nervous system. In animals it has, in small doses, produced vomiting, diarrhœa, paralysis, and death in a few hours. It seems, also, to produce extensive sores on the hands of dyers; and even in parts where the vapour alone could come in contact, the vapour being charged, perhaps, with chromic acid. (Ducatel, *Op. cit.* p. 145.)

A case of poisoning by this salt has lately been detailed by Mr. Wilson, of Leeds, (*Lond. Med. Gaz.* xxiii. 734). It is worthy of remark, that in this case there was neither vomiting nor purging; death appeared to be induced by the indirect effect on the nervous system; an occurrence which, as remarked by Mr. Taylor, (*Report on Toxicology,*) is by no means unusual, even with irritants far more powerful than the bichromate of potassa.]

2. *Vegetable Irritants or Acrids.*

This genus, though including a considerable number of species, admits of being discussed with brevity, for the symptoms and morbid appearances produced by all are nearly the same. There is another reason, also, why it will not be necessary

to dwell minutely upon them; they are seldom resorted to for the purpose of destroying life.

The vegetable acrids, when swallowed in large doses, very generally give rise to vomiting, by means of which the poison is discharged. Sometimes, however, they are retained by the stomach, particularly when the quantity has been small; and in these cases diarrhœa usually sets in, attended by abdominal pain, which is at first remittent, but becomes more constant in proportion to the development of inflammation in the intestinal tube. The belly now becomes tense and tender. The debility is great, and giddiness and tendency to delirium are sometimes, though rarely, observed.

The *morbid appearances* produced by the vegetable narcotio-acrids are inflammation and its essential concomitants, redness, together with, occasionally, ulceration, principally in the stomach, duodenum, and large intestines.

These poisons are direct local irritants, and probably do not enter the blood. Such, at least, is the conclusion deduced by some from the fact of their action, when externally applied being in a great measure limited to the parts with which they are brought in contact.

The symptoms and morbid appearances will not, it is obvious, enable us to determine whether a vegetable acrid has been used in any particular case, much less to assign the precise substance which has been employed. Nor will chemistry be of much assistance in such an investigation, for we are but very imperfectly acquainted with the proximate principles of vegetables, and but in a very few instances know of re-agents by which their presence may with certainty be detected. Our chief reliance must be placed upon our knowledge of the physical and botanical characters of the various substances which may become the object of toxicological inquiry.

With respect to *treatment*, we have nothing to advise but that the poison be removed from contact with the body with as much speed as possible, and that intestinal inflammation, should it follow, be controlled by the usual means. There is no one of these poisons for which there exists a true chemical antidote.

The following list includes the plants which yield the more important vegetable acrids: although given in a former part of this article, we repeat it here for the convenience of reference:—

Euphorbia officinarum, &c.
Jatropha curcas, &c.
Ricinus communis.
Momordica elaterium.
Cucumis colocynthis.
Bryonia alba vel dioica.
Ranunculus acris, &c
Anemone pulsatilla.
Caltha palustris.
Delphinium staphysagria.
Daphne mezereon.
Juniperus sabina.
Convolvulus jalapa.
Narcissus pseudo-narcissus.
Gratiola officinalis.
Stalagmitis cambogioides.

The euphorbium mentioned in works upon the materia medica is the inspissated juice of the euphorbia officinarum, an African plant. A similar substance, however, may be obtained from several other species of the same genus. In consequence of the violence with which it acts, it has been long since discarded from medical practice. Its active principle is of a resinous nature, or it is rather, according to the researches of Buchner and Herberger, a combination of two resins bearing to each other the relation of an acid and a base. The latter they conceive to be that which gives it its acridity. Euphorbium in a large dose, whether internally administered or externally applied to a wound, is a powerful poison. Even when kept in contact with the sound skin, it has produced extensive inflammation and gangrene.

The seeds of the jatropha curcas are powerfully acrid, and the same property is possessed by a fixed oil and a volatile acid produced from them by distillation. The juice of the root of the jatropha manihot possesses, as is well known, similar powers; though the root itself, when deprived of the juice, constitutes, under the name of tapioca, a wholesome and nutritive food. Half a pint of the juice has caused death within an hour.

The seeds of the ricinus communis, which upon pressure afford castor oil, operate when chewed as a drastic purge. A single seed is sufficient to produce such an effect. Neither the nature of the acrid principle, nor the precise part of the seed in which it resides, has been ascertained. When castor oil is unusually active, it is probably owing to its containing an undue proportion of this principle.

The momordica elaterium, cucumis colocynthis, and bryonia alba, are all found in the same natural order, the Cucurbitaceæ, and all possess acrid properties in a very intense degree. The active principle of the first resides in a fecula deposited from the expressed juice of the fruit; that of the second in a pith found within the capsule; and that of the third in the root. The two first are frequently employed by the physician in consequence of their purgative virtues. The elaterium has been found by Dr. Morries to contain a crystalline principle which is the source of its drastic energies, and this discovery has been confirmed by Mr. Hennell. A tenth of a grain of this principle produces in man a very considerable purgative effect.

The acrid principle of the colocynth appears to be of a resinous nature, being soluble in alcohol and but sparingly in water. It has received the name of colocynthin, though the substance so called is probably not entirely freed of foreign matters. In point of activity, colocynth is scarcely inferior to elaterium. It has frequently produced fatal effects.

The bryony, which is a British plant, possesses properties perfectly analogous to, and scarcely less active than the two others with which it has been associated. Its acrid virtues reside in a principle soluble in water, which was discovered not long since by Brandes and Firnhaber, and which they have named bryonine. There are upon record some cases in which decoctions of the bryony produced death with hypercatharsis and the other symptoms already detailed.

The different species of ranunculi, particularly the acris and sceleratus, afford by expression or

decoction with water a highly poisonous fluid. The same is true of the caltha palustris and the anemone pulsatilla, plants which belong to the same natural order. The latter plant, dried and reduced to powder, has produced gangrene when externally applied as a counter-irritant.

The seeds of the delphinium staphysagria, a plant which also belongs to the Ranunculaceæ, have been found by Lassaigne and Fenoulle to contain an alkali which is the principle that gives them their activity. Orfila found that six grains of this delphinia dissolved in vinegar killed a dog in forty minutes.

A crystalline principle possessing neither acid nor alkaline properties has been found by Dublanc in the bark of the daphne mezereon, to which it owes its acrid properties. The bark, as well as the berries of this tree, have produced very violent symptoms, and even death. The root of the daphne laureola or spurge laurel, a British species, is, according to Withering, powerfully acrid.

The leaves of the juniperus sabina and an essential oil which may be procured from them by distillation, possess highly acrid properties. Internally, they produce dreadful irritation of the stomach and bowels, and applied externally to a recent wound, very extensive diffuse inflammation is the consequence. They are reputed to possess the power of causing abortion, but they probably do not exert any specific influence on the uterus. Death has occasionally occurred in consequence of their internal exhibition for such purpose.

Half an ounce of the aqueous extract of the narcissus pseudo-narcissus, or common daffodil, internally exhibited, killed a dog in less than twenty-four hours; and one drachm applied to a wound produced a similar result in a quarter of the time. The symptoms and morbid appearances were in both cases the same, or such as belong to the vegetable acrids generally.

The root of the convolvulus jalapa possesses, as is universally known, acrid virtues, and is hence extensively employed as a cathartic medicine. Mr. Hume, of London, was supposed to have insulated its active principle, which he named jalapine. The substance, however, which he obtained has been since shown by Pelletier to be nothing but the ammoniaco-magnesian phosphate. More recently Buchner and Herberjer have stated it to be a resinous substance constituting about one-tenth of the weight of the root, and, like that of euphorbium, composed of two others with opposite electrical relations.

Scammony or the inspissated juice of the root of the convolvulus scammonia, possesses analogous properties to jalap, but according to Orfila it is much less active.

The gratiola officinalis, or hedge hyssop, proved a powerful poison in the hands of Orfila. Three drachms of its watery extract, retained by a ligature on the œsophagus in the stomach of a dog, killed it in twelve hours. The same quantity applied to an incision in the thigh of a dog, killed it in twenty-five hours. Half a drachm of the extract, dissolved in water and injected into the jugular vein of another dog, destroyed it in two hours. Serious accidents have occurred to man from the incautious use of this plant.

The gum resin, called gamboge, and which is obtained from incisions made in the leaves and young shoots of the stalagmitis cambogioides, is one of the most violent of the vegetable acrids employed to produce a purgative effect. Orfila found that a drachm and a half, retained mechanically in the stomach, killed a dog in ten hours, and in very small doses it produces in man dangerous hypercatharsis. Externally applied, it produces extensive cellular inflammation.

In the preceding summary we have entered into no details in reference either to the mode of procuring the different active acrid principles, or the physical, chemical, or botanical characters of the various plants in which they are found. These are points of the greatest importance, but to discuss them in an adequate manner it would be necessary to extend this article to an inconvenient length; the chemical constitution and properties of the leading poisonous vegetables are given with great detail and clearness in the *Traité de Chimie* of Berzelius, vol. vi.; and their botanical characters and relations will be found unfolded in a very able and satisfactory manner in the English edition of Richard's Botany, translated and edited by Dr. Clinton.

3. *Animal Irritants or Acrids.*

The animal as well as the vegetable kingdom furnishes several substances, which, from the nature and violence of their action on living beings, deserve to be ranked among the acrid poisons. Those which are most entitled to attention are certain species of insects, fish, and reptiles, and organic matter in a state of ordinary or modified putrefaction.

The symptoms which they produce are pretty nearly the same as result from the action of the vegetable acrids, with this difference, that they more frequently and decidedly influence and disturb the nervous system. Their powers are, therefore, in all probability not expended upon the parts to which they are immediately applied, but directed also to distant organs, which they affect either through the medium of sympathy or the circulation.

Cases of suspected poisoning by these substances are to be investigated, and of actual poisoning treated upon the general plan already briefly explained under the head of the vegetable acrids.

Cantharides.—This substance is an insect, the lytta vesicatoria, and is familiarly known to every one as an external application for the purpose of producing vesication. Its active principle, the cantharadin, was first obtained by Robiquet, and has since been more particularly examined by Gmelin. It occurs in small crystalline scales, like plates of mica, which melt when heated, and sublime unaltered, are insoluble in water or cold alcohol, but soluble in the latter with the assistance of heat.

Cantharides is sometimes though not often exhibited internally by the physician; and in such cases, in consequence of its activity, the dose is necessarily extremely small. It has, however, in several instances been taken in considerable quantity for the purpose of procuring abortion, and with the view of stimulating the genital organs, and exciting sexual desire. In some few cases it

has been swallowed with the view of effecting self-destruction.

[In regard to the quantity of cantharides required to destroy life, any dose larger than the maximum quantity prescribed as a medicine, may prove injurious. The smallest quantity of powder known to have killed is recorded by Orfila, (*Op. cit.*) It was that of a young female, who took twenty-four grains in two doses. She died in four days; but as abortion preceded death, the case was not a simple one. An ounce of the tincture has been known to destroy. (Taylor, *Op. cit.* p. 228.)]

The symptoms which characterize a poisonous dose of cantharides are burning heat of the throat and stomach, difficult deglutition, abdominal pain, vomiting, the matters discharged being often bloody and containing membranous flakes, parching thirst, strangury, bloody urine, priapism, and, in some rare cases, gangrene of the genital organs. The nervous symptoms observed are headach, convulsions, loss of memory, and delirium. The preceding effects have been produced by scruple doses of the powder.

In a fatal case recorded not long since by Orfila, the œsophagus, stomach, and intestines, the omentum, and peritoneum, the kidneys, ureters, bladder, and urethra, were highly inflamed, and the tongue, mouth and fauces were excoriated.

Cantharides will remain in the stomach for a considerable time without losing its characteristic appearance and properties. If found there, the cause of the poisoning is revealed; but it must be recognised by its external characters, for chemistry can contribute little, if at all, to its identification, and the same may be said of the symptoms and morbid lesions. There is no antidote for this poison: oil, which was once so considered, is decidedly improper, for it confers solubility upon the cantharidin. The poison should be expelled from the stomach, and the inflammation it excites should be met by antiphlogistic measures. Demulcent drinks and the warm bath are calculated to alleviate the dreadful irritation of the urino-genital system which is sometimes observed.

Poisonous Fish.—Under this head we do not intend to allude at all to those kinds of fish* which, though they constitute wholesome food to the generality of mankind, nevertheless produce, when used by some individuals, sickness, vomiting, cutaneous eruptions, and other alarming symptoms. Such effects, when they are observed, are undoubtedly referable to some peculiarity of constitution, or idiosyncrasy, as it is usually called. Two other varieties of poisonous fish remain to be noticed,—those which are so constantly, and to all individuals, and those which though generally edible and innocent, acquire under circumstances not well understood, injurious properties, the origin of which it is not very easy to assign.

Those of the first variety are so rare on our coasts that it is not necessary to enter into any particulars respecting them. Of the latter variety, or such as, though generally wholesome, become occasionally poisonous, the only ones which have attracted the attention of toxicologists are the mytilus edulis, or muscle, the oyster, and the common eel.

Muscles, &c.—There is a variety of theories as to the origin of the poison of muscles. Some refer it to copper derived from the copper bottoms of ships; others to their having been, when used, in a state of putrefaction; others, to a disease to which they are subject; and others again merely to an idiosyncrasy in the individuals who become affected by them. Some of these conjectures, *ex. gr.* the two first, are easily disproved; and it is the opinion of those who have considered the subject most maturely that none of them afford a perfect solution of the question. Dr. Christison throws it out that those which are poisonous may have developed in them an animal principle of a peculiar nature to which their noxious properties are owing, and suggests the investigation of such a principle as a proper object of chemical research.

The symptoms are such as characterize gastric and internal irritation of a high degree, to which are sometimes superadded distressing dyspnœa and nettle-rash, together with coma, convulsions, and paralysis previous to death. The symptoms usually begin in a couple of hours, and quickly reach their maximum degree of intensity. The duration of the attack, whether fatal or otherwise, is very variable, death sometimes occurring in a few hours, and sometimes not for three or four days.

The morbid appearances which have been observed are inflammation of the stomach and bowels; but cases have occurred in which no organic lesion has been detected.

Oysters and eels have sometimes acquired deleterious properties, but the accounts which have been published do not enable us to comprehend either the nature of the change which they experience or the cause of it. The action they have been observed to exert is that characteristic of a simply irritant poison.

Poisonous Serpents.—The most poisonous reptiles with which we are acquainted are the cobra de capello and rattlesnake; but as these do not exist in the British isles, we shall enter into no details respecting them. In England, however, a reptile is indigenous, the viper, the bite of which is always productive of distressing symptoms, and has in some cases even destroyed life. The poison is secreted by a pair of glands situated near the eye on either side, and is deposited in a sac connected with the cavity of a hollow tooth. When the animal inflicts a bite, the poison is forced from the bag into the wound through a perforation in the crown of the tooth.

In about twenty minutes after the infliction of the bite, the part becomes the seat of lancinating pains, which extend up the limb, and of swelling, which after a little time assumes a livid colour and is extremely hard. The pulse is feeble, rapid, and irregular; the patient appears in a fainting state; bilious vomiting, sometimes accompanied by jaundice, sets in, and is followed by dyspnœa, cold sweats, imperfect vision, convulsions, and derangement of the intellect. Death sometimes, though rarely supervenes.

It is a curious fact that the virus of vipers may be taken into the stomach with impunity. This

* Oysters, crabs, trout, salmon, turbot, herring, halibut, mackerel, &c.

has been fully ascertained by experiments on birds, and even on the human subject.

The morbid lesions are chiefly such as are visible to the eye, namely, inflammation, swelling, and lividity of the wound and adjacent parts.

It is not ascertained whether the poison of venomous reptiles acts by entering the blood, or is the result of nervous sympathy. In support of the former opinion, the fact is relied upon to which the attention of the profession was first particularly called by Dr. Barry, namely, that the influence of the virus can be suspended, and even altogether subdued by the timely application of the cupping-glass to the wound. Addison and Morgan, however, as we have already seen, find no difficulty in reconciling such facts with their views.

An outline of the appropriate treatment is readily sketched. Should a cupping-glass be at hand it should be immediately applied to the bite, and as much blood as possible drawn, with the view of washing away the poison from contact with the extremities of the nerves and the patent mouths of the divided blood-vessels. But, if this manipulation cannot be performed within a few minutes after the infliction of the bite, the part should be carefully cauterized either with the potassa fusa or strong nitric acid, with the view of decomposing the virus. When the effects of the poison are fully developed, the treatment must be conducted on general principles.

The consequences of the sting of the wasp and bee might be here with propriety discussed, but they are seldom such as to entitle them to a separate consideration.

Animal matter diseased or putrid. — Of animal substances rendered poisonous by disease we have instances in the several matters by means of which contagious and infectious diseases of a definite character are propagated, but the examination of these belongs rather to the practice of medicine than to toxicology. We shall allude, and with brevity, to those only which are but occasionally developed, and which seem to act the part of irritant poisons.

When cattle are over-driven, though their flesh does not produce any disagreeable effects when eaten, if externally applied in the raw state to a wound, however small, a diffuse cellular inflammation is the result, which sometimes has destroyed life. The purulent matter discharged from the nostrils of glandered horses presents us with an instance of a similar kind. When this matter is applied to the hand by inoculation, inflammation of the part and an eruption of carbuncles is the consequence; and there are even well-authenticated cases of the disease having been taken by grooms without inoculation.

A disease to which cattle are subject, and which has been particularly studied in Germany, where it is known under the name of *milzbrand*, develops in the flesh of the animals it attacks highly acrid properties. The intestinal canal of persons who use the flesh, and even of those who have been engaged in flaying the beast, becomes highly irritated and inflamed, and they are seized with all the symptoms of cholera. More frequently, however, malignant pustules are thrown out, or rather a carbuncular eruption analogous to that observed in the cattle themselves, which has often proved fatal in twenty-four hours.

The most interesting example, however, of poisoning to be traced to a virus resulting from morbid action is that with which we are so familiar as a consequence of wounds incurred in dissection. The effects to be observed in such cases cannot be referred to animal matter in a state of spontaneous decomposition, for they are never found to occur unless at so early a period after death as to preclude the possibility of ordinary putrefaction having been established. Experience, also, would seem to prove that they are more frequently produced by the fluids effused in the chest and abdomen, as a consequence of inflammation, than by any other of the solid or fluid constituents or secretions of the body.

The symptoms which usually set in are briefly as follow. In a few hours after the reception of the wound an acute pain is felt at the tip of the shoulder, and a swelling, at first colourless, is observed on the lateral part of the neck between the trapezius and sterno-mastoid muscles, which is acutely sensible upon pressure. At first the wound exhibits no unusual appearance; but some time after the occurrence of the symptoms just detailed, it is found covered with a small pustule containing a milky fluid. The pain and swelling at and above the shoulder now become worse, and extend to the axilla, from thence to the thorax, and down along the side; and a similar species of diffuse inflammation seizes upon the arm and forearm, following the course of the great absorbent vessels. This inflammation Mr. Collis conceives to be a species *sui generis*, quite different from phlegmonoid erysipelas. Toward the close of the attack, particularly when the termination is unfavourable, a few pustules similar to that upon the wound appear in other parts of the body, and the skin of the inflamed regions is studded with little solid elevations, which at first sight are taken for vesicles. The constitutional invasion is sometimes, though not always, ushered in by distinct rigors and vomiting, and a low typhoid fever of the most malignant type is present from the very commencement.

Several individuals eminent for their anatomical zeal and scientific acquirements, have fallen victims to this formidable malady; amongst whom we know of none more distinguished or lamented than the late Mr. Shekleton, museum curator to the Royal College of Surgeons in Ireland. An instructive account of his case, with some others of a similar description, has been published by Mr. Collis in the third and fourth volume of the Dublin Hospital Reports.

No lesions of internal organs have, as far as we are aware, been traced to this affection.

After the reception of a cut in dissecting, the part should be rendered as clean as possible by soap-water, and a cupping-glass, or the mouth, which will probably answer better, should be applied until by suction a considerable quantity of blood is drawn, and the surface of the wound entirely freed from all foreign matters. These prophylactic measures will, generally speaking, be sufficient; but for greater security it will be advisable to apply the potassa fusa or aqua fortis to the wound, with the view of destroying any of

the poison which may not have been previously removed, or at least of modifying the inflammation which may follow. When the hand and arm have become swollen, and the fever already described has set in with violence, the treatment which has been found most beneficial consists in the free administration of opium, port wine, and other stimulants, the inflammation being at the same time combated by the usual topical antiphlogistic applications. Mr. Collis, on general grounds, but without any experience of its efficacy, recommends calomel in repeated doses, so as to produce rapid salivation.

Animal Matter in a State of Ordinary Decay.—The effects just examined are the result of inoculation with animal matter modified in a certain manner by circumstances not well understood, but not at all in a state of decomposition or decay. Animal substances, however, in the putrid state, possess, as has been proved by the experiments of Orfila, similar powers; that is, when introduced into a wound they excite diffuse inflammation, and, at the same time, fever of the typhoid type. In animal flesh brought to this state by keeping in close vessels, Lassaigne, by an elaborate analysis, found carbonate and cascate of ammonia, together with a fetid volatile oil, in which the noxious properties are conceived chiefly to reside.

Certain changes which spontaneously take place in particular articles of food, and which are usually considered as instances of a modified putrefaction, occasionally develop in them properties of a highly injurious description. The substances subject to such changes are common bacon and varieties of sausages, and of cheese, which are extensively consumed in Germany. The nature of the active principle of the poisonous sausage has been the subject of numerous researches, and it would appear now pretty well determined that it is a matter analogous in its chemical properties to the fat acids. The changes in question occur only to sausages which have been boiled before being salted and dried, and their noxious powers are not manifested unless putrefaction has set in, and cease if it should pass a particular limit.

The symptoms caused by these substances do not set in usually until twenty-four or forty-eight hours after the meal. Pain in the stomach, vomiting, purging, and aridity of the fauces, mouth, and nose, are those first observed: the voice becomes hoarse, deglutition difficult, and the ball of the eye, the eye-lids, and the pupils become fixed. There are fits of swooning, the pulse is small, and the skin extremely cold. The secretions are suspended, but diarrhœa often continues throughout the attack. There is no fever, and the appetite, it is said, is unaffected. The functions of the cerebrum also continue undisturbed. When the case proves fatal, which it does, if at all, between the third and eighth day, death is usually preceded by dyspnœa and convulsions.

Post-mortem examinations have disclosed appearances indicative of inflammation throughout the entire intestinal canal from the fauces to the anus. The body, it is said, putrefies with unusual slowness.

Destructive effects have also frequently been produced by cheese, particularly in Germany, with symptoms and morbid appearances almost identical with those just described as resulting from the use of the poisonous sausage. The experiments also of several German chemists who have elaborately examined the subject, concur in attributing the poisonous properties of the cheese to an acid fat analogous to that of which mention has just been made. Both poisons, however, must be further investigated before we can decide upon their real nature.

In France and Switzerland an acrid principle has sometimes been developed in milk, particularly that of the goat and sheep, which has produced severe cholera and even death. Its nature and the circumstances in which it originates are entirely unknown.

Several cases have occurred on the continent in which bacon acted as a violent acrid poison. The symptoms and morbid appearances are pretty nearly the same as those produced by the poisonous sausages and cheese. The poisonous principle also is conjectured to be of the same nature.

II.—Narcotic Poisons.

The substances in the discussion of which we have been hitherto engaged irritate the parts of the body with which they are brought in contact, and even determine a greater or less degree of inflammation of them. We have now, however, to enter upon the consideration of a totally different description of poisons. The narcotics do not irritate or inflame, but, nevertheless, they produce death with as much, if not more certainty and despatch, while in the body we are frequently unable to recognise any appearances of a morbid character. All the poisons of this class hitherto noticed are derived exclusively from the vegetable kingdom, if we except prussic acid, which admits of being also extracted from certain artificial mineral salts. The narcotics usually enumerated by toxicological writers are prussic or hydrocyanic acid, opium, its alkaline principles morphia and narcotine and their salts, hyoscyamus, lactuca, and solanum. Before discussing in succession the various particulars connected with poisoning by each of these, we shall make some observations having a reference to the group generally.

The symptoms produced by the narcotic poisons are such as indicate a derangement of the nervous system. There is pain of head, vertigo, partial or complete blindness, stupor, sometimes amounting to insensibility, paralysis, or convulsive action of the muscles under the control of the will, and previous to death, profound coma.

When, in a post-mortem examination, we look for morbid lesions, the search is almost invariably unsuccessful. In some cases congestion of the veins of the head is observed, and also an effusion of serum into the ventricles and between the pia mater and arachnoid membrane, but these appearances are much more frequently wanting.

It is scarcely necessary to repeat here that the general opinion entertained in reference to the manner of action of the narcotics is that they enter the circulation, and are, by means of it, conveyed to the brain or spinal marrow, upon which their powers are thus directly brought to act. Nor does the reader require to be reminded that a different theory has been proposed and very ably supported by Addison and Morgan, who refer their action to the sympathy which subsists be-

tween the centre of the nervous system and those expansions of it on which the morbific impressions are made. We have already stated our reasons for inclining to this latter doctrine, and shall now merely add, that whatever difference of opinion exists as to the medium through which the influence of the narcotics is propagated to the brain, all physiologists seem to admit that their operation is most powerful and rapid when they are made to pass into the blood.

The symptoms and morbid appearances produced by the pure narcotics are not sufficiently characteristic to enable the practitioner who observes them to declare that they could not have been the results of natural disease. Such cases, in fact, may and have been confounded with apoplexy, epilepsy, inflammation and hypertrophy of the brain, affections of the spinal marrow, and what is denominated by Chevalier, asphyxia idiopathica. Distinctions undoubtedly do exist between the effects of these diseases and of narcotic poisoning, but we are seldom if ever enabled by them to establish a satisfactory diagnosis. In medical jurisprudence, therefore, they are, *per se*, of comparatively little importance; but as they often contribute to the elucidation of doubtful cases, it will be proper to notice them briefly here. 1. An attack of apoplexy is usually announced by certain premonitory symptoms well known to the practical physician, which are of course wanting in cases of narcotic poisoning. 2. Apoplexy more frequently attacks the old and corpulent, whereas death by a narcotic poison cannot be said to occur oftener at one period or in one habit of body than another. 3. The apoplectic attack is sudden, whereas, on the other hand, the symptoms of the narcotics gradually augment in intensity. To this statement, however, prussic acid is an exception, for its effects upon the system are almost instantaneously developed, especially when it is given in a sufficient dose. 4. Patients in a narcotised state from the action of a poison may be roused, at least for a short time, to consciousness, and a perception of what is going on in their vicinity, but this can never be accomplished by those in the apoplectic coma. 5. When narcotics destroy life, this is usually effected in a few hours, and is never delayed beyond the twelfth; but the apoplectic stroke is often not fatal for twenty-four hours, or even more. Apoplexy, however, sometimes kills almost instantly, and the same may be said of some of the narcotics, for example, prussic acid.

The diagnostic distinctions afforded by the morbid appearances after death are not much more satisfactory. When the morbid changes are either simple congestion or serous effusion, they do not assist the diagnosis, as both may be produced by narcotic poisoning, or by simple or serous apoplexy. If, however, a clot of blood be found in the brain or its ventricles, all doubts as to the cause of death may be considered as in a great measure removed, inasmuch as such an extravasation has but very rarely been known to result from the action of the narcotics upon the animal economy.

Epileptics seldom die during the paroxysm. This, however, may occur, and when it does death may be referred to the action of a narcotic drug. It will be proper, therefore, to say a few words upon the means of distinguishing between such cases. 1. Warning symptoms usually precede an epileptic fit; but in poisoning there are of course no precursory signs. 2. The epileptic paroxysm commences abruptly; the effects of the narcotics are, with few exceptions, gradual in their access. 3. The epileptic paroxysm, when fatal, is, generally speaking, of considerably longer duration than the attack which results from the narcotics; and, as another ground of distinction, though one not susceptible of much practical application, it may be observed that the first epileptic invasion scarcely ever terminates in death.

The morbid appearances met with on dissection will, in dubious cases, show that death is the result of epilepsy rather than of narcotic poisoning. This conclusion may be drawn when tumours or abscesses are found in the brain, or fungous growths upon the dura mater, or when worms occur in quantity in the intestinal canal, peritoneal sac, or other parts.

But should there be no morbid lesions, what inference are we then justified in making? Can we conclude that death was the result of the administration of narcotics? Such a deduction is not allowable, for experience proves that epileptic cases frequently occur, which, upon post-mortem examination, exhibit no changes of structure whatsoever.

Inflammation of the brain, or, as it is termed by the French, ramollissement, is attended with symptoms imitating very closely those which result from the action of narcotics. The course, indeed, of cerebral inflammation is seldom so short; but death does in some cases follow with as much rapidity as in cases of poisoning. They are completely distinguished by the post-mortem appearances belonging to ramollissement, which are abscess in the substance of the brain, or preternatural redness and softness of some limited portion of the cerebral mass. (See Softening of Organs.)

The history of the affection next in order, namely, hypertrophy of the brain, is not sufficiently known to enable us to say whether it can or cannot be distinguished by its symptoms of poisoning by the class of substances under consideration at present. Some pathologists, in fact, do not recognise it as a distinct form of cerebral disease.

Diseases of the spinal cord, such as inflammation of itself and investing membranes, and extravasation of blood into its substance, are of very rare occurrence, and when met with, may be generally distinguished from the effects of narcotics by their longer duration. From the latter they are completely separated by the appearances presented on dissection.

As to the sudden death which sometimes is observed to take place without any organic disease of brain or heart, and which is classed by Chevalier as syncopal asphyxia, we have only to observe that it can be confounded with the effects of those narcotics only which, like prussic acid, act with great energy and rapidity on the system.

From a review of what precedes, it is obvious that a sound diagnosis can seldom be derived, in the cases under consideration, from symptoms

alone; so that here, as in the case of the irritant poisons, it will generally be essential to call in the aid of chemical analysis. In applying, however, to narcotic substances chemical investigation, difficulties of a peculiar nature arise. Many of these substances are, as far as respects internal constitution, but very imperfectly known, so that we are unable to apply to them re-agents by which their presence can be detected; and almost all are capable of undergoing such changes in the alimentary tract, as will render tests applicable to them in a state of integrity entirely useless. These statements are fortunately less true of the ordinary and the energetic narcotics than of those which are rarer, and whose action on the animal economy is less intense.

Prussic Acid—[Hydrocyanic Acid.]—This acid exists in a variety of vegetable productions, from all which it may be obtained by distillation, in combination either with water or an essential oil. It may be thus procured from the bitter almond, and, indeed, from the kernels of most stone fruit, from the peach-blossom, from the leaves of the prunus lauro-cerasus, and the leaves and bark of the prunus podus, and from the flowers, bark, and root of the sorbus aucuparia or mountain-ash. For medical purposes it is usually obtained from the ferrocyanide of potassium, or the bicyanide of mercury, salts familiar to the chemist. However obtained, it is, as has been already more than once observed, a poison of the most overwhelming description, destroying life almost instantaneously, and in doses inconceivably small.

The symptoms which follow on the exhibition of prussic acid vary with the magnitude of the dose, and according as it proves fatal or not. When the quantity of the poison swallowed is insufficient to produce death, the usual effects experienced are pain and weight of head, particularly in the occipital region, rapid pulse, nausea, and sometimes salivation. Such symptoms have sometimes been observed in patients under the influence of the acid exhibited for some time in medicinal doses.

When the quantity exhibited is large enough to produce death within a few seconds, the patient sinks without any morbid symptom whatsoever. In fatal cases, however, which run a somewhat longer course, death is invariably preceded by violent tetanic convulsions. A similar difference has also been observed in experiments on the inferior animals.

[It has been an interesting question among medical jurists, whether a person, after having swallowed a strong dose of prussic acid, could retain the power of performing certain acts of volition, indicating the preservation of sense. One individual exclaimed, after taking it, "it's gone;" and, in answer to a question put to him, said "I have taken it." He was about to speak again, but his articulation failed him, he became insensible, and died immediately afterwards. In another case, in March, 1824, a commercial traveller was found dead in his bed at an inn. The evidence clearly showed that he died from the effects of prussic acid taken by himself; yet, after taking a large dose, he had evidently performed several acts of volition: after swallowing the acid from a phial, he had corked the phial, placed it on a chair at the back of the bed, turned over in bed, drawn up the bed-clothes, and composed himself in a position of rest, in which he was found. From the evidence at the inquest, it appeared that not less than three drachms of prussic acid had been taken, and probably even a larger quantity. In this case there manifestly had been no convulsions.

It would seem, consequently, that an individual may speak, and even answer a question rationally, and execute other voluntary acts, after he has taken this poison, and immediately before falling into a state of insensibility. Whether this were practicable or not, was an interesting topic of inquiry in the case of Belany, who was tried for poisoning his wife by prussic acid, in the Central Criminal Court, England, in August, 1844.]

In individuals poisoned by prussic acid, the external appearance of the body is natural, with the exception of the eyes, which are extremely prominent, and present an unusually glistening appearance. The venous system is invariably congested, particularly that part of it which supplies the brain, and the blood it contains is generally uncoagulated. In two cases recorded by Metzdorf, the bile was of a deep blue colour.

Some physiologists of eminence conceive prussic acid to be absorbed, and carried by means of circulation to the brain and spinal marrow; organs which, judging from the symptoms, would appear to be principally affected by it. Nor is this opinion destitute of striking facts, which may be adduced in its support. Experiment proves that the rapidity of its action is proportional to the absorbing faculty of the tissue to which it is applied, and that its influence may be suspended by interrupting, with a ligature, the circulation in the poisoned part. Lastly, there are cases upon record in which it has been detected by chemical analysis in the blood. These facts completely establish that hydrocyanic acid does occasionally enter the vascular system; but it is impossible to admit that, in cases in which life is destroyed by it almost instantaneously, its absorption could have taken place, or that its deadly action can be due to any thing but the impression which it makes on the sentient extremities of the nerves. It is scarcely necessary to remind the reader here, that though its absorption were admitted to be an invariable occurrence, the portion of the theory which maintains the actual contact of the poison with the central mass is, by the views of Addison and Morgan, rendered superfluous and improbable.

The symptoms produced by prussic acid will not, it is obvious, enable us to infer that it has been administered; and the same, as we have already seen, may be said of the appearances presented after death. Some, indeed, contend that poisoning by prussic acid is sufficiently characterized by the peculiar stare and glazed character of the eyes noticed above; others by the odour of the poison being emitted by the blood, particularly that which occupies the heart and large vessels; and others, again, by the body resisting in an unusual degree the setting in of putrefaction. All these circumstances are occasionally observed, but they are so far from being constant that they do not occur even in the majority of cases. Our chief resource, therefore, in this, as in most other toxicological investigations, must be chemical experiment. Such processes, in fact, must be applied to the matters

in which the poison is supposed to exist, as will verify or refute suspicion.

The odour of prussic acid, which is usually compared to that of the peach-blossom,* is so peculiar that it is by some considered as furnishing a sufficiently delicate test of its presence; and in this way it is said to have been often detected in the blood of animals poisoned by it. Orfila considers it more delicate than any chemical re-agent with which we are acquainted. This, however, is a statement which can scarcely be maintained, particularly if, as Christison observes, there be individuals who are altogether insensible of the peculiar impression which it usually makes upon the olfactory organs.

There are two very sensible chemical tests for prussic acid, namely, sulphate of copper, and a mixture of a proto- and a per-salt of iron, the manner of application of which we shall now explain.

1. Let the solution to be tested for prussic acid be rendered alkaline with caustic potash, and to it let there be then added a few drops of a solution of the persulphate of copper. If the poison be present, a dirty green precipitate is thus formed, which, upon the addition of a little dilute sulphuric acid, is converted into one of a perfectly white colour. In the greenish precipitate we have peroxide of copper mixed with bicyanide of the same metal, the former of which alone is dissolved upon the addition of the acid. The sulphate of copper thus applied will, according to Lassaigne, detect one part of prussic acid in 20,000 of water.

2. To the suspected solution rendered alkaline, as in the preceding experiment, let there be added a few drops of a mixed solution of a proto- and a per-salt of iron. Should the poison be present in the fluid, a precipitate of a dirty brown colour will be formed, which, upon acidulation with sulphuric or muriatic acid, will be converted into prussian blue. The precipitate first formed is a mixture of prussian blue and of the two oxides of iron precipitated by the excess of alkali employed, the latter of which are re-dissolved upon the addition of the acid. Some have recommended for the performance of this experiment a proto-salt and others a per-salt of iron; but those who know that prussian blue is composed of a cyanide united to a sesquicyanide, and who understand the theory of its production, will perceive the necessity of the presence of iron in the double state of oxidation. The green vitriol of the shops alone will undoubtedly often answer, but it is because it is not a pure proto-salt, but includes a little sulphate of the peroxide.

In addition to the two preceding tests, the nitrate of silver and proto-nitrate of mercury are sometimes mentioned by systematic writers. The former affords with the acid a white, the latter an ash-grey precipitate, both of which, when dried and exposed to the heat of a spirit lamp, evolve a gas (cyanogen) which burns with a beautiful purple flame.

Should the acid be sought for in organic matters, such, for example, as the contents of the stomach, these should be slightly acidulated with sulphuric acid, and the solution obtained by filtration should be introduced into a retort, and subjected to distillation at a temperature of 212° until an eighth part of the fluid has passed over. This portion will contain the acid owing to its volatility, and to it the tests already enumerated and explained may be then applied. The sulphuric acid is added for the purpose of saturating and fixing any ammonia which may have been developed by putrefaction.

Some facts have been recently ascertained by Leuret and Lassaigne having a close relation to the topic just discussed, and which may, therefore, with propriety be mentioned here. In animals poisoned by prussic acid and kept unburied for three days, they found it impossible to detect the poison: when buried, however, within twenty-four hours after death, they were able to find it until the eighth day, but not after. The failures in both cases they attribute either to its evaporation or spontaneous decomposition.

So rapid is the action of this poison, particularly when the dose is large, that there is seldom time for unloading the stomach either by emetics or mechanical means. Nor do we know of any agent which can in this case discharge the functions of a chemical antidote. The alkalies were indeed once reputed as such, but this opinion is now no longer entertained, as the hydrocyanates of ammonia and potash have been proved by direct experiment to be highly poisonous. There are, however, substances which by their stimulant powers counteract the anodyne influence of the poison on the nervous system, and are hence by many described as antidotes to it.

Animals asphyxiated by prussic acid may often be restored by the assiduous application of the water of ammonia, by means of a feather, to the nostrils. In this way a fox, to which about half an ounce of the acid of the Dublin pharmacopœia had been administered in successive doses, and in which the motions of respiration and circulation had for better than a minute apparently ceased, was brought to life last winter in the museum of the Royal College of Surgeons in Dublin. The animal did not entirely revive until after a lapse of fifty minutes. The success of such experiments in the case of the inferior animals led Mr. John Murray, of London, to recommend ammonia generally as an antidote to the effects of prussic acid; and there can be no doubt of its efficacy, in cases at least which, if left to themselves, would not prove very rapidly fatal. In applying it, the patient's head should be held over a vessel containing water of ammonia, in order that some of the gas which it evolves may during inspiration be drawn into the lungs. The aqua ammoniæ, also, of the pharmacopœia should be diluted with about twelve waters, otherwise such a quantity of the alkali enters the chest as to give rise to serious inflammation of the bronchial passages.

The aqua chlorinii diluted with four times its volume of water, and applied in precisely the same manner as the volatile alkali, has also been found a very valuable counter-stimulant in poisoning by the hydrocyanic acid. Its virtues as an antidote to this poison were first noticed in Germany, but have been brought into chief notice by

* Dr. A. T. Thomson states that this is not the odour of pure prussic acid, but that it belongs to an essential oil adhering to the acid when the latter is extracted from vegetables. (See article SEDATIVES.)

M. Simeon of Paris. Orfila has compared it with ammonia, and obtained with it much more satisfactory results. In some of his experiments, though not applied until the convulsions had ceased, and life appeared altogether extinct, the animal was in ten minutes placed beyond danger.

The cold affusion has also been recommended by Dr. Herbert, a physician of Gottingen; and Orfila admits its utility, stating at the same time that he considers it inferior to the treatment both by ammonia and chlorine. It should be repeated every fifteen minutes until the animal has recovered.

The poisonous properties of the bitter almond and its essential oil, of laurel and cherry water, and of certain liquors and sweetmeats, in the preparation of which the two first are employed, depending on the presence of prussic acid, it would be superfluous to make each the subject of a separate discussion. Dr. A. T. Thomson represents the essential oil, even when entirely freed from adhering acid, as a powerful poison, "operating primarily as an excitant," and in fatal cases producing "violent convulsions." This statement, however, is quite inconsistent with the experiments of Stange and Goppert, referred to by Dr. Christison, and the recent very interesting researches of Robiquet and Boutron-Charlard, who found it quite inert when re-distilled from caustic potash.

[A case of poisoning by *ratafia*, which is composed of one part of essential oil of bitter almonds to seven parts of spirit, has been lately recorded. (*London Lancet*, June, 1841.) A little girl, 8 or 9 years old, the subject of the case, took a teaspoonful; but under proper treatment recovered.

The cyanuret of potassium has caused death in several instances, when taken by mistake or in improper doses. A gentleman was poisoned in France by a dose of twelve grains. In another case, fifteen grains proved fatal to a man, aged 30, in a quarter of an hour. (Taylor, Report on Toxicology, *Op. cit.* p. 562.)

The production of Prussian blue by an admixture of the protoxide and peroxide of iron, precipitated from the green sulphate by caustic potassa, has long been known as an excellent test for prussic acid. The application of these mixed oxides as an antidote in poisoning by this acid, has been lately proposed by Messrs. T. & A. Lunth, of Edinburgh, and when administered sufficiently early it may be successful, for, by mere contact, it speedily converts the poison into the insoluble inert compound, Prussian blue. In the experiments of Mr. Lunth, it was found that when the acid with the antidote was given to dogs, they lived, whilst the same dose of the acid without the antidote proved fatal. The method by which the Messrs. Lunth prepare the antidote is not stated; but Mr. Taylor (*Report on Toxicology*) has found that it may be prepared by precipitating, in a closed vessel, a strong solution of the common green sulphate of iron by caustic potassa, and washing the oxide repeatedly with water recently boiled, until the alkali and the surplus sulphate are removed.

The cold affusion with excitants must be resorted to at the same time.]

Opium. — This powerful drug is, as is well known, obtained from the papaver somniferum, by incising its capsules and inspissating the milky fluid which flows from them. It is to the toxicologist the most interesting of the anodyne poisons; for from the energy with which it acts, and the slight degree of distress or pain which it produces, it is very frequently employed by the suicide and the murderer. For such purposes it is also recommended by the small amount of organic lesion which it causes, even when administered in a poisonous dose.

The effects of opium on the animal economy vary somewhat according to the quantity exhibited. Thus, in the ordinary medicinal doses it acts first as a stimulant, exciting the mind and adding strength and tone to the muscular system; these effects, however, quickly subside, and are succeeded by a drowsy and lethargic state. When the dose is large, the stage of excitement appears entirely wanting; or, in other words, stupor approaching to coma almost immediately sets in. In the lower animals, convulsions very generally occur, but in man these are seldom witnessed. The breathing is slow, sometimes stertorous; the pulse is usually about ninety, weak, and irregular, occasionally, however, slow, full, and strong, like the pulse of apoplexy. The muscles are quite relaxed, the face is pale and tranquil, sometimes tumid, suffused, and anxious, and the body is usually bathed in sweat. The pupil is almost always greatly contracted, but some rare cases have occurred in which it has been considerably dilated. The stomach, as might be anticipated, continues undisturbed; but to this statement there are exceptions, for cases are recorded in which vomiting commenced almost immediately after the swallowing of the poison.

The operation of solid opium is seldom deferred beyond half an hour, and the action of the fluid preparations generally commences sooner. When a case of poisoning by opium terminates favourably, the patient falls into a profound sleep, which lasts for from twenty-four to thirty-six hours, out of which he awakes merely affected by slight nausea, thirst, and vertigo. In fatal cases, death takes place within from seven to twelve hours. The amount of a poisonous dose it is impossible to assign with accuracy: it is dependent upon age, upon idiosyncrasy, and upon habit. The latter is the most influential modifying cause, some people having acquired by use the power of swallowing with impunity eight ounces of the tincture per diem.

[In a case lately recorded by Dr. M. H. Houston, of Wheeling, Va., (*Amer. Journ. of the Med. Sciences*, Oct. 1843, p. 372,) ten grains of morphia seemed to destroy in about ten minutes. In the cases of poisoning by opium recorded by the coroner of the city and county of New York, during the years 1841, 1842, and 1843, (J. B. Beck, *Transactions of the New York State Medical Society*, vol. vi. part 1, p. 72, Albany, 1844.) the smallest quantity was one drachm; the largest an ounce and a half. The shortest time between the taking of the poison and death, was 8 hours; the longest, 20 hours. The average time of six cases was 14 hours. Of the cases of poisoning by laudanum, the smallest quantity was one drop; the largest, 16 ounces. The

shortest period between taking the poison and death, was 2 hours; the longest, 48 hours. Average of 23 cases, 12 hours.]

The morbid appearances to be detected after death are not very characteristic or important. The back and most depending parts of the body are usually livid; the veins and sinuses of the head are in a state of marked congestion; and serous effusions are found on the surface of the brain and within its ventricles. Extravasation of blood into the cerebral mass has also been recorded, but as a pure consequence of the action of opium it is of extremely rare occurrence; and the same may be said of redness of the villous lining of the stomach, of which mention is made by some writers. The lungs and heart are usually gorged with blood, which, generally speaking, is fluid, though it has also been found in the usual coagulated state. Welper also found, both in man and other animals poisoned by opium, the kidneys gorged with blood, and denies the commonly received opinion that this drug suspends their secerning action, having always observed in his experiments the bladder distended with urine. It is an old remark, and one the truth of which would appear pretty well established, that the bodies of animals destroyed by opium enter very rapidly into putrefaction.

[In particular idiosyncrasies, and especially in infants, very small doses of opium may prove poisonous. In 1838, a man, aged 45, was killed by ten grains of solid opium. Four grains and a half, mixed with nine grains of camphor, killed a man in nine hours, with all the symptoms of narcotic poisoning. In September, 1843, an instance occurred in London, of a woman, aged 38, being killed by eight grains of the drug, given in two doses. The smallest fatal dose of the tincture to an adult, which Mr. Taylor (*Manual Med. Jurisprudence*, p. 23) has found recorded, is two drachms. Occasionally very large quantities have been taken without fatal results ensuing. A young lady took an ounce of laudanum in whisky, and recovered in five days: there was no vomiting, and the cause of the symptoms was not even suspected until she had recovered from her stupor, and confessed that she had taken the poison. Mr. Taylor refers to a case, communicated to him by one of his class, of a medical student, after a hearty supper, who, at nine o'clock of the evening, swallowed four ounces of tincture of opium, made by himself from opium procured at a respectable druggist's. He went to bed and slept until six o'clock the next morning, when he was awakened by a feeling of nausea. He then vomited freely; and, as he supposed, the whole of the contents of the stomach, smelling strongly of opium, were ejected. He recovered perfectly, without feeling any other symptom than inability for muscular exertion. This, Mr. Taylor remarks, is the largest dose which he has ever known taken without fatal consequences; and it is certainly surprising, that symptoms of narcosis and even death were not produced by its retention for so many hours in the stomach. It is a common error to suppose, that narcotic phenomena must necessarily result a short time after the reception of the drug into the stomach.

Most cases of poisoning by opium end fatally in from six to twelve hours; but the fatal event has occurred in two hours and a half.

It has been not unfrequently observed in cases of poisoning by this drug, that the individual has recovered from the first symptoms, and has then had a relapse and died. In December, 1843, a gentleman swallowed a quantity of laudanum, and was found labouring under the usual symptoms of poisoning by opium. The greater part of the laudanum was removed from the stomach by the stomach-pump, and he so far recovered from his insensibility as to be able to enter into conversation with the surgeon; but a relapse took place, and he died in the following night.

In young infants the action of opium is exceedingly uncertain. They are liable to be narcotized by very small doses. Great caution is, consequently, needed in administering the drug to them. (J. B. Beck, *New York Journal of Medicine* and *Lond. Med. Gaz.* Mar. 1844, p. 767.)]

The influence of opium, as may be readily inferred from the symptoms it produces, is exerted principally upon the brain or centre of the nervous system. But whether it be conveyed to this organ through the medium of the circulation, or acts upon it indirectly by the impression which it makes upon the sentient extremities of the nerves, is still a matter of dispute among physiologists. Many facts would seem to warrant the conclusion that it enters the blood, though chemists have failed* in detecting it there. But even though its presence in this fluid were established, it would not, as has been already more than once observed, follow that nervous sympathy was not the channel through which its poisonous energy was propagated. On this head we shall add nothing further than that opium operates as a poison whether introduced into the stomach or the rectum, applied to a wound or injected into a vein, and that the symptoms it excites in each case are almost exactly the same.

Before proceeding to the description of the experiments by which opium is to be sought for in toxicological investigations, it will be indispensable to premise a brief statement of its chief proximate constituents, and their most salient and characteristic properties. Besides extractive, resin, a fatty matter, a substance analogous to caoutchouc, ligneous fibre, and some salts of lime and magnesia, opium includes two peculiar proximate principles, morphia and narcotine; the former of which is in union with an acid, the meconic, also found in this drug alone. The morphia and narcotine are the principles which confer upon opium its activity; and there is good reason for believing that its anodyne virtues are due exclusively to the former, and its stimulant powers to the latter; for when the narcotine is removed by the action of sulphuric ether, the residue acts as a pure narcotic. Direct experiment proves meconic acid to be destitute of any poisonous action. These three principles may be separated in the following manner.

Let an aqueous infusion of opium be treated with ammonia, and the morphia, narcotine, and

* M. Barruel (Archives Générales, vii. 558) describes himself as successful in the search. His experiments, however, appear inconclusive.

some resin will precipitate, while the meconic acid will remain dissolved in union with the volatile alkali. From the precipitate the narcotine is removed by hot sulphuric ether, and the morphia by distilled vinegar, ammonia being again added to the solution in order to throw down the vegetable alkali, should it be required in an insulated state.

To procure the meconic acid, acetas plumbi must be added to the solution from whence the other two principles were precipitated by the volatile alkali, and which now includes meconate of ammonia. A meconate of lead is thus formed, which being insoluble, subsides, and from this the acid can be procured by suspending the precipitate in water, passing through it sulphuretted hydrogen, and filtering in order to separate the sulphuret of lead. The solution thus obtained yields crystals of the acid, and if again united to oxide of lead, and separated as before, they will be obtained purer and of a whiter colour.

In instituting experiments for the detection of opium, our search may be directed towards the morphia or meconic acid. For both these principles there exists very delicate tests, the most certain of which, with the manner of applying them, it will be proper to mention before proceeding further.

If to morphia a little strong nitric acid be added, it is dissolved with effervescence, and the solution assumes a deep orange colour. This process is not applicable to morphia in a perfectly pure state, for the development of the orange colour has been clearly traced to foreign vegetable matter of a resinous nature invariably present in the alkali as ordinarily prepared, but which, nevertheless, may be entirely removed. Others of the vegetable alkalies, for example strychnia and brucia, are similarly affected by nitric acid, and from a similar cause.

If morphia in a pulverulent state be brought into contact with permuriate of iron, it is dissolved, and the solution exhibits a beautiful blue colour, which, however, when dilute has a tinge of green.

If morphia be rubbed up with a little of a cold solution of starch, and iodic acid be then added, the morphia deoxidizes the acid, and the iodine set free is immediately indicated by the formation of the blue iodide of starch. This relation of the morphia to iodic acid is quite characteristic, and furnishes a most sensible process for detecting its presence.*

Meconic acid is characterized by striking with a dilute solution of permuriate of iron a beautiful red colour. A similar change is effected in the ferruginous salt by the sulpho-cyanic acid. The persulpho-cyanuret of iron, however, may be distinguished from the permeconate by the colour of the former being destroyed, but that of the latter not, by the muriate of gold. This method of discriminating between them acquires practical importance from the discovery of Gmelin and Tiedemann of sulphocyanide of potassium in the saliva of man.

* In a recent case of poisoning by acetate of morphia, in reference to which the writer was engaged professionally by the coroner, the test by iodic acid was the only one which afforded unequivocal evidence of the poison in the contents of the stomach.

Having premised thus much upon the chemistry of opium, we have next to inquire how a case of suspected poisoning by it is to be investigated by the toxicologist.

The symptoms, whether alone or combined with a post-mortem examination, can lead to little more than suspicion. The odour of opium is strong and peculiar, and has been frequently recognised in the stomach and intestines when other methods of investigation afforded but unsatisfactory results. On the whole, however, the chief reliance must be placed on the application of the chemical tests for its active principles, which have been above enumerated.

If a pure aqueous solution of meconate of morphia were the subject of experiment, the acid might be thrown down in the form of meconate of lead by the addition of a little acetas plumbi, and be separated from the oxide of lead by sulphuretted hydrogen, as already described. The solution, also, from which the meconic acid has been precipitated, if deprived by sulphuretted hydrogen of any unprecipitated oxide of lead, will deposit the morphia on the addition of a slight excess of the water of ammonia; and to the acid and the alkali when thus insulated the tests already described may be applied. This method will also answer for opium itself and its several medicinal preparations, these being converted into aqueous infusions, and, if acid, rendered nearly neutral before the addition of the acetate of lead. But when morphia or meconic acid is sought in complex mixtures, such as the ordinary contents of the stomach, other preliminary steps are indispensable, the object of which is to afford a final solution containing as little as possible of other matters than those which it is the purpose of our experiments to detect.

These steps are as follows:—The mixture is to be infused for some time with distilled water acidulated with acetic acid, then thrown upon a filter, and the solution thus obtained is to be evaporated to dryness at or under 212°. Upon this extract boiling alcohol, specific gravity 810, is to be digested, and the spirituous solution thus obtained is to be deprived by distillation or evaporation of its alcohol. This second extract is to be acted upon by water, and the resulting infusion, when filtered, is to be treated with acetate of lead, &c., with the view of insulating and subjecting to their appropriate re-agents the morphia and meconic acid sought for by the process. By prosecuting this route, opium, though present in an organic mixture in very minute quantity, may often be detected. Instances, however, have occurred in which, though the poison was undoubtedly swallowed, it could not be found in the intestinal tract; and these are usually considered as accounted for by supposing it to be either absorbed or decomposed in virtue of the digestive powers of the stomach and inferior intestines.

When called to treat an individual labouring under the influence of opium in a dangerous degree, the first object for the physician to accomplish is the expulsion of the poison from the stomach. This may sometimes be effected by half-drachm doses of sulphate of zinc, given two or three times at intervals of fifteen minutes; or by a solution of tartar-emetic introduced into the sto-

mach or rectum, or injected into the veins. In the latter method the quantity employed should not exceed a single grain, in the former it may amount to ten. Should the case, however, be an urgent one, the better plan will be to resort at once to the stomach-pump; for when opium has been swallowed in a poisonous dose, the stomach is often so paralysed as to be either insensible to the action of emetics, or but very slowly influenced by them.

The evacuation of the poison being achieved, the next point which should fix the attention of the medical attendant is the assiduous employment of means for obviating the state of drowsiness and torpor which is the invariable result of the action of opium after it has abided for some time in the stomach. Every variety of chemical and mechanical stimulant should in succession be employed; or what is found to answer better than any thing else, the patient should be kept constantly shaken and driven with speed over rough roads in an open two-wheeled vehicle, supported of course by an attendant on each side. This course should be diligently prosecuted until all tendency to lethargy is overcome, and, in some cases, in order to the attainment of this desirable result, the stimulation and agitation must be followed up for ten or twelve hours.

When the poison is removed from the stomach, venesection to the extent of twelve or sixteen ounces has been found beneficial; but it should not be practised sooner, as by promoting the absorption of the poison, it might prove more injurious than beneficial. When the lethargy has proceeded to such an extent that the motions of the chest and diaphragm have ceased, it will be advisable to restore them by artificial means, resorting at the same time to every practicable plan of stimulation.

As to antidotes for opium, there are none which deserve the name. The alkalies and the infusion and tincture of galls have been vaunted as such, the former separating the morphia from the acid which confers upon it solubility, and the latter throwing it down as a gallate. These re-agents, by reducing the solubility of the active principle of the drug, will diminish its action on the animal economy, but experiment proves that they do not divest it of its poisonous influence. The stimulating effects of opium, which, as we have seen, are with some probability attributed to the narcotine, may, as Magendie has shown, be obviated by the exhibition of vinegar. It should, however, be recollected that this, by increasing the solubility of the morphia, will contribute to the augmentation of the narcotism produced by the poison.

Hyoscyamus.—Several species of this genus possess powerfully narcotic properties, and in their action are found closely to resemble opium. The hyoscyamus *niger*, however, is the only one on which we shall observe, for it is the most generally disseminated and the most active, and it alone holds a place among the articles of the materia medica. Its narcotic principle, which Brandes has found to be an alkali analogous to morphia, is found in every part of the plant,—in the stem, leaves, berries, and more especially the root; but the extract and tincture employed in medicine are prepared exclusively from the leaves. It exercises poisonous powers whether injected into a vein or the subcutaneous cellular substance, applied to a wound, or introduced into the stomach.

When hyoscyamus is swallowed in a poisonous dose, the most remarkable effects it produces are giddiness and loss of speech, great dilatation of the pupil, delirium, frequently of the most violent type, and subsequently, a lethargic or comatose state. It has seldom been known to give rise to any symptoms indicative of gastric irritation or inflammation.

There is no record of morbid appearances caused by the hyoscyamus.

From the symptoms, this plant is concluded to be a pure narcotic. The medium, however, through which its influence comes to be exerted on the nervous system has not been ascertained. It is generally conceived to undergo absorption.

The treatment of an individual labouring under the poisonous influence of hyoscyamus is precisely similar to that already described under the head of opium. The poison is to be speedily expelled from the stomach, and the state of torpor counteracted by every allowable method of stimulation.

Lactuca.—Two species of this plant, the virosa and sativa, are, from their effects on the animal economy, usually classed among the narcotic poisons. An extract of the leaves of the lactuca virosa, introduced by Orfila, to the extent of three drachms, into the stomach of a dog, deprived it of life in two days, without giving rise to any remarkable symptoms. When applied to a wound it also proved fatal, death, however, being preceded by giddiness and stupor. Collin of Vienna states that he employed the extract with much success in the treatment of dropsy.

The lactuca sativa, or garden lettuce, after it has flowered, contains a milky juice possessed of considerable narcotic powers. When obtained by pressure, and dried by exposure to the air, it constitutes the lactucarium of the Edinburgh pharmacopœia. It smells strongly of opium, and has similar stimulant and anodyne powers, but requires to be exhibited in a larger dose. There can be no doubt that, if swallowed in sufficient quantity, it would prove destructive of life; but we are not aware that any record of such a case exists. Caventou and Boullay could not find any alkaloid in lactucarium to which its sedative powers could be referred.

Solanum.—There are several species of this genus, but in a toxicological point of view it will be sufficient to allude briefly to the solanum nigrum and solanum dulcamara. Orfila states that an extract of the former possesses powers analogous to and equally energetic with lactucarium. The dulcamara has also anodyne virtues, but in a much lower degree than the solanum nigrum, or nightshade. Despasses, it may be observed, has discovered in both a peculiar alkaline principle endowed with narcotic powers. The berries of the solanum tuberosum, or potato, have been known to destroy pigs.

III.—Narcotico-acrid Poisons.

Under this head are grouped the poisons which both produce a local irritation and exert an influence on the nervous system. The term is far from being happily chosen; for, in the first place,

symptoms of irritation are often absent, and, in the second, the effects directed to the brain and its prolongations are not always of an anodyne or sedative kind. Still further to show the imperfection of toxicological nomenclature and classification, it may be observed, that many of the mineral poisons, placed among the irritants, determine derangements of the nervous system very similar to those produced by the substances upon the discussion of which we are about to enter. The true narcotico-acrids are the products of vegetables chiefly found in the natural orders Solaneæ and Umbelliferæ. The Ranunculaceæ also afford a few. It is not necessary to detail the symptoms and morbid appearances which characterize the narcotico-acrid poisons generally, as those produced by both narcotics and acrids have been already minutely discussed. Individuals of the class also differ so essentially in these respects, that their effects could not be comprehended within a single description.

Solaneæ.—Of the plants of this order possessing most activity, those most common and therefore most interesting, are the atropa belladonna or deadly nightshade, the datura stramonium or thorn-apple, and the nicotiana tabacum or tobacco plant. These poisons may be conveniently discussed together, not only from their close botanical relations, but because they all agree in exciting a greater or less degree of delirium as their most prominent symptom.

Atropa Belladonna.—All parts of this plant, the stem, leaves, root, and berries, are poisonous in a high degree. Its activity has been traced by Brandes to a peculiar alkaloid, which he terms atropia, and which is distinguished from all others of vegetable origin by the smallness of its atomic weight, which, upon the hydrogen scale, would appear not to exceed 44. According to Orfila, half an ounce of the extract prepared from the leaves will destroy a dog in thirty-six hours, if introduced into the stomach; a quarter of an ounce in twenty-four hours, if applied to a wound; and a much smaller dose with still more rapidity if injected into a vein.

When belladonna is used in medicinal doses, either in the form of external application or internally exhibited, the chief effect to be observed is dilatation of the pupil. But when the quantity is considerable, more serious consequences are observed to ensue. The symptoms indicative of irritation are seldom well marked. Dryness of the throat with difficulty of deglutition is very generally experienced, and aphthæ of the mouth and fauces, abdominal tension, and strangury, have been sometimes, though rarely witnessed. The narcotic symptoms are delirium, usually of a very extravagant description, dilatation and insensibility of the pupils to light, accompanied by partial blindness; and lastly, a lethargic or comatose state. This latter effect is not observed for a considerable time after the administration of the poison; in one case it did not set in until after the lapse of twelve hours. Convulsions of an extensive or violent nature are scarcely ever witnessed, but occasionally muscular twitchings and subsultus tendinum have preceded death. In the few fatal cases which have been examined, dissection has disclosed no very peculiar morbid appearance.

Datura Stramonium.—An alkali has also been discovered in this plant by Brandes, which is the cause of its activity. It probably resides in every part, but is most abundant in the seeds.*

It is unnecessary to enumerate the symptoms produced by stramonium, as they are almost identical with those which result from the use of belladonna.

Post-mortem examinations have not discovered in the case of the thorn-apple any morbid lesions of consequence.

Nicotiana Tabacum.—The poisonous virtues of the tobacco are due to the presence of an alkaline principle, which has been discovered and very attentively studied by Possett and Reimann. It is a colourless liquid, very soluble in water, alcohol, and ether, and forming with several of the acids crystallizable salts. One grain of it, according to Berzelius, will destroy a dog.

The symptoms produced by tobacco when exhibited in a moderate dose, are, in the first instance, a slight degree of excitement, which is shortly followed by giddiness, syncope, nausea, and vomiting, feeble pulse, a state of stupor or lethargy, insensible pupil, laborious breathing, and convulsive twitches of the muscles generally. To these effects it gives rise no matter how it be administered, whether introduced into the stomach or injected into the rectum. Several fatal cases are on record which have resulted from its administration in the latter form. A single drachm infused in a pint of hot water, and given as an enema, has in one instance destroyed life.

The only morbid changes of note resulting from the action of this poison, and to which publicity has been given, are, vascular injection of the omentum and of the mucous and peritoneal coat of the intestinal tubes, together with detached spots of extravasation on different parts of the latter tunic. The limbs also have been found extremely flexible, and the back exhibiting a livid hue.

Notwithstanding the activity of tobacco as a poison, it is, as is well known, most extensively employed as an article of luxury. Some use the dry and powdered leaves to stimulate the Schneiderian membrane, others inhale the vapours which result from its combustion, and there are some who even chew the leaves. It is difficult to admit that such practices can be indulged in for any length of time without injury to health; and, indeed, the pallid and emaciated visages, debilitated frames, and deranged digestion of the young men of the present day amply attest its noxious influence.

The essential oil of tobacco, which is a combination of a true volatile oil with nicotine, is probably in a great measure indebted to the latter principle for its activity as a poison. According to Brodie it operates on the system in a manner different from the leaves, for while the latter paralyse the heart, the former produces coma and convulsions.

In cases of poisoning, and they are not uncommon, by the tobacco injection, strong stimulants, such as brandy and ammonia, should be exhibited internally, and an infusion of galls thrown into

* Orfila found, in experiments on dogs, the extract of the seeds analogous, and equally energetic in its action, to that obtained from the leaves of the belladonna.

the rectum with the view of rendering the nicotine insoluble. (See art. Sedatives.)

Umbelliferæ.—Many plants of this order are narcotico-acrid in their effects upon the animal body. They agree with the Solaneæ in very generally causing delirium in an over-dose, but beside this they also give rise to coma and convulsions. We shall limit our observations to the following plants, all of which are native, namely, the conium maculatum, cicuta virosa, œnanthe crocata, and œthusa cynapium.

Conium Maculatum, *or Common Hemlock.*—The active principle of this plant, by which Socrates is said to have perished, has been recently found by Brandes to be an alkaloid, possessing properties somewhat similar to those of strychnia. The extract made from the leaves was found by Orfila a tolerably active poison in experiments performed by him on the lower animals. An ounce destroyed a dog in five minutes when introduced into the stomach; ninety grains killed another in an hour and a half when applied to a wound; and a third perished in two minutes when a scruple was injected into its venous system.

The symptoms produced in man by poisonous doses of conium are, giddiness, delirium, coma, and convulsions. When the dose is insufficient to produce death, very violent delirium is usually observed.

The only facts disclosed by post-mortem examination are, venous congestion in the head, and general fluidity of the blood throughout the body.

Cicuta Virosa, *or Water-hemlock.*—This plant possesses more energy as a poison than the conium. It gives rise, also, to somewhat different symptoms. These are, gastric irritation, vomiting, giddiness, profound coma and insensibility, and finally, very violent tetanic convulsions.

Upon examination after death, nothing particular has been observed but venous congestion of the brain.

Œnantha Crocata, *or Hemlock Dropwort.*—This plant, which is often confounded with the conium maculatum, is much more active as a poison than either it or the cicuta. The symptoms usually commence with burning heat in the throat and epigastrium, which is followed by a state of stupor, and subsequently, in every instance, by violent convulsions. In some fatal cases the latter were the only well-marked symptoms. Death is seldom protracted beyond the fourth hour. The morbid appearances have not been recorded.

Æthusa Cynapium, *or Fool's Parsley.*—This plant, which is often mistaken for true parsley, produces nausea, vomiting, headach, giddiness, sopor, and a partial paralysis or numbness of the extremities. Pains of stomach, swelling of abdomen, lividity of surface, and great dyspnœa have also been observed. It has sometimes proved fatal.

[Several fatal cases from eating of the root and leaves of this powerful poison have been recorded lately by Mr. Bossey, (*Lond. Med. Gazette*, May, 1844.) Death, in one case, occurred in five minutes.]

Ranunculaceæ.—Some of the plants of this natural order have been already discussed under the head of the acrid poisons. There are, however, two of them which combine with their acrid a narcotic action. These are the aconitum napellus and the helleborous niger.

Aconitum Napellus, *or Monk's-hood.*—The poisonous principle of the aconite, which is conceived by Peschier to be an alkali, is found in every part of the plant, but probably exists in greatest quantity in the root. At least such would appear to follow from the experiments of Orfila on dogs. In a sufficient dose it destroys life with rapidity, whether taken into the stomach, applied to a wound, or introduced into the blood. Brodie first remarked that the leaves when chewed produced a partial paralysis, or numbness of the lips, accompanied by a tingling sensation; and the same result has been obtained by Christison on chewing a single seed. In fatal cases, burning heat in the throat, vomiting, purging, abdominal tension, delirium, and convulsions, have all been observed.

In two cases dissected after death, the morbid appearances detected were slight inflammation and vascular injection of the mucous membrane of the œsophagus, stomach, small intestines, and rectum, and congestion of the blood-vessels of the head.

Helleborus Niger, *or Christmas Rose.*—The active principle of this plant, which is said to be an acid oil, is found in most abundance in the root. A decoction of the root has produced, in forty-five minutes, in the human subject, vomiting, delirium, and convulsions, and death before the termination of the second hour. The lungs, stomach, and intestines of persons poisoned by this plant exhibit decided symptoms of inflammation.

Digitalis Purpurea.—The manner of action of this plant, as indicated by the symptoms, renders it necessary to separate it from the other narcotico-acrid poisons. In the leaves, which are considered its most active part, a crystallizable alkali is said to have been discovered by M. Panguy to which he has applied the term digitalin.

The effects of this poison, like those of mercury, are liable to accumulate, and without any premonitory symptoms to become suddenly developed, sometimes a considerable time after the medicine has ceased to be exhibited. In cases which terminate favourably vomiting first sets in; giddiness, beating in the head, and depression of spirits are experienced; and with these very frequently diarrhœa, sweating, salivation, and a very feeble and retarded pulse. In fatal cases the attack is usually ushered in by violent pain over the eyes, together with confusion of intellect; and to these succeed, within twenty-four hours, profuse diarrhœa, delirium, convulsions, and general insensibility. The most constant and characteristic consequence of digitalis, and that which renders it principally valuable as a therapeutic agent, is its influence in weakening and retarding the action of the heart. The salivation, also, to which it gives rise, may be mentioned as a curious, and, with very few exceptions, a peculiar symptom.

The stomach has been found inflamed in an individual destroyed by six ounces of a decoction of the leaves, and the membranes of the brain injected with blood.

[A fatal case of poisoning by this plant has

been lately recorded by Mr. Wilson. (*Lond. Med. Gazette*, Aug. 1844.)]

The **Veratrum Album** and **Colchicum Autumnale** may with propriety be discussed together, for they both owe their activity to the same principle, the veratria, an alkali detected in them by Pelletier and Caventou. The toxicological action of this alkali has been studied both by Magendie and Andral. The latter found it to excite, when swallowed in very small doses, violent vomiting and purging, and in larger quantities, or when injected into a vein, to cause death with tetanic convulsions.

The symptoms produced in man by the white hellebore and meadow-saffron themselves are so similar to those which characterize the veratria, that it is unnecessary to detail them. They indicate very clearly an irritating action exerted locally upon the intestinal tube, and a remote one directed to the nervous system. The seeds of the colchicum possess similar powers to the root, and a tincture of them is at present much used in the treatment of gout and rheumatism.

Plants including Strychnia and Brucea.—Several species of the genus strychniæ and the brucea antidysenterica produce analogous effects upon the animal body. In both distinct alkaline principles have been detected, to which the terms strychnia and brucia have been applied. These alkalies, and the plants in which they are found, cause violent tetanic spasms, which destroy life by suspending those motions of the chest and diaphragm which are essential to respiration. From other poisons, however, which give rise to violent spasms, they differ in not impairing sensibility in the slightest degree.

Strychnia.—This principle is one of the most energetic of poisons, acting in extremely small doses, and with equal certainty, no matter what be the manner of its application. A sixth of a grain dissolved in alcohol, and injected into the pleura, killed a dog in two minutes. It is least active when swallowed, and most so when introduced directly into the blood.

[Cases of poisoning by nux vomica are not unfrequent. In 1837–8, there were three cases noted in the return by the coroners of England, and one case of poisoning by strychnia. (Taylor, *Op. cit.* p. 265.)

In regard to the quantity required to destroy life, Dr. Christison thinks, that half a grain inserted in a wound would destroy a man in a quarter of an hour. It is impossible to say what quantity administered internally would prove fatal; but it is probable that half a grain would generally be sufficient for the purpose.]

In all cases the symptoms are the same. Those first experienced are starting, and stiffening of the extremities, which gradually increase, and finally terminate in a tetanic paroxysm. An interval of calm succeeds, during which the intellect and the senses are found in the normal state; but another paroxysm shortly follows, and destroys life apparently by producing a state of asphyxia or suffocation.

In animals poisoned by strychnia the intestinal canal has been found partially inflamed.

Strychnia, as usually prepared, is turned to an orange-red colour by the action of nitric acid, but this is not true of the alkali in the perfectly pure state. The change of colour is by some referred to the adhesion of resinous matter, from which it is with difficulty entirely freed; by others to the presence of a little brucea, a principle with which it is usually associated. The only other property which can be referred to as serving to distinguish it from the other vegetable alkalies, is its extreme bitterness, a distinct sensation of this description being produced by one grain of it dissolved in 600,000 of water.

Strychnos Nux Vomica.—The nut of this plant, though an article of the materia medica, is a deadly poison, and owes its activity to the presence of strychnia in combination with igasuric acid. The symptoms it produces need not be detailed, as they are quite the same with those which result from strychnia alone. In addition, however, it often gives rise to vomiting.

When death rapidly ensues, it is impossible to observe in the body any morbid changes of importance. But in slower cases, the head is found in a state of venous congestion, and the stomach and intestines are inflamed. The heart is usually empty and flaccid, and the cortical substance of the brain and cerebellum has been observed to present that softened structure which is an index of inflammation. The body, also, has in some cases continued rigid from the period of death.

The strychnos sancti Ignatii and tieuté, the latter of which affords the upas or Javanese poison, both contain strychnia, and produce effects quite analogous to, but somewhat more violent than, those which result from the use of the nux vomica. They need not therefore be recounted.

[The smallest dose recorded as having proved fatal, is three grains of the alcoholic extract. Two cases occurred in London, in 1839, in each of which fifty grains of the powder, considered to be equal to one-fourth of a grain of strychnia, destroyed. In one of the cases, death took place in an hour. Usually it occurs in from one to two hours. (Taylor, *Op. cit.* p. 266.)]

To the treatment of poisoning by strychnia, and the vegetable preparations in which it occurs, it would not be necessary to advert, were it not that M. Donné, of Paris, has recently put forward chlorine, iodine, and bromine, as efficacious antidotes. These principles, he says, combine with the strychnia, and convert it into innoxious compounds. This conclusion he arrived at through experiments on animals; and we should also mention, on the same authority, having forgot to do so in the proper place, that the same agents exercise a similar effect upon veratria, the active principle of colchicum, and white hellebore.

Brucea Antidysenterica.—The bark of this tree was by mistake imported into Europe from South America, instead of that of the Bonplandia trifoliata, the true angustura bark.* It includes an alkali denominated *brucea*, and which, though much less active, is analogous in its action to strychnia. The symptoms, therefore, and morbid appearances which it and the bark produce need not be enumerated.

* This generally received opinion Berzelius considered as erroneous. According to him, the false angustura bark is obtained from the strychnos nux vomica.—Traité de Chimie, tom. vi. p. 218.

The true and false bark may be distinguished from each other by introducing into infusions of them in muriatic acid a drop of ferro-prussiate of potash. This will give a greenish blue precipitate with the latter, but none with the former.

Woorara, **Ticunas**, and **Curare**, employed as poisons by the native Americans, are usually supposed to contain strychnia. The last, however, has been proved by Boussingault and Roulin to include a peculiar principle, called by them curarine; and their experiments have been confirmed by the subsequent researches of Pelletier and Petroz.

[Of late, Mr. W. Ley has recommended the extract of cannabis Indica as an antidote. (*Provincial Med. Journ.* August, 1842, and March, 1843.)]

Immediately after strychnia and brucea, and the plants in which they occur, we may with propriety mention the seeds of the **menispermum cocculus**, or cocculus indicus. The active principle of this plant, discovered by Boullay, and termed by him picrotoxia, is an alkali. Like strychnia, it kills with tetanic convulsions; but, in order to produce such an effect, it must be given in a larger dose. Ten grains of picrotoxia have destroyed a dog in less than half an hour, and in the second tetanic fit.

Cocculus indicus is, it is said, a good deal employed by brewers to communicate to their liquors a bitter taste and intoxicating quality. In large doses it is a powerful poison, producing, in addition to tetanic paroxysms, sickness, vomiting, and other symptoms of intestinal irritation. Three drachms of the seeds introduced into the stomach have killed a dog, and a less quantity, when applied to a wound, has produced a similar result. It is fatal in very small quantity when injected into a vein. The examination of the bodies of animals destroyed by cocculus indicus, induced Webfer to conclude that it acts, at least partly, by exhausting the irritability of the heart; for immediately after death this organ was always found motionless, and distended with blood. The effects of this poison on man have not been accurately noted.

The **upas antiar**, another Javanese poison, distinct from the upas tienté, is supposed to include picrotoxia. It has particularly attracted the attention of physiologists, from its power of destroying the irritability of the heart.

[**Cytisus Laburnum.** — Some experiments that have been made recently by Dr. Christison, (*Edinb. Med. and Surg. Journal*, Oct. 1843,) show that laburnum bark is a most energetic poison,—as powerful even as nux vomica. There appear to be no means of detecting the nature of the poison, especially when administered in powder or infusion; or when, as in a case recently detailed by Dr. Christison, (*Op. cit.*) a decoction of the bark was given as food. (See, also, Taylor, Report on Toxicology, *Brit. and For. Med. Rev.* Oct. 1844, p. 562.) The active principle of the seeds of the Cytisus was separated from it many years ago by MM. Chevallier and Lassaigne. To it they gave the name *Cytisine*. It is possessed of powerful emeto-cathartic properties. (Magendie's Formulary, the writer's edition, Philad. 1825.)]

Camphor. — A solution of this substance in oil or alcohol acts upon dogs in a great measure like cocculus indicus, producing paroxysms of general spasm. These are succeeded by coma, accompanied by laborious breathing, and in this state life is soon extinguished. In lumps camphor excites no convulsions, but merely irritates and inflames the stomach and intestinal canal.

In the human subject two scruples of camphor have produced languor, succeeded by giddiness, insensibility, and convulsions. Delirium and somnolency have also been witnessed, and the breath is usually loaded with the odour of the poison.

The morbid changes produced by camphor in the human body have not been recorded. In dogs the heart is found destitute of contractility, and filled on the left side with arterial blood. The brain has been found vascular in a morbid degree, and softened; and the stomach, duodenum, ureters, urethra, and spermatic cords, inflamed. The odour of camphor, also, emanates from every part of the body.

Poisonous Fungi.—We shall conclude the history of the vegetable narcotico-acrids, by a few observations on the principal cryptogamous productions possessed of deleterious properties.

According to Dr. Greville, there are twenty-six edible species of fungi indigenous in Britain, namely, tuber cibarium, moschatum, and album; amanita casarea, and muscaria; agaricus procerus, campestris, edulis, orcades, odorus, eburneus, ulmarius, ostriatus, riolaceus, deliciosus, piperatus, and acris; boletus edulis and scaber; fistulina hepatica; hydnum repandum; morchella esculenta; helvella mitra and leucophæa. Of these but three, in these countries, are served up as food at the tables of the luxurious; the tuber cibarium, agaricus campestris, and morchella esculenta.

Orfila, in his enumeration of poisonous fungi, includes four species of amanita, — the muscaria, alba, citrina, and virides; seven species of hypophyllum—the maculatum, albocitrinum, tricuspidatum, sanguineum, crux meliteure, pudibundum, and mellitum; and seven species of agaricus—the necator, acris, piperatus, pyrogalus, stypticus, annularis, and urens. To these Christison adds, on the authority of Sowerby and Brandes, the agaricus semiglobatus, and also the agaricus campanulatus, and expresses his opinion that the list is still incomplete. It may be observed that the formation of a perfect list is rendered additionally difficult by the circumstance of certain species being innocent in one climate and poisonous in another, and by the fact of their qualities being to a certain extent influenced by a dry or rainy season, and by the period of the year at which they are produced.

The deletrious fungi have been the subject of numerous experiments, but chemists are not yet quite agreed as to the nature of their active principle. Very recently Le Tellier announced that in some he had detected one, in others two, poisonous constituents, one of which is volatile and acrid, the other fixed and possessed of narcotic powers. These conclusions, however, require verification.

There are certain external signs or obvious characters by which wholesome may be often distinguished from poisonous fungi. The latter, for example, usually exhibit a warty pileus or cap,

exhale a heavy and peculiar odour, and sometimes when chewed produce a styptic taste. Those of an orange colour are also very generally poisonous, and the same may be said of such as possess a tough or corky texture. Those also which grow in shady places or on the trunks of trees should be suspected, and if when cut they shortly assume a blue colour, this circumstance may be considered as conclusive of their noxious properties. These rules will often serve as useful guides, but they must not be implicitly relied upon, for all are subject to exceptions.

The symptoms produced by the poisonous fungi are sometimes of purely an irritating kind. Very often also they appear to operate exclusively as narcotics; but in the greater number of cases both classes of effects are combined.

The symptoms of irritation which have been witnessed are an unaccountable feeling of anxiety, urgent dyspnœa, scorching thirst, tormina of the bowels, abdominal tension, and profuse diarrhœa, the matters discharged being particularly offensive. Dimness of vision, giddiness, delirium, and coma, constitute the usual narcotic symptoms. Convulsions are rare. It may be mentioned as a peculiarity of this class of poisons, that the symptoms are rather slow in beginning, but are of unusually long duration. They have not in some instances commenced for twelve, and in several they have lasted for better than forty-eight hours.

The morbid appearances which have been noticed are lividity of the body, fluidity of the blood, distension of the abdomen, inflammation, and even gangrene of the stomach and intestines, and venous congestion of the lungs and brain.

It is scarcely necessary to say that there exists no antidote to the poisonous fungi. Our reliance must be entirely placed upon the prompt expulsion, by emetics or otherwise, of the noxious contents of the stomach; and it is worthy of being noticed here that the fungi continue for an unusually long time in this viscus, having in one instance been discharged by vomiting nearly three days after they had been eaten.

Ergot or spurred Rye.—The seeds of the cerealia are sometimes rendered unwholesome by imperfect ripening, apparently owing to the presence of a free acid in the grain, for the flour is, if not perfectly cured, at least greatly improved by the addition to it of a little carbonate of magnesia. In some instances, however, they, or rather the meal prepared from them, acquires very deleterious properties from the presence of a remarkable production known to botanists under the name of secale cornutum or ergot of rye, from the plant in which it is principally developed. It has also been observed in wheat, oats, and barley, but more rarely, and in a state of less development. This ergot or spur of rye which replaces in the ear sometimes one, sometimes several grains, is a cylindric growth varying from three lines to an inch and a half in length, and of the thickness of a crow-quill. Internally it is of a greyish colour, but outside it is covered by a bluish-black husk, presenting two or three dotted streaks of a lighter shade. The amount of it present in rye is influenced by the nature of the soil and the character of the season. When the ground is damp and stiff, and the season unusually moist, we have combined the circumstances which have been found most favourable to its production. The district of Cologne in France, and several parts of Germany, have in particular been infested by it, but it has scarcely ever been produced in these countries in sufficient quantity to render it an object of interest to the toxicologist.

With respect to the nature of this substance different opinions have been entertained, some viewing it as a spontaneous morbid growth, others as a parasitic fungus, and others still as the work of a species of papilio which punctures the glumes of the unripe plant, and thus causes an exudation of milky juices, which by inspissation are finally converted into the spur. In support of this latter theory it has been alleged that a similar growth may be produced by punctures inflicted with a needle.

The ergot has been subjected to analysis by several chemists. Vauquelin found in it neither starch nor sugar, but a considerable quantity of a principle of an animal nature, and very prone to putrefaction. According to Robert, it includes prussic acid, but this statement is not in accordance with the experiments of other chemists.

When the ergot is exhibited to man in a dose of about two drachms, the symptoms usually produced by it are vertigo, headach, suffusion of face, nausea, succeeded by vomiting and purging, spasms of the stomach and intestines, and an universal feeling of debility and fatigue. If gradually introduced into the system, as occurs to those who have used for a considerable time rye-meal impregnated with it, the effects are materially different and of a twofold description. Either a convulsive disorder is established, or the disease usually known under the name of dry gangrene. The former begins with dimness of sight, giddiness, and insensibility, symptoms which are quickly succeeded by frightful convulsions of the entire body. In this severe form the disease proves rapidly fatal; but in milder cases the convulsions occur only in paroxysms, and in the intervals the chief indication of disease which presents itself is an extreme voracity of appetite. This voracity either terminates in death, preceded by coma and convulsions, or in recovery after the previous appearance of anasarca, diarrhœa, cutaneous eruptions, or abscesses in different parts of the body. The latter affection, or gangrenous ergotism of the French, begins with a sense of weariness and debility. After the lapse of a considerable but variable period of time, sometimes one, sometimes several weeks, the extremities become cold, numb, and stiff, and are seized with excruciating pains. A pyrexial state next sets in, accompanied with epistaxis; and, finally, the fingers and arms, afterwards the toes and legs, shrivel up and drop off at the joints in succession. In this modification of ergotism the appetite is also from the commencement inordinate.

Alcohol.—The origin of this remarkable fluid, together with its physical and chemical characters, are so well known that any allusion to them here would be quite superfluous. We shall therefore proceed at once to the consideration of its influence upon the animal economy.

Alcohol and alcoholic fluids generally, when swallowed by man in moderate quantity, invari-

ably produce a greater or less degree of excitement; that is, they augment the temperature of the body, accelerate the movements of the heart and respiratory organs, give tone and strength to the muscles, energy and rapidity to the operations of the mind, and in general call up a train of pleasurable emotions. Nor is this state of temporary exaltation followed by any material subsequent languor or depression. When, however, the limits of moderation are transgressed, and such a quantity of a spirituous fluid is used in successive doses as to produce the state usually designated by the term intoxication or drunkenness, the consequences are materially different. The excitement, indeed, just described, is in the first instance observed, but it soon puts on a more formidable character, being attended by suffusion of face and conjunctivæ, difficult articulation, giddiness, incoherency of mind, and, very frequently, true delirium. An irrepressible drowsiness next succeeds, which terminates in deep and sometimes stertorous sleep, from which, in cases which terminate favourably, the individual awakes affected by debility, giddiness and headach, universal languor, and very often nausea and vomiting. The result, however, is sometimes different. The somnolency just described passes not into sleep, but a state of general insensibility, accompanied by feeble and moderately rapid pulse, stertorous breathing, and dilated and non-contractile pupil, a combination of symptoms from which recovery is seldom witnessed.

The case just described is an instance of simple poisoning by fermented liquors, and many such have been observed. It, however, more frequently occurs that life is destroyed either by the occurrence, during the fit of intoxication, of apoplexy in an individual predisposed to the disease, or in consequence of his exposure to extreme cold, or his accidental suffocation during the lethargic or somnolent state.

Should the spirituous liquor be drunk not in divided portions, but all at once and in large quantity, apoplectic coma with stertorous breathing sets in, almost immediately, and death follows usually within a few hours.

In habitual drunkards a particular affection, at present known under the name of delirium tremens, is often witnessed, which may with propriety be noticed here. Delirium, characterized by constant incoherent talking, is its leading symptom, and is accompanied by tremours of the limbs, particularly the upper extremities. In fatal cases coma, as in the preceding instance, precedes and ushers in death.

Looking to the preceding history of symptoms, alcohol, it would appear, should be classed with the purely narcotic poisons. Cases, however, have occurred, though very seldom, in which, after the cessation of its narcotic action, symptoms of gastro-intestinal irritation and inflammation have set in, which justify the position usually assigned to it in the arrangements of toxicologists.

The morbid appearances which have been observed in the stomach in cases of poisoning by alcohol are unusual redness and vascularity of its mucous lining. Such appearances are, according to Orfila, invariably witnessed in the stomachs of the lower animals. In man, however, though sometimes found, they are very generally wanting. In the head, as might have been anticipated from the symptoms, the principal lesions are to be found. These are venous congestion, serous effusion into the ventricles and between the membranes, and extravasation of blood into the substance of the brain, producing genuine sanguineous apoplexy. When delirium tremens proves fatal, serous effusion is found in the brain, and in some rare instances flakes of coagulable lymph are attached to the membranes. Andral also in a single case witnessed a very extensive softening of the mucous tunic of the stomach. Should death take place very quickly, as when a large draught of spirituous liquor is swallowed, post-mortem examination will not display any morbid lesions of the brain or other organs.

Alcohol is generally conceived to enter the circulation, and through it to exert its poisonous influence on the nervous system; and in support of this theory the fact is alleged of a spirituous smell being perceptible not only in the stomach of persons who die of intoxication, but also in the brain and other organs. When, however, death occurs, as it often has, within a few minutes, it is difficult to admit that absorption could have taken place, and we are compelled, with Addison and Morgan, to refer its noxious influence to nervous impression and cerebral sympathy.

The diagnosis of a case of poisoning by alcohol will, in most instances, not be difficult. The symptoms already detailed, combined with the alcoholic odour of the breath, will often clear up the nature of the case even during life; and when it terminates fatally, the contents of the stomach, if subjected to distillation in a retort, will furnish a product which by rectification from dry carbonate of potash, or fused chloride of calcium, will acquire all the physical and chemical characters of alcohol. This method of research will always lead to a positive result when the individual dies shortly after swallowing the fermented fluid. Should the fatal event, however, be delayed for a few hours, the alcohol is absorbed, and cannot of course be subsequently detected in the stomach. We may also add, that in cases of rapid poisoning, if the chemical search for alcohol be not instituted within a reasonable time, it will not prove successful, as the poison escapes by evaporation or transudation.

The treatment of a person labouring under dangerous drunkenness is very simple. The stomach must be emptied by an emetic, or should this fail or be too slow in its operation, by the application of the stomach-pump; and the somnolency or coma, should it have set in, is to be obviated by the assiduous use of the various means of stimulation recommended under the head of opium. In delirium tremens, opium in large and repeated doses has proved a very efficacious remedy. It is, however, only suitable during the continuance of the delirium and tremours. Should a somnolent or comatose state be established, its use should be strictly inhibited. From the morbid appearances which have been witnessed in cases of delirium tremens, such as the effusion of serum and coagulable lymph in the brain, there is good reason to conclude that the disease occasionally passes into, or is complicated with, phrenitis,

Should such a combination be in any instance suspected, the exhibition of opiate preparations should be preceded by depletion from the head and other antiphlogistic means of treatment. (See a paper by Dr. Lendrick, Dublin Journal, No. iv. p. 7.)

IV.—Poisonous Gases.

The atmosphere in which we live, and by means of which those changes are effected in the blood as it circulates through the lungs, known under the term aeration, consists, in the main, of a mixture of four volumes nitrogen and one oxygen, a minute quantity of carbonic acid being also present, and a variable proportion of aqueous moisture. Such is the nature of the gaseous medium which we respire, and it is the only aeriform fluid which admits of being inhaled for a length of time without the production of effects injurious to or destructive of life. No single known gas at least can supply its place, and the same may, in all probability, be said with truth of any artificial mixture differing in the nature, or even the proportion, of its essential constituents from the natural atmosphere. Every known gas, therefore, may, under this point of view, be considered as a poison. All, however, are not equally energetic, and the manner of action of all is not the same.

The first circumstance deserving of attention which serves to distinguish some from others of the gaseous poisons is, that certain of them will, in the pure or unmixed state, pass into the lungs, while against others the glottis closes spasmodically, unless they be diluted with a sufficient quantity of atmospherical air. This difference of property has suggested a division of them into the *respirable* and the *irrespirable*: the former being oxygen, nitrous oxide, nitrogen, hydrogen, carbonic oxide, and carburetted hydrogen; the latter, ammonia, chlorine, muriatic acid gas, nitric oxide, nitrous acid vapour, sulphurous acid gas, carbonic acid, cyanogen, and sulphuretted hydrogen.*

Nysten (Recherches Chemico-physiologiques) has resolved the poisonous gases into the *negative* and *positive*, or into those which merely operate by excluding atmospherical air, which alone can effect the proper aeration of the blood, and those which exercise on the parts with which they come in contact, or on the system generally, a directly injurious action. It is probable, however, that if we except nitrogen, there does not exist a truly negative aerial poison; and when we find Nysten arranging subcarburetted hydrogen, carbonic oxide, and nitrous oxide, among the negative gases, there can be no doubt that the method which he adopted for determining to which class each individual belonged led him to erroneous results. This eminent physiologist laid it down as a principle that a truly negative gaseous poison can, when injected into the blood, produce no injurious effects save what are the result of its mechanical action; and, therefore, that when other and distinct morbid phenomena are observed to follow, they establish a direct or positive deleterious influence. It would be easy to show, from *à priori* considerations, that this criterion could not be relied upon. The conclusions, however, to which Nysten was guided by it are so inconsistent with experience, that any further objection to its validity would appear altogether unnecessary.

Of the positive gases, or those which are directly noxious, all do not operate in the same way. Some irritate or even inflame the parts with which they come in contact, while the action of others is directed chiefly to the nervous system. Hence the common division of them into irritants and narcotics, which, being founded on their manner of action, is probably, in a practical point of view, the best which can be employed by the toxicologist. In the following table an attempt is made to combine the principles of classification which have been just explained.

I. NEGATIVE.

Nitrogen.

II. POSITIVE.

1. *Narcotic.*
   - Oxygen.
   - Hydrogen.
   - Nitrous oxide.
   - Carbonic oxide.
   - Subcarburetted hydrogen.
   - Sulphuretted hydrogen?
   - Cyanogen?
   - Carbonic acid.
2. *Irritant.*
   - Ammonia.
   - Chlorine.
   - Muriatic acid gas.
   - Nitric oxide.
   - Nitrous acid gas.
   - Sulphuretted acid gas.

Nitrogen.—This is one of the respirable gases, that is, when perfectly pure it can be drawn into the lungs. Being, however, incapable of effecting the arterialization of the blood, its inhalation cannot be repeated more than three or four times in succession without the production of asphyxia. The venous blood, in fact, reaches unchanged the left side of the heart, and, passing from thence to the brain, suspends the influence exercised by this organ in determining the contraction of the respiratory muscles, and thus causes death by suffocation. As pure nitrogen is not a natural product, and as it is but sparingly produced in chemical processes, no instances have occurred of death resulting from its inhalation.

Oxygen.—This is the constituent of the atmosphere which performs the most important functions in the process of respiration. It was, indeed, long supposed to be the only element of the air we breathe essential to life, and the nitrogen was considered to act merely by diluting it, and thus reducing the energy with which it acts upon the system. That this latter gas operates at least partly in this way there can be little doubt. The experiments, however, of Dr. Edwards would seem to establish that it also is sometimes absorbed, and, therefore, in all probability, discharges other and higher uses in the animal economy.

In the earlier experiments performed upon the smaller animals immersed in a given volume of oxygen, it was observed that life was maintained a much longer time than it would be in an equal bulk of atmospherical air. This method of experimenting does obviously not enable us to examine apart the effects of oxygen gas, for carbonic acid

* This enumeration of poisonous gases is obviously imperfect. It, however, includes all those which merit the attention of the toxicologist.

is gradually evolved, and we witness merely the influence of the mixture upon the animal. To insulate the agency of the oxygen, so that it alone may be studied, it is necessary to cause this gas to be inspired from one reservoir and expired into another, a thing which can scarcely be accomplished unless in the case of the human being; or, when the experiment is conducted by surrounding the animal with a given volume of the gas, to remove the carbonic acid by chemical means as fast as it is produced. Operating in the first-mentioned way, Allen and Pepys observed phenomena somewhat different from those which belong to ordinary respiration. A glow of warmth was felt over the entire body, accompanied by a gentle diaphoresis, the pulse was decidedly accelerated, and the animal temperature appeared to undergo a slight augmentation. The excitement thus produced rapidly subsided upon the termination of the experiment, leaving behind it no depression or other inconvenience whatsoever. (Phil. Trans. 1808.) These experiments would seem to lead to the conclusion that pure oxygen when respired operates as a stimulant, but that its action is not sufficiently violent to justify us in considering it as a poison.

To such conclusion, however, it may be objected, that the experiment in question was not carried sufficiently far to put us in possession of the true physiological action of the gas; that if it had been respired for a longer time, the observed effects would have been different: and some researches conducted not long since by Mr. Broughton, (Quarterly Journal of Science, January, 1830, p. 1,) have, in point of fact, led him to the belief that oxygen when respired sufficiently long exercises a narcotic influence. The first effects noticed by this physiologist were increased activity of the pulmonary and aortic circulation. A degree of languor, which gradually passed into extreme debility was next observed, and to this succeeded general insensibility and loss of power over the voluntary motions. The heart, however, continued to beat, and the intestinal muscles to contract, long after the cessation of the movements of the diaphragm and purely voluntary muscles, and after sensibility had been completely extinguished. In rabbits, cats, and guinea-pigs, upon whom the experiments were chiefly performed, the symptoms just enumerated did not begin to manifest themselves until after the lapse of an hour, and death took place between the sixth and twelfth hour. Post-mortem examination showed the blood of a bright scarlet colour in both arteries and veins, and unusually prone to coagulation.

The views of Broughton are pretty generally adopted, by Christison among the rest; and in accordance with them we have classed oxygen among the narcotic gases. We confess, however, we are by no means satisfied of their soundness. In his method of experimenting, the carbonic acid produced by the animal was mixed with the oxygen, and it is at least possible that the sedative effects observed were due to the former gas.

Hydrogen.—This gas in the pure or unmixed state may be respired with impunity a few times, the only remarkable consequence which follows being a peculiar modulation of the voice, which lasts until the greater part of the hydrogen is expired. But should its inhalation be continued much longer, speedy death by asphyxia is the consequence, as, like nitrogen, it is unable to effect the aeration of the blood. If this event be prevented by mixing oxygen with the hydrogen, a decidedly narcotic effect is produced. Thus, Allen and Pepys found that guinea-pigs made to respire a mixture of four volumes of hydrogen and one oxygen, first became somnolent, and were finally thrown into a profound, sleep, from which, however, they recovered perfectly upon being withdrawn from the mixture; and De Wetterstedt of Stockholm found a similar mixture to produce the same effect upon a young female labouring under phthisis. (Berzelius, Traitè de Chimie, vol. vi. p. 106.) In such experiments, it should be observed, some hydrogen disappears, which is of course absorbed by the blood.

Nitrous Oxide.—The singular effects of this gas when respired were first studied by Sir H. Davy, who detailed its influence on himself, and gave publicity to the accounts drawn up by several of his friends of the sensations which they experienced. (Researches, chemical and philosophical, chiefly concerning nitrous oxide and its respiration.) The first feeling of Davy upon respiring the gas was giddiness, which was succeeded by an uncommon sense of fulness in the head, accompanied by loss of distinct sensation and voluntary power; but these, in less than half a minute, the respiration being continued, diminished gradually, and were followed by a sensation analogous to gentle pressure on all the muscles, attended by a highly pleasurable thrilling, particularly in the chest and the extremities. The objects around became dazzling, and the hearing acute. Towards the last inspirations the thrilling increased, the sense of muscular power became greater, and at last an irresistible propensity to action was indulged in. These effects ceased very soon after respiration, for in ten minutes he had recovered his natural state, and what is particularly worthy of notice, the excitement he experienced was not followed by the slightest languor or depression. By repeated trials he found that he could breathe nine quarts of the gas for three, and twelve quarts for more than four minutes, but that he could never respire it in *any* quantity so long as five minutes. The pleasurable sensations also were with him at their height about the middle of the experiment.

Several others have been affected in a similar manner from the respiration of the nitrous oxide, but the effects of the gas are not the same upon all individuals. Some, for example, have been thrown by it into a state of syncope, others into convulsions. The researches of Davy (Opus citat. p. 394) prove that in such experiments the gas is absorbed in quantity by the blood. When injected slowly into this fluid, Nysten found that it was condensed, and that the only effect resulting from it was a slight staggering.

Carbonic Oxide.—Some interesting experiments upon the respiration of this gas were made a few years ago in the laboratory of the Dublin Society by the assistants of Mr. Higgins, the professor of chemistry. Three inhalations produced in one gentleman vertigo, tremours, and a lethargic state bordering on insensibility, which was succeeded by debility and headach of some hours'

duration. Another, who after a forced expiration inhaled the gas three or four times, was struck down suddenly and remained for half an hour apparently lifeless, and almost without pulse. After the failure of various other means of stimulation, he was at length revived by inflating his lungs with oxygen, but continued nevertheless, throughout the day, affected by convulsive movements of the body, stupor, severe headach, quick and irregular pulse, and subsequently with nausea, and slight febrile paroxysms of an intermittent nature.

Nysten found that when gradually introduced into a vein, carbonic oxide produced a state analogous to that of intoxication.

Subcarburetted Hydrogen.—This gas is copiously disengaged in collieries, and, when mixed with a proper proportion of common air, constitutes the explosive atmosphere usually known under the name of fire-damp. We are not aware of subcarburetted hydrogen having been inhaled in the pure state, but as the fire-damp does not in any perceptible degree embarrass the respiration of the workmen in coal-mines, we are entitled to conclude that the gas is innoxious when diluted with fourteen volumes of atmospherical air, for a mixture thus composed cannot be ignited.

There are several other gaseous compounds of carbon and hydrogen, one of which, the olifiant gas, has been known for a great length of time, but their effects when singly respired have not been made a subject of experiment by the physiologist; and the same may be said of the mixed compounds of the same elements which are found in the gases prepared from oil, coal, and resin. The experience indeed of gas-men proves that atmospherical air is not rendered injurious to health by being highly charged with the artificial illuminating gases; but an accident which occurred some time ago in Paris, shows that if a certain limit be transgressed, poisonous effects will follow. In consequence of the leaking of the gas-pipe which supplied a warehouse, five individuals who slept in the building were attacked during the night with stupor, and one of them died with most of the symptoms of narcotic poisoning. The phenomena, however, witnessed in this case can scarcely be considered as due exclusively to the influence of the gas, for one of the lungs was found congested, and the bronchus distributed to it blocked up by a kidney-bean. (*Christison*, p. 704.)

The gaseous mixture which is produced by passing the vapour of water over red-hot charcoal, and which consists of subcarburetted hydrogen, hydrogen, carbonic oxide, and carbonic acid,* was inhaled by Sir H. Davy, (Op. cit. p. 467), both in the pure form, and diluted with two-thirds its volume of atmospherical air. In the latter state, when breathed for about a minute, it produced slight giddiness and pain in the head, and a momentary loss of voluntary power. The pulse also was rendered quicker and feebler; but all the effects went off in five minutes. The first inspiration of it in the undiluted form caused a sort of numbness and loss of feeling in the chest and about the pectoral muscles. After the second he lost all power of perceiving external things, and had no distinct sensation except a terrible oppression on the chest. This feeling disappeared during the third expiration, but he felt (to use an expression of his own) as if sinking into annihilation. The further inhalation of the gas was now suspended, and after the lapse of a minute his pulse was found threadlike, and beating with excessive quickness. He now moved instinctively to the open air, where, upon arriving, his head became giddy, his knees trembled, and he had but just sufficient voluntary power to throw himself upon the grass. Here the painful feeling of the chest increased with such violence as to threaten suffocation; but upon respiring for about a minute a mixture of oxygen and nitrous oxide, he felt relieved, and in an hour the painful feelings had disappeared, leaving behind them only an excessive weakness and swimming of the head. In three quarters of an hour after this, having walked about slowly in the mean time, great giddiness again returned, accompanied by nausea, loss of memory, and deficient sensation. To these, in about an hour and a half, a violent pain in the forehead and between the eyes succeeded, and transient pains in the chest and extremities; but these affections gradually diminished, and at ten at night no disagreeable feeling remained.

From the preceding detail, the conclusion of Davy would appear pretty well established, namely, that the gaseous mixture which he respired, "acts as a sedative, i. e. that it produces diminution of vital action and debility, without previously exciting."

Carbonic Acid.—This gas being copiously disengaged during the combustion of ordinary fuel, the burning of lime, and as the result of the vinous fermentation, the respiration of animals and the growth of plants, it is more frequently the cause of accidental as well as intentional death than any other of the aerial poisons. The action of carbonic acid was once conceived to be purely negative, or to depend merely upon its inability to aerate the blood. But this opinion is amply refuted by a variety of facts enumerated by Dr. Christison. 1. The state of asphyxia produced by the respiration of an atmosphere charged with carbonic acid, is removed with much greater difficulty than that which is the result of immersion in hydrogen or azote. 2. If the azote of atmospheric air be replaced by an equal volume of carbonic acid, such atmosphere will prove rapidly poisonous. 3. If a tortoise be made to respire atmospheric air with one lung and carbonic acid with the other, it perishes in a few hours. This experiment was performed by Rolando, of Turin. 4. Effects analogous to those which result from the respiration of the gas are produced by its prolonged contact with the skin or stomach. In the latter method of application, for example, it gives rise, as is well known, to intoxication; and Collard de Martigny has shown that when an animal is enveloped by an atmosphere of carbonic acid, the access of atmospherical air to the lungs being still permitted, so as to maintain ordinary respiration, death, if the experiment be continued sufficiently long, is the invariable consequence.

Carbonic acid in the pure state cannot, as Sir H. Davy has shown, be inhaled; for the irritation it

* This gas was probably removed, as allusion is made to some method of purification which was employed.

produces in the fauces is such that the glottis closes spasmodically, and thus prevents its entrance into the lungs. The undiluted form, then, may be considered as a true negative poison, destroying life by simple suffocation. Of death produced in this way, many instances occur in distilleries and breweries, from the workmen incautiously entering, or falling accidentally, into the fermenting tuns. It also often accumulates in old wells, in mines, where it constitutes the choke-damp, and in caverns, like that of the Grotto del Cane, near Naples, occurring in volcanic districts, in a state of such purity as suddenly to asphyxiate individuals who enter them.

In such situations, however, it will more frequently occur that the carbonic acid is diluted with a greater or less quantity of atmospherical air. If the proportion of the former gas be not too great, the mixture will enter the lungs, and Davy found, in an experiment performed on himself, that when it amounted to 30 per cent., such atmosphere could be respired for one minute, the only effects being a slight degree of giddiness and inclination to sleep. But should the respiration of such a mixture be persisted in for a longer time, consequences of a much more serious description are observed. A sense of weight in the head, attended by giddiness, is the first symptom, and this is rapidly succeeded by a somnolent state, which finally terminates in coma, with stertorous breathing. In convalescence from the asphyxia produced by a mixture of air and carbonic acid, violent and irregular convulsions, general insensibility, and dumbness, have been observed.

Confined atmospheres, such, for example, as those of small and close apartments, in which a number of individuals respire without any provision for renewing the air, or in which the combustion of carbonaceous matters is conducted without a flue, acquire deleterious properties of an analogous but still more energetic description. Nor is this difficulty to be understood; for in such atmospheres carbonic acid is not only developed, but an equivalent portion of their oxygen is withdrawn. The emanations, indeed, from burning charcoal are not always of the same description. When the combustion is brisk, carbonic acid is the only product; but Orfila has shown that, when languid, equal volumes of carbonic acid and subcarburetted hydrogen are evolved (Toxicol. Gén. ii. 474); and experience proves such mixture, when respired, to be in an eminent degree injurious to the animal economy. The same eminent toxicologist, it may also be observed, has established, that when the coals are red-hot, considerably less atmospherical oxygen is consumed, than when the combustion is languid. The narcotism established in these cases continues for an unusual length of time, and, though delirium sometimes supervenes, it is not, as in other instances of narcotic poisoning, to be looked upon as the precursor of convalescence.

It is often said that if an atmosphere including carbonic acid supports the combustion of a taper, it is respirable, and such is the test relied upon by those employed in the sinking of wells for pumps, at the bottoms of which it is liable to accumulate. Such an atmosphere will undoubtedly admit of being respired for a certain length of time, but will, nevertheless, often finally induce a state of the most dangerous asphyxia. It is even said that a female servant fell *suddenly* down upon entering a cellar in which the vinous fermentation was going on, although the candle which she carried with her continued to burn. (Archives Gén. de Médecine, xiv. 205.) The literal correctness of this statement may be doubted; but, even though it were shown to be erroneous, abundant facts still remain to prove the fallacy of the method in question as a test whether a given atmosphere contaminated with carbonic acid be or be not poisonous.

Several instances of poisoning by the fumes of burning charcoal, and some of suffocation produced by the crowding of people into confined and narrow rooms, are upon record. Scarcely a month elapses without an account of death produced by a charcoal chaffer placed incautiously in bedchambers without a flue; and in the celebrated narrative of the suffocation of one hundred and twenty-three out of one hundred and forty-six Englishmen, incarcerated for a single night in a dungeon at Calcutta, we have a very striking illustration of the injurious properties acquired by air which has been repeatedly respired. In all such cases, the effects, as has been already stated, are pretty nearly the same with those which result from the respiration of simple mixtures of atmospheric air and carbonic acid. If there be any distinction, it is that a greater or less degree of delirium is more constantly present in the former than in the latter instances.

In individuals destroyed by respiring air contaminated by carbonic acid, the countenance is usually tranquil and composed, sometimes red, often particularly pale, but more usually of a livid colour. The eyes are prominent and exhibit a glistening appearance, and the tongue is black and protruded between the teeth. The lungs, heart and brain are in a state of venous congestion, and the ventricles of the latter organ include a considerable quantity of serum. According to some toxicologists the back is extremely livid, the blood fluid, and the muscles are in a great measure destitute of irritability. In some instances effusion of blood on the surface of the brain has been observed, and it is also said that the stage of rigidity which usually succeeds to death has occasionally not been established.

The treatment of poisoning by carbonic acid may be discussed under two distinct heads:—1st, when the asphyxia is complete; 2d, when the functions of the heart and lungs being performed, there still prevails a state of coma, or a greater or less degree of insensibility.

To remove the asphyxia produced by carbonic acid the means which have been found most efficacious are, the cold affusion, bleeding from the arm or jugular vein; or should this method of depletion not succeed, cupping from the nape of the neck or other part in the vicinity of the head. In conjunction with these, the artificial inflation of the lungs with oxygen, if practicable, should be resorted to, and it will be frequently found advantageous to employ the stimulating powers of a galvanic machine of about forty couples. (See article Galvanism.) In this form of asphyxia also, as in other kinds, it will be proper to main-

tain the temperature of the body by external heat, and to apply to it assiduous and general friction with warm flannel.

As soon as the movements of the heart and chest are restored, our attention must be directed to the prevention of a relapse, and to the removal of the state of insensibility or torpor which remains. With a view to the accomplishment of these objects, the local bleeding from the vicinity of the head should be repeated, unless contra-indicated by peculiarities in the case; ammonia or its carbonate should be applied at intervals to the Schneiderian membrane of the nose, and even introduced frequently in small doses into the stomach. By the steady prosecution of this plan of treatment, the stupor, though generally deep and lasting, will in most instances be finally removed.

Sulphuretted Hydrogen. — The experiments of Dupuytren and Thenard demonstrate sulphuretted hydrogen to be in the highest degree inimical to the animal economy, for they found air impregnated with 1-150th of this gas to prove fatal in a short time to a horse, with 1-800th in about the same time to a dog, and when containing but its 1-1500th immediately to destroy a small bird. Sulphuretted hydrogen is evolved in nature, though in no great quantity, and impregnating certain mineral springs, acquires for them the title of *sulphurous*. It is also invariably disengaged as the result of the putrefaction of organic matters, particularly those of an animal nature. Old privies, for example, especially such as, like those of Paris, are unconnected with any sewer, and continue uncleaned out for a length of time, exhale it in considerable quantity; not, however, pure, but in a state of mixture and combination with ammonia. Sulphuretted hydrogen is not alone poisonous when taken into the lungs. It is equally so when applied to other parts of the body. It also proves fatal whether forced into the cellular tissue, stomach, or rectum, or simply applied to the skin. Chaussier found that nine quarts introduced through the anus of a horse killed it in one minute, and that a rabbit to whose skin alone it was applied perished in ten minutes.

We are not aware that any instances are recorded of death produced by sulphuretted hydrogen alone. When evolved in virtue of putrefaction, this gas is accompanied by ammonia; and in all the alleged cases of poisoning by sulphuretted hydrogen, the volatile alkali has also been a component part of the noxious atmosphere. The effects of such atmosphere were detailed about forty years ago with great particularity by M. Hallé, in a work upon the nature of the exhalations from the Parisian privies. According to this authority, the symptoms vary with the degree of concentration of the exhaled vapours.

When undiluted with atmospherical air, they determine a sudden and complete asphyxia, from which recovery is very rare, unless the affected individual be almost immediately withdrawn from the influence of the exhalations.

When the noxious vapours are respired in a state of admixture with a large proportion of atmospheric air, their injurious effects are more slowly developed, and are of a twofold description. In some a somnolent state terminating in coma is produced, from which, however, they may be roused, though with difficulty; all recollection of what occurred in the interval being entirely effaced. In others a variety of symptoms, which differ in different individuals, first present themselves, such as pains, particularly of the stomach and arms, delirium, dyspnœa, a state approaching to asphyxia, with dilated and immovable pupils, and feeble and irregular pulse; and to these succeed violent tetanic spasms of both trunk and extremities. Finally, in fatal cases, a short time previous to death, the patient becomes remarkably tranquil, and indeed almost insensible. In the milder cases, or where the vapours have been much diluted, and the exposure of short duration, nausea, a certain degree of lethargy, with slight abdominal and thoracic pains, constitute the only symptoms which have been observed.

In individuals poisoned by exhalations including the hepatic gas, the blood in every part of the body is found fluid, and of a dark colour, the muscles destitute of contractility, and the lungs in a state of sanguineous congestion. The smell, also, peculiar to sulphuretted hydrogen emanates from the body, and may, according to Chaussier, be detected in the different organs by introducing into them slips of polished silver, or a small quantity of recently precipitated carbonate of lead.

The substance just mentioned, or, what will answer equally well, a slip of filtering-paper moistened with a solution of sugar of lead, constitute as delicate tests as can be desired for sulphuretted hydrogen. The former is blackened by the gas, while upon the latter a film of sulphuret of lead is formed, so thin as to exhibit a beautiful iridescent play of colours.

Should it be deemed expedient to deprive an atmosphere of any sulphuretted hydrogen it may include, this may be very readily and completely done by introducing into it a little chlorine gas, which will seize upon one of its elements, the hydrogen, while the other is deposited. The same object may also be accomplished by nitric acid in the vaporous state.

With respect to *treatment*, it will be sufficient to refer to what has been already said; for the manner of action of sulphuretted hydrogen and carbonic acid being the same, their effects should, in all probability, be combated in a similar manner.

Cyanogen.—There have been no opportunities of observing the effects of this gas upon the human subject, but the experiments of Coullon, and those of Hurrefield, referred to by Christison, prove it to be a powerfully narcotic poison; the symptoms which characterize it being coma, and more rarely convulsions. Like prussic acid, it sometimes produces a local and temporary paralysis of the parts of the body to which it is applied.

Irritant Gases.—The manner of action of the irritant is in one respect the same with, in another essentially different from, that of the narcotic gases. Both, oxygen being excepted, are incapable of aerating the blood, and would for this reason, if for no other, ultimately destroy life. In addition, however, to this, the narcotic gases exercise upon the nervous system an injurious influence of a specified description, and the irritant ones excite

in the mucous membrane with which they come in contact a greater or less degree of irritation and inflammation. In the pure state, the irritant gases are all irrespirable.

Ammonia.—The aqua ammoniæ of the pharmacopœia, at ordinary temperatures, is constantly exhaling ammoniacal gas, and is hence often applied as an analeptic remedy to the nares in syncope, hysteria, epilepsy, asphyxia, &c. From this application of it several accidents have arisen; for, in virtue of its escharotic powers, when applied in too great quantity, it corrodes and of course inflames the mucous membrane lining the different bronchial passages. The symptoms which in such event present themselves are of course those of a very severe bronchitis, and the morbid appearances are extreme vascularity of the lining membrane, exudation of lymph upon its surface, and, at some points, excoriation and ulceration. To prevent consequences of this description, the aqua ammoniæ, before being held to the nose, should be diluted with about three volumes of water.

Chlorine.—This gas is often developed in the laboratory of the chemist, and, in great quantity, in factories for the preparation of the bleaching salt of lime; and, though highly irritating to the larynx and lungs, admits of being inspired when sufficiently diluted with atmospheric air. In this state, however, it frequently, by its stimulating and corrosive qualities, produces an inflammation of the bronchial mucous membrane, which either terminates fatally, or lays the foundation of some formidable form of thoracic disease. The younger Pelletier fell a victim to phthisis thus produced; and a gentleman of this city (Dublin), Mr. Roe, is said to have died some years ago of a chronic bronchitis which originated in a similar cause. Paradoxical, however, as it may seem, the respiration of an atmosphere impregnated with a small quantity of chlorine has recently been recommended as an efficient means of contending with tubercular phthisis. Experience, indeed, proves that air slightly impregnated with it is not injurious to health; for, as Christison remarks, the workmen employed in the manufacture of chloride of lime are not less healthy than those engaged in other laborious occupations. Dyspeptic affections connected with acidity of the stomach would appear to be the only injurious consequences which result from its habitual inhalation.

Muriatic Acid Gas.—There can be no doubt that this gas will, when respired sufficiently long, and in a sufficient state of concentration, produce an acute bronchitis. Its effects, however, when so applied have not been observed, or at least not recorded. In consequence of its corrosive powers, Guyton Morveau employed it several years ago as a disinfector; but in this respect there can be no doubt that it possesses an efficacy inferior to chlorine or the vapour of nitric acid.

Nitric Oxide, and Nitrous Acid Vapour.—When the nitric oxide comes into contact with oxygen, and it cannot be respired without such an occurrence, it is converted into nitrous acid; so that, in a practical point of view, and in reference to our present discussion, the consideration of the former merges in that of the latter. So irritating are the vapours of nitrous acid, that a very minute quantity of them will render the atmosphere in which they exist irrespirable, by determining the spasmodic closing of the glottis. This, for example, occurred to Sir H. Davy, who, intending to breathe nitric oxide, for some time previously respired pure nitrous oxide, for the purpose of excluding oxygen altogether from the lungs. His attempt, however, was unsuccessful; for the small quantity of oxygen in the mouth and fauces gave rise to the formation of a sufficient quantity of nitrous acid to cause a convulsive closing of the larynx, as already described, and to produce extensive inflammation of the tongue, mouth, and throat. In reading the account of this experiment, one cannot but feel astonished that it should ever have been instituted by so intelligent an individual. Had he accomplished his intention of respiring the gas, upon suspending the process, air would of course have been inhaled, and the nitrous acid thus formed in the lungs by the union of the nitric oxide with atmospherical oxygen, would to a certainty have produced destructive corrosion and inflammation.

Notwithstanding the stimulating qualities of nitrous acid, if mixed with a sufficiently large quantity of air, it will pass into the lungs; and it is worthy of remark, that when in such instances injurious consequences follow, pneumonia, not bronchitis, is the disease usually established. Such at least, as Desranges relates, was the nature of the attack experienced by a chemical manufacturer who incautiously inhaled the vapours given off from a carboy of nitric acid accidentally broken: and by some hatters, whose cases are given by Reitz in a German journal, who slept in an apartment in which the manufacture of nitrate of mercury was proceeding, a preparation employed in the felting of furs, and which is obtained by the action of nitric acid on mercury.

Sulphurous Acid.—This compound, which at common temperatures and pressures is a gas, is the sole product of the combustion of sulphur, and is thus occasionally prepared for the purpose of bleaching silk or woollen goods, of whitening grain during the process by which it is kiln-dried, and with a view of restraining the vinous fermentation. Certain varieties also of anthracitous coal which abound in iron pyrites, during their combustion frequently evolve this gas; and the same has also frequently occurred in collieries in which some of the beds have either spontaneously or by accident taken fire. Nor is iron pyrites the only sulphuret which leads to accidents of this description. In quicksilver mines the native cinnabar often burns for a length of time, filling the galleries and shafts with sulphureous vapours, which greatly incommode the workmen, and sometimes make it necessary to suspend their operations until the combustion is extinguished, and the atmosphere within the mine renewed by appropriate means of ventilation.

Sulphurous acid is a very suffocating gas, and must be largely diluted with atmospherical air before it will pass through the glottis. When applied even in this attenuated state to the mucous membrane which lines the air-passages, it excites in it an extreme degree of irritation, and would no doubt ultimately produce, provided its contact

were continued sufficiently long, a state of active inflammation.

Consequences, indeed, of this description have not been observed, for in the great majority of cases, as when it proceeds from the combustion of pyritous coal, it is accompanied by a large proportion of carbonic acid, the narcotic influence of which screens and obscures the proper action of the sulphurous gas. An atmosphere, however, of this compound nature would appear to affect the system to a certain extent in a peculiar manner, and to be more injurious than one impregnated with carbonic acid alone. Such inference at least would seem to follow from the narrative given by Surgeon Braid of an accident which occurred at Leadhills in 1817, and which is alluded to by Dr. Christison. Smoke from one of the steam-engines having got into the working, four individuals who endeavoured to force their way through the impure air were immediately asphyxiated, and several others, who in two hours after descended to the same part of the mine, were very quickly seized with dyspnœa, headach, palpitation, vomiting, debility, and pains of the lower extremities. When first seen by Mr. Braid, who visited them while below, the greater number were in a delirious state, as was indicated by the frantic violence of some and the terror manifested by others. Three, in addition to the four who had first descended, perished, but in a few days the rest perfectly recovered. Similar accidents have since occurred at Leadhills, and, according to Mr. Rald, in a colliery connected with a burning mine in the possession of the Devon Company.

The morbid appearances are not given by Surgeon Braid; but they were probably essentially the same with those which belong to poisoning by carbonic acid alone. Should such be the case, there can be no doubt that the same line of curative treatment ought in both cases to be pursued.

[In concluding the subject of poisons, it may be interesting to specify those that are most frequently taken by the suicide or employed for homicidal purposes. Two statistical articles of this kind we possess—one formed from the returns made by the coroners of England of the number of inquisitions held in the years 1837 and 1838, where death was caused by poison (*London Med. Gaz.* Nov. 1839); and the other by Dr. John B. Beck, of New York, on the deaths from poisoning in the city and county of New York, during the years 1841, 1842 and 1843; obtained from the records of the Coroner. (*Transactions of the New York State Medical Society*, vol. vi. Part 1, p. 72, Albany, 1844.)

The number of deaths by poison returned by the coroners of England, in the two years mentioned above, were 541; of which 282 were males, and 259 females. The poisons taken may be arranged in the following numerical order:

Laudanum	133
Opium	42
Other preparations	21
	196
Arsenic	185
Sulphuric acid	32
Prussic acid	27
Oxalic acid	19
Corrosive sublimate and mercury	15
Mixed or compound poisoning	14
Oil of bitter almonds	4
Poisonous mushrooms	4
Colchicum, nux vomica, (of each 3,)	6
Nitric acid, caustic alkali, tartar-emetic, acetate of morphia, strychnia, deadly nightshade, aconite, (of each 2,)	14
Bichromate of potassa, nitrate of silver, Goulard's extract, sulphate of iron, chloride of tin, hellebore, castor oil seeds, savin, hemlock, cantharides, cayenne pepper, (of each 1,)	11
	527
Unknown	14
	541

From the report of the coroner of the city and county of New York, there were 83 cases of death from poisoning in the years mentioned. Of these 46 were males; 37 females.

Of these there were poisoned by	
Arsenic	13
Opium	8
Laudanum	39
Paregoric	1
Solution of morphia	3
Corrosive sublimate	3
Colchicum	1
Sulphuric acid	2
Tinct. of sanguinaria	4
Tartar-emetic	1
Ardent spirits	1
Gin	1
Alcohol and laudanum	1
Brandy and laudanum	1
Strychnia	1
Prussic acid	1
Phosphorus	1
Carbonate of Potassa	1
	83
Of these, there were, suicides	50
Poisoned by mistake or through ignorance, &c	28
Unknown	5]

JAMES APJOHN.
ROBLEY DUNGLISON.

TRANSFORMATIONS.—This term denotes those adventitious or accidental tissues which, when developed in organs, usurp to a greater or less degree the place of the natural structure, so that it appears to be, if it have not actually been, transformed into the new substance. Hence modern pathologists, Dupuytren, Cruveilhier, Andral, and others, regard these accidental tissues as transformations properly so called. We cannot, however, admit that all the accidental tissues described by them as transformations are strictly so. We have familiar instances of real transformation in the ossification of cartilage where that does not take place as an obvious effect of age, as in the ossification of the laryngeal cartilages from dis-

case in the mucous membrane; or of the costal cartilages in phthisis; or in the alteration which an exposed mucous membrane exhibits, and the close resemblance which it assumes to the cutaneous tissue—analogous, as Beclard has remarked, to what we see in trees, when roots are changed to branches, and vice versa under altered circumstances.

In treating of the various transformations noticed by morbid anatomists, we shall follow the order of the natural and healthy development of these tissues, as the same order is frequently observed in their morbid changes. We shall therefore commence with the cellular and terminate with the osseous tissues.

1. **Cellular Transformations.** — The production of these tissues is generally due to the effusion and organization of coagulated lymph, and is more particularly observed in the union of *serous surfaces* under disease, particularly between the surfaces of the pericardium, of the pleuræ, and of the peritoneum, sometimes with the total obliteration of their cavities.

These adventitious formations are frequently accompanied by a very considerable number of small granulations, which are converted into a dense and thick cellular tissue, as seen on the pleura, peritoneum, &c. This change is not, strictly speaking, a transformation, since we find the serous membrane itself unchanged, the false membrane being deposited above or below its surface.

The *mucous membranes* are much less frequently the seat of this change, but the accidental cellular tissue sometimes seen between the globe of the eye and the lid, the occasional obliteration of the nasal and the biliary ducts, of the Eustachian and the Fallopian tubes, and sometimes even of the vagina, are due to this organization of lymph.

It may, indeed, be looked upon as the germ of, and as affording a matrix for, the other morbid structures, and observed equally with respect to natural growth or morbid formations; it has already been considered among the inflammatory products.

2. **Vascular Transformations.**—The next step after the deposition of lymph assuming a cellular structure, is the generation of blood-vessels by which the part becomes organized; this generation of vessels being one of the most curious and important points in pathology, and being the offspring of nearly all the morbid products, deserves a more minute investigation.

If we examine by the aid of the microscope a clot of effused lymph, we observe, after a certain period, a series of continuous vesicles forming a kind of canal, or a single canal itself without any vesicular appearance; this is found after a time to contain a fluid which gradually assumes the character of blood; the canal elongates at each extremity, and vessels are formed laterally, so as to give it the same disposition which we find in the trunk of the vena portæ and its hepatic and abdominal ramifications. The vessels by their further development at length inosculate with those of the parent or surrounding tissues. Kaltenbrunner describes the latter vessels as being ruptured and projecting the globules of the blood through the clot, and thus forming the canals of communication as observed in a part under inflammation.

The process we have now described, and which has been alluded to by Hunter, Home, and Bäer, Laennac, Beclard, Lobstein, Carswell, and several others, is identical with the commencing organization of the embryo.

From some of these observations, and from the experiments of Vogel, Home, and Brand, there is reason to believe that the formation of these vesicles and tubes is due to the disengagement of carbonic acid gas found in small proportion in the human blood. During its coagulation there is an extrication of this gas, which may be observed to form a number of vesicles or small canals in the clot of blood, and, remaining after its desiccation, may be shown by careful and fine injection. The development of the radicle and plumula of plants has been ascribed to the same mode of formation.

Erectile or Vascular Tissue. — This comprehends those accidental developments of the vascular system recognised under the name of nævi materni, or the aneurism by anastomosis, or spongy aneurism: these may either be accidental or congenital. The proper seat of this species of tumour is the skin or its cellular membrane: it is extremely rare in any of the internal organs; its principal situation is on the lips or scalp, and young subjects are more liable to this kind of formation. It consists of a congeries of blood-vessels with a considerable dilatation of the veins, showing sometimes a distinct pulsation followed by a kind of vascular erection, particularly on the approach of the menstrual period, &c. It has some resemblance to the natural erectile tissues of the clitoris and nipple, or the substance of the placenta. When not congenital, it commonly begins with a small spot, which soon acquires a development that might not have been expected from so small a commencement. Its roots occasionally shoot into the muscular fibres beneath. It seems to be a disease strictly local, but capable of reproduction while any portion remains, therefore requiring its total extirpation in order to effect its cure.

The character above mentioned will distinguish this kind of tumour from the fungus hematodes of Hey, although unfortunately the structure of which we now treat is known under the latter name by most of the continental writers. The late researches of Recamier authorise us in believing that many hemorrhoidal tumours are of this description, and not from varicose veins; that the transudation from these tumours depends upon their connection with the arterial vessels, and upon their increased action in that part, and not upon any mechanical obstructions in the system of the vena portæ or elsewhere preventing the return of the venous blood.

3. **Membranous Transformations.**—False membranes, the origin of which we have previously described, are found accidentally developed in various parts of the body, forming bands of communication and union between the different viscera of the chest and abdomen, becoming at length an integral part of the body, and assuming its vital properties; they are subject, therefore, to the same transformations and diseases as the parent tissue to which they belong. Irritation from

the pressure or friction of any foreign body may give rise to the formation of this tissue, as exemplified in the formation of false articulations after dislocation or fracture; in the capsules formed around any foreign body lodged in the part (as a bullet, for instance), and circumscribing the coagula seen in the brain in apoplexy, which have been therefore designated apoplectic cells.

The various *serous, synovial, and other cysts*, come under this head, although they are not owing to the same cause; the lining membrane of these cysts may undergo the same changes as we observe in other serous membranes from disease: it may become granulated and converted into a false and imperfect mucous membrane, as observed in pulmonary vomicæ, &c. The contents of these cysts are still more various than the structure of the lining membranes which produce them, and may contain either the simple constituents of the blood or various morbid products. They sometimes contain fluid or coagulated serum, serum tinged with blood, pure blood (or other substances resembling it, but of a darker colour) or its fibrous coagulum, albuminous mucus, fatty or tubercular matter, or a kind of substance resembling concrete albumen, and even several species of other cysts. Two or more of these products may be found in different cells of the same cyst, some of which would appear to be secreted by the lining membrane in different stages of its progress, from one kind of secreting surface to another. The more simple contents of these cysts strictly resemble the constituents of the blood, and were probably the offspring of the cyst itself. The surrounding cellular tissue evidently forms the cyst in many instances by its gradual change into a serous surface. From their various contents these cysts have been called serous, synovial, melicerous, atheromatous, and steatomatous, &c. The serous cysts, that are to be distinguished from true hydatids, are more frequently met with in the kidneys and ovaries than in any other parts.

It would be out of place here to enter into the much agitated question of the cystic origin of the various other tumours to be mentioned hereafter. Where the cysts are found to contain pus, and open externally or take a direction to do so, it is found that a serous is gradually changed into a surface highly vascular, granulated, and imperfectly mucous. These accidental membranes resemble the mucous membranes of the ureter, biliary ducts, &c. in not being possessed of either the follicular glands or villi of ordinary mucous surfaces.

The lining membrane of the tubercular cavities of the lungs and common fistulæ are examples of this.

4. **Cutaneous Transformations.** — As the mucous surfaces become more exposed to the air, they gradually assume more and more the character of cutaneous surfaces, of which they are naturally a continuation, as observed in prolapsus uteri, &c., but generally without the vascular tissue in which the colouring matter resides. The cicatrices in the skin of the negro, as accidental cutaneous tissues, are usually white.

Fibrous Transformations. — The accidental mucous membranes alluded to above, sometimes undergo a metamorphosis into fibrous tissue. These fibrous transformations are frequently produced at the expense of the cellular membrane, in the form of bands, irregular patches, or of granulations; and tumours of various kinds, simple or lobulated, such as the pancreatic and mammary of Abernethy, often confounded with scirrhus, sometimes connected with organs in apparently a healthy state, and sometimes accompanied with inflammation or atrophy of these organs.

The coats of arteries are more frequently the seat of this kind of change than the veins, and observed in the course of nature where these vessels are no longer necessary, (as in the umbilical and other vessels of the fœtus), and as the result of disease when vessels are the seat of aneurism or of wounds, and are thus rendered useless.

The synovial membrane, the cartilages, and even the muscles may undergo this change, as connected with fractures or dislocations. A muscular or a tendinous wound is united by this tissue, and not by its own substance.

5. **Cartilaginous Transformations.**—These are produced at the expense of any of the other tissues that precede it in the natural order of growth, that is, the cellular or parenchymatous, the serous, fibrous, and fibro-cartilaginous. 1. Hence they are found in the different organs themselves, or under their serous membranes, or in the cellular tissue of organs connecting different textures, or under the inner coats of arteries. 2. They are found in situations where they might be least expected, for instance, in the form of round cartilaginous bodies, floating in the interior of veins, particularly of the pelvis, being readily felt or moved about in the vessels by the hand. Hence they have been called phlebolites. They are also found loose and detached in the cavities of joints, where they vary extremely both in number and in size, either with rough or smooth surfaces. 3. In these various situations they may be in the form of small points, broader patches, larger knots, as seen in the serous membranes of the chest and abdomen, and in the serous cysts above alluded to. 4. In the joints as well as in the veins it would seem they are formed in the cellular tissue under the lining membrane; and carrying that membrane before them in their growth, they become attached at length by a mere peduncle, which at last gives way and leaves them floating in the interior. 5. In all these instances their structure is homogeneous, and, as we find in natural cartilages, they are without a trace of vessels, except in the event of their becoming ossified.

6. **Transformations into Osseous Tissue or Ossifications.**—In these formations, like the preceding, the same law of successive development is observed, being as strictly followed as in the healthy formation of bone; so that the cellular membranes, fibrous and cartilaginous, may any of them become transmuted into an osseous matter, but differing somewhat in its chemical composition from healthy bone, in form, structure, and composition.

1. They occur either granular, tubercular, or stalactitic, membraniform, or lamellated. 2. They may be seated in the sub-serous cellular tissues of the natural cavities or of cysts, varying much in extent. 3. Sometimes they are isolated, more frequently in company with other morbid products,

as seen in the parenchyma of different organs, but these have more the character of earthy deposits than of bone.

In structure they are found in radiated fibres, more nearly approaching the texture of natural flat bones. In composition they are very various, both with respect to their earthy or saline ingredients, as well as the proportion of animal matter they contain.

It is commonly said all the tissues may become osseous, but, correctly speaking, the cellular membrane, fibrous and cartilaginous tissues are, perhaps, the only parts that are convertible into bone, and with respect to the sub-mucous cellular tissue this change is seldom if ever observed.

It is well known that as age advances the phosphate of lime predominates more and more in the system, and when this substance has consolidated the bones, it transports itself to other parts, according to their greater or less affinity or approach to the osseous structure.

The first in the degree of affinity is the cartilaginous tissue; this is a necessary step to arrive at the osseous state, since cartilages become bone by the simple addition of the phosphate or carbonate of lime.

In old age the cartilages of the ribs and the larynx, and trachea, and sometimes the primary bronchi, are the first to undergo this change; afterwards the symphysis of the pubes, the sutures of the cranium, and the articulation of other bones become ossified, and even the cartilages of many of the joints. A remarkable exception to this was discovered by Harvey, in dissecting the body of Thomas Parr, who died at the age of 142 years.

1. The *ossification of the cartilages* generally commences by coloured spots in their centres, and open spaces observed in them that are filled with a kind of medullary matter, and the ossification gradually extends to the whole of the cartilage.

The fractures or other wounds of cartilages are reunited by means of a ligament or band formed by the thickened perichondrium becoming ossified. This consolidation is a much slower process than that of the formation of bone.

2. Of *fibro-cartilage*.—The most frequent instance of ossification of the fibro-cartilages is that of the cartilages of the ribs, which almost uniformly undergo that change in advanced life; sometimes in phthisical subjects are ossified even at an early period; and, on the other hand, one or two rare instances are recorded, in which the cartilages were perfectly natural, even though the subjects had reached an unusually protracted period of life.

3. Of *fibrous tissue*.—The articular tendons and ligaments sometimes present points of ossification, whilst, on the contrary, the aponeuroses are perhaps never ossified, except the tendinous part of the diaphragm. The dura mater, pericardium, proper tunic of the spleen, the sclerotic of the eye, and the periosteum, are very subject to ossification.

The ossification of the fibrous tissues of the heart, and more particularly of the arteries, seems the natural consequence of advancing age as well as of disease. The greater liability of arteries to this change appears connected with their possessing more of a fibrous texture than veins. It commences in the cellular or fibrous tissue of these parts: (see Diseases of the Heart and Arteries.) The valves of the heart very frequently participate in this change, and even those of the veins, but more rarely, passing from the fibrous to the cartilaginous and osseous states.

4. Of *the muscular tissue* of the heart, the left ventricle seems the most subject to ossification, and afterwards the right, and, lastly, the auricles. True ossification of the muscular tissue itself is very rare, nor are the cases on record, with one or two exceptions, fully worthy of credit. Reynauldin has described a very remarkable case, in which the ossification was of considerable extent, the parietes of the left ventricle being converted into a petrified mass. (Vid. *Andral*, vol. i. p. 343, and Journal de Corvisart, Janv. 1816.)

5. Of the *nervous system*. — Osseous concretions have been occasionally met with in the cerebrum and cerebellum, and even in the nerves; the retina itself is said not to have escaped, or at least it is certain that other membranes of the eye have been ossified, particularly the hyaloid membrane.

6. Ossifications of the *serous membranes* have been seen in the pleura and peritoneum and the tunica vaginalis in old hydroceles.

The ossification of the synovial membrane is frequently the result of specific inflammation, and generally produces a perfect ankylosis of the joint. With respect to the *parenchyma of organs*, there is reason to believe that the uterus, testicle, and the thyroid gland are the only seats of true ossification; in other instances it is the fibrous and not the parenchymatous tissues that become ossified.

It will probably not be considered out of place here to add a few words on *the accidental development of the teeth*. The teeth of this kind that we meet with are generally such as are the least removed from their natural state (those we call supernumerary), and are found either in the alveolar processes, or in their immediate neighbourhood. Among other cases reported by Lobstein is that of a man fifty years of age, in whom three teeth were found under the tongue, each in its proper cyst; another in whom a tooth in its cyst was found in the orbit of the eye; in a third instance a cyst was seen upon the diaphragm, which contained four perfect teeth, besides a quantity of fatty matter and hair. Ruysch describes a fatty tumour of the stomach which contained four molar teeth, and a tumour the size of a child's head, situated upon the lumbar vertebræ, which contained two incisors, two canine, and eight molar teeth: two other incisors were imbedded in a rudiment of the jaw-bone.

Connected with parturition several cysts have been observed containing a fatty and lardaceous matter with portions of bone as well as teeth; these have either preceded or followed the birth.

But the ovaries are most frequently the seat of these singular productions; numerous cases in proof of this are on record.

In all these instances the laws relative to the ordinary production of teeth have been followed, the capsules having been filled as usual with gelatinous fluid, the crown having preceded the

formation of the fangs, as found during the different periods of their progress from the capsules to the milk teeth. The other teeth followed the usual order of succession, and the first set have been occasionally followed by those of the second dentition, the molar teeth being as usual the most numerous. Lastly, all that had a form sufficiently definite to be recognised were found to correspond exactly with the natural ones of the human species.

It might be of some interest to ascertain how far the circumstances connected with some of these osseous deposits correspond with what has been observed relative to the bone-earth or phosphate deposits in the bladder. These are known (so well pointed out by Dr. Prout) to arise at a more advanced age from debilitating causes acting through the nervous system, and inducing an irritable and cachectic habit of body, with sallow skin, disordered stomach and bowels, pain and distress of mind, and are found to be as much increased by mercury and alkalies, as they are relieved by acids and tonics.

Laennec has observed that in the worst cases of chronic pleuritis, attended with sero-sanguineous effusions into the chest, ossification of the pleura may be anticipated. We want further data on this subject.

In reference to other more remote or immediate causes of these different transformations, it may be stated in a general way that they are not necessarily connected with pre-existing irritation or inflammation, although these states not unfrequently precede, accompany, or follow such changes of structure.

In many instances they are clearly dependent upon pressure or the repeated friction that a part may be subjected to, or upon some further demand made upon the part, or some new function imposed, for the accomplishment of which a new structure is required.

F. Duesbury.

TRANSFUSION.—The operation of transfusing the blood of one animal into the veins of another gave rise, about the middle of the seventeenth century, to one of the most celebrated controversies which has ever agitated the professors of medicine. Transfusion was then supposed to be a recent discovery, and the most extravagant notions concerning its value prevailed. The honour of its invention was contested by the French and English, though passages in the ancient poets* not obscurely indicate that it was known at a very early period; and Libavius (in defensione Syntagmatis Arcanorum Chymicorum contra Heningum Schneumannum, Actione 2, p. 8, an. 1615) thus plainly describes the method by which it was performed fifty years previously to the origin of the French and English controversy. "Adsit juvenis robustus, sanus, sanguine spirituoso plenus: adstet exhaustus viribus, tenuis, macilentus, vix animam trahens. Magister artis habeat tubulos argenteos inter se congruentes, aperiat arteriam robusti, et tubulum inserat muniatque: mox et ægroti arteriam findat, et tubulum fœmineum infigat. Jam duos tubulos sibi mutuo applicet, et ex sano sanguis arterialis, calens et spirituosus saliet in ægrotum, unaque vitæ fontem afferet, omnemque languorem pellet." Boyle, in his work on the Usefulness of Experimental Philosophy, relates the experiments performed by Dr. Christopher Wren, Savillian professor in the University of Oxford, who transfused medicated infusions into the veins of animals. Dr. Wren's method consisted in putting a ligature on a vein, and having made an opening between the ligature and the heart, in introducing a slender syringe or quill fastened to a bladder, containing the matter to be injected, and then propelling it into the current of the circulation. Dr. Lower afterwards connected the carotid artery of one animal with the jugular vein of another, by means of a tube; and whilst blood was thus transfused, he also permitted it to flow from time to time from a tube inserted in the upper portion of the jugular vein of the animal on which transfusion was practised, that, as plethora was induced, it might be relieved. The operation was continued until the animal from which the arterial blood was taken died at the side of that into which it passed. This experiment Dr. Lower frequently exhibited in the universities, and the dog which had received the fresh charge of blood generally leaped from the table immediately after the operation, shook himself, and ran away without ailment. Dr. Lower proposed, in a letter addressed to Mr. Boyle, that experiments should be made to ascertain the effects of changing the blood of the old and young, of the sick and healthy, of hot and cold-blooded, and of tame and wild animals. He expected that this exchange of blood would alter the nature of the animals in which it was made. "The most probable use of this experiment," he says, "may be conjectured to be that one animal may live with the blood of another; and, consequently, that those animals that want blood, or have corrupt blood, may be supplied from others with a sufficient quantity of such as is good, provided the transfusion be often repeated, by reason of the great expense that is made of the blood."

The operation was introduced into Germany by Major, professor of medicine at Kiel; and in 1666 it was first performed on man in France by Denys and Emmerez. In the succeeding year their example was followed by Lower and King; and in 1668 two Italian physicians, Riva and Manfredi, repeated the experiment.

In Paris, transfusion of the blood of animals into the human subject occasioned the most violent excitement. A fierce controversy was directed by Lamartinière and Perault against Denys and Emmerez, which was scarcely extinguished by the decision of the authorities forbidding transfusion. Each party engaged in this dispute committed the most extravagant excesses. The protectors of transfusion laid claim to the discovery of an universal remedy, which would restore health, youth, and vigour, assuage diseases of the mind, calm the most violent dispositions, and might even prolong life beyond its natural term. Their opponents contended, that not only were these pretensions false, but that the operation was always dangerous and sometimes fatal. The whole controversy degenerated into a contest of the most virulent abuse, in which each party degraded

* ——— Quid nunc dubitatis inertes?
Stringite ait gladios: veteremque haurite cruorum:
Ut repleam vacuas juvenili sanguine venas.—*Ovid.*

itself in the attempt to overwhelm its rival with reproach, by denouncing it with every ignominious epithet.

The whole city was agitated by this contest; it became the topic of the day; and as it occasioned eager debate in every circle of society, from the courtier to the student of science, some account of experiments which attracted so much notice may not be useless or uninteresting.

Denys and Emmerez performed transfusion by connecting the artery of the emittent animal with the vein of the recipient, blood having been generally extracted from the latter. Their first experiments were made on brutes. The blood of three calves was transfused into three dogs, without any evil consequences; and that of four wethers into a horse twenty-six years old. From these and other experiments on brutes, they proceeded to a moderate transfusion of blood into the human subject. Calves or sheep were, from some hypothetical notions concerning the qualities of their blood, preferred for these experiments, and the first trials were said to have been unattended with evil consequences. From the method employed, however, the quantity of blood transfused in each trial could not be correctly ascertained; and it is probable that the eager character of the inquirers led them to imagine that greater than the actual quantities of blood passed in each experiment. Some fatal cases soon occurred. M. Gaspar de Gurie de Montpoly relates one which is well calculated to expose the extraordinary expectations indulged by the promoters of transfusion. Baron Bond, son to the first minister of state of the king of Sweden, being affected with a malady which terminated in mortification of the intestines, underwent the operation twice, was reported to have been strengthened by it the first time, but died soon after the second operation.

Denys performed his first experiments on the human subject on the 15th of June, 1667, on a young man of fifteen or sixteen years of age, who had been much weakened by repeated bleedings. He had become very languid, torpid, and slightly dropsical. Denys reports that the first operation restored him to perfect health.

On the 23d of November, 1667, Dr. Lower and Dr. King made the first trial of the transfusion of the blood of animals into the human subject, on a man named Arthur Coyn, at Arundel House, in the presence of many persons of consideration and intelligence. Having prepared the carotid artery in a young sheep, a silver pipe was inserted into it, and the blood was permitted to flow freely out into a vessel. In the space of a minute about twelve ounces of sheep's blood escaped, and this fact guided them in judging of the quantity afterwards transfused. A rough approximation, at best, could by this means be attained, and even this was vitiated by the subsequent employment of a smaller tube. The arterial pulse was observed to have been communicated to the vein in the arm of the man during two minutes, and then the experiment terminated. Due allowance being made for the diminished size of the pipe, nine or ten ounces of blood were supposed to have been transfused. The man professed to have received great benefit from the operation, and, it is said, no ill consequences ensued.

The crisis of the controversy was brought about by an experiment performed by Denys on an insane man. The insanity of this unfortunate person was periodical, and was attributed to severe disappointment. He had, during the seven or eight preceding years, alternately recovered and relapsed, but the fit generally lasted eight or ten months. He had been bled in his feet, arms, and head eighteen times, and had bathed forty times. Numerous applications to his forehead had been tried, and potions administered, but the remedies seemed rather to exasperate than to relieve his malady. His last relapse had occurred four months before the operation was tried, at a place twelve leagues from Paris. He had been confined, but contrived to escape, and ran away to Paris, in a dark night, quite naked. He was said to have spent these four months without sleep, rending his clothes, running naked about the Marais du Temple, and endeavouring to burn every thing that he could lay his hands upon. M. de Montnor proposed to Denys and Emmerez to subject this man to a trial of transfusion. They encouraged the experiment, saying, that they "could indeed give good assurance for his life, and that the operation was incapable of causing the death of any one, if discreetly managed;" but professing to doubt whether it would relieve his malady. They, however, encouraged the hope that some improvement might be expected from transfusing the blood of a calf, which might, they supposed, from its mildness and freshness, allay the heat and ebullition of the patient's blood.

The operation was performed on the 19th of December, before many spectators distinguished by rank and professional eminence. M. Emmerez opened the crural artery of a calf, and made every other necessary preparation in their presence; and after having drawn from the patient about ten ounces of blood, only five or six ounces of the blood of the calf could be introduced, on account of the constrained position of the patient and the pressure of the spectators. The operation was, moreover, discontinued, because the man complained that he was about to swoon. Nevertheless, he supped two hours afterwards, and passed the night in singing, whistling, and other of his usual extravagances. During the following days little change occurred in his symptoms, and the absence of improvement was attributed to the smallness of the quantity of blood transfused. Eager to perceive some advantage, they imagined that his violence had in some degree subsided, and determined to repeat the experiment once or twice. The second trial was made on the Wednesday following the first experiment, in the presence of Hourdelot, Lallier, Dodar, de Bourges, and Vaillant, all very able physicians. As he was very thin and meagre, having been wandering through the streets in nakedness and hunger for some months, it was thought proper to abstract only two or three ounces of blood from him, and to transfuse a pound. The quantity was much more considerable than in the first experiment, and the effects, which were immediate and very sensible, are thus described: As the blood entered his veins, he felt an increase of heat along his arm and in both axillæ. His pulse speedily rose, and a copious perspiration covered his face.

Immediately afterwards the pulse became very irregular; he complained of pain in his loins, that he was sick, and that he should be suffocated unless released. The pipe was therefore removed from the vein, and during the closing of the wound he vomited freely food which he had taken about half an hour previously. He continued to vomit much, and was frequently purged during the early part of the night, but fell asleep about ten o'clock, and did not awake until the following morning at eight o'clock. Denys reports that he then "showed a surprising calmness and presence of mind." He made a glassful of black urine, confessed himself to M. de Veau with much propriety, and continued drowsy and unwilling to be disturbed during the rest of the day. Next night he slept well. On the following morning he filled another urinal with water as black as that of the preceding day, and bled so freely from the nose that it was considered proper to take two or three small vessels of blood from him. Next day he again confessed himself, and was admitted, at his own request, to the sacrament of M. Bonnet, it being then a time of jubilee. After this day his urine was restored to its natural colour. His wife came to Paris, after having vainly sought him elsewhere. He received her with much joy, and told her all that had occurred to him. He treated her with kindness, and she rejoiced in his manifest improvement. Denys was not immediately satisfied with the symptoms of his patient, and from what he observed, thought that a third transfusion would be necessary for his cure; but as he gradually improved, the operation was deferred, and sanguine hopes were entertained that he would be gradually restored.

He continued in this promising condition two months; at the expiration of which period, having indulged in various excesses, he was attacked by a violent fever. Denys and Emmerez were importuned by his wife to try the operation again; and though they professed to have been perfectly satisfied with the result of the previous trial, were with great difficulty induced to repeat it, and only in consequence of the continued importunity of the wife, who had previously resorted to various remedies without effect. "When the operation was attempted the third time," says the sentence given at the Chastelet, "it was at the instant request of his wife: those that were to perform the operation refusing to do it without the permission of the solicitor-general; some days after that, the operation was begun, but as scarcely any blood issued, either out of the foot or the arm of the patient, a pipe was inserted, which made him cry out, though it appeared not that any blood of the calf passed into his veins; the operation was given over, and the patient died the next night." From other accounts it appears, that as soon as the transfusion was commenced, the patient was seized with shivering, and complained of great oppression, crying out, "Arrétez:—je me meurs—je suffoque." Lamartinière accuses the transfusers of disregarding their patient's cries, and continuing the operation until he died in their hands. Denys, on the other hand, affirms that little or no blood entered the man's veins; accuses the wife of having administered poison to him; says that he demanded that the body should be examined; and the inspection being refused, that he applied to the magistrates to be heard in his own justification. Meanwhile, the enemies of the operation united, and are said to have offered money to the woman to give evidence against the transfusers. These contests terminated with the sentence of the Chastelet, which decided "that the operation had succeeded well the first two times, and had been undertaken the third, but at the earnest request of the woman, who moreover had ill observed the orders of those that made the operation, and who was suspected to have caused the death of her husband," &c.—"And then, that for the future no transfusion should be made upon any human body, but by the approbation of the physicians of the Parisian faculty."

This sentence was fatal to the practice of transfusing the blood of animals into man. Probably the patient whose death occasioned this declaration against the operation, died from the admission of air into his veins, but the experiment had in no case been followed by an auspicious result, though in some it had produced no evil consequences. It had been applied to no rational purpose, had not been supported by any well-devised experiments, had sometimes been pernicious, and once, at least, fatal. Transfusion was, therefore, proscribed, in France, by a decree of the court of the Chastelet, and elsewhere by public opinion. As the blood of animals had alone been used, every subsequent discovery has tended to support the justice of this decision. The extravagant notions entertained by the promoters of this operation, that it could remove disease and prolong life, as they had elevated public expectation to the highest pitch by their promulgation, so, when they were dissipated, they rendered the prostration of its credit greater and more permanent; and no inquiry was made whether there remained not purposes of a more reasonable character to which, under such modifications as science should suggest, so powerful an agent might be applied.

Dr. Harwood, professor of anatomy in the University of Cambridge, attempted to revive the inquiry concerning the utility of transfusion, by making it the subject of his thesis in 1785. He performed many experiments on animals, which he exhibited in his lectures on comparative anatomy in the schools of the University. One of his experiments is thus related in a note to Dr. Hutton's abridgement of the Philosophical Transactions. "A dog, of middling size, from whose jugular vein eight ounces of blood had been previously evacuated, was supplied with an equal quantity from the carotid artery of a sheep. During the operation, the dog showed evident marks of uneasiness, but was little affected in any other way, till about twenty-four hours after the operation, when he had a shivering fit, succeeded by a considerable degree of heat, thirst, and the usual symptoms of fever, all of which disappeared in the course of the next day, and the dog remained afterwards in perfect health. This experiment being several times repeated, and the quantity of transfused blood being occasionally increased or diminished, the feverish symptoms were observed to be more or less violent in proportion to the *quantity of arterial blood* introduced into the vein of the recipient animal. It now occurred to Dr.

Harwood, that the uneasiness of the animal during the operation, and the febrile disease with which he was attacked some hours afterwards, might probably arise from the preternatural degree of stimulus occasioned by the introduction of the highly oxygenated arterial blood into the right side of the heart. The experiment was therefore repeated with this difference, that the blood was conducted through the tube from the jugular vein of a sheep, instead of an artery. The animal was perfectly composed during the operation, and did not suffer the slightest inconvenience at any time afterwards." The conclusion to be drawn from these experiments is very different from that proposed by their author. It is very probable that little if any blood was transfused in the second experiment, as the force of the current in the jugular vein is not great. The experiments therefore prove, that though small quantities of blood may be introduced from animals of a different species into the dog, yet, that the operation occasions a constitutional disturbance which has a direct relation to the quantity of blood transfused. Accordingly, two pounds of blood having been taken from a large pointer, and three pounds of blood from the jugular vein of another dog introduced, the recipient animal was severely affected with vomiting and purging; afterwards was very drowsy and stupid; then suffered much from fever, which terminated in a copious evacution of blood, by stool, by urine, and by vomiting. He took no nourishment for three days after the operation except water, and was more reduced than Dr. Harwood ever saw an animal in that time. Afterwards he gradually regained his health, and lived some years. But another dog, having been bled till he fell into convulsions, and was apparently expiring, on being replenished with blood drawn from the jugular vein of a sheep, began to respire half a minute after the supply was commenced; and when he had received a quantity of sheep's blood equal to that which he had lost, he leaped from the table and walked home, without experiencing any apparent inconvenience, either then or at a subsequent period. This experiment was performed before a very crowded meeting at the public schools in the botanic garden at the University. It was frequently repeated afterwards, and a variety of animals were subjected to the same experiments with equal success. Dr. Harwood concludes from these experiments, "that the blood of a herbivorous animal may be substituted for that of a carnivorous animal, and *vice versâ*, without danger or even inconvenience to the animal which receives it." Later experiments show that this conclusion must be regarded with extreme suspicion; but the experiments of Dr. Harwood are so well authenticated, and were, in general, so carefully conducted, that the question (notwithstanding the more recent investigations of Prevost and Dumas) is still open to investigation.

The great defect in most of the experiments yet related, is the want of precision in ascertaining the quantity of blood transfused. Concerning the majority, it cannot be confidently affirmed that any considerable quantity was received by the animals subjected to the operation. When the blood of a different species was injected, much temporary disturbance often occurred in the health of the recipient animal, but it generally recovered from a moderate transfusion. This constitutional disturbance must be attributed to a difference in the qualities of the blood of the animals bled, which blood circulating through the various tissues occasioned an unnatural excitement, that gradually subsided as the elements of this foreign fluid were assimilated to the blood of the recipient animal.

Little is known concerning the distinguishing qualities of the blood of different animals; and for what is known we are chiefly indebted to the investigations of Prévost and Dumas. (Annales de Chimie et de Physique, vol. xvii. p. 281.) The sources of variety yet discovered chiefly consist in a difference in the proportion of the serum and globules, and in the form of the globules, which are either elliptical or spherical. They are spherical in all mammiferous animals. Hewson (Phil. Trans., vol. xliii. p. 230, &c.) even says that they have not an equal diameter in the same animal, and that in some animals these molecules change their size according to the age of the animal. They are elliptical in birds, (Prevost and Dumas), and differ little in size in this class; a difference which is also only observable in their greater diameter. They are also elliptical in all cold-blooded animals: arterial blood contains a greater quantity of globules than venous, and they are found in a greater relative proportion in the blood of birds than in that of any other class. Then follow the mammiferous animals, and of these the carnivorous appear to have more than the herbivorous. In general, the number of the globules has a certain relation to the comparative development of the animal heat. In the cold-blooded, fewer globules are found than in the other genera.

The investigations of chemists have, however, failed to discover many causes of difference in the blood of animals, which are of a nature so subtle as to elude their researches. The sense of smell detects in the halitus of the blood; the eye discerns in its colour and consistency; and observation concerning the time in which changes occur in it when at rest, and concerning the nature of the changes themselves, expose a sensible difference in its qualities, the source of which no analysis has yet determined.

An animal bled until complete syncope is produced, every muscular motion extinct, and the action of the heart and respiration suspended even for some minutes, (as is proved by experiments which will be related,) may be revived by the transfusion of blood from an animal of the same species. But if the blood be transfused from an animal of another species, but whose globules are of the same form, though differing in size, the animal is only imperfectly restored, and can seldom be kept alive more than six days. (Prévost et Dumas, Annales de Chimie et de Physique, loc. cit.) In the animals on which this experiment was tried by Prévost and Dumas, the pulse became quicker, the respiration remaining undisturbed; but the heat of the body fell with remarkable rapidity when it was not artificially sustained. After the operation the dejections became mucous and bloody, and continued so till death.

If blood containing spherical globules be in-

jected into a bird, the animal dies as though it were poisoned, with violent symptoms of distress of the nervous system; an effect which occurs, whether the animal have been previously copiously bled or not. The transfusion of sheep's blood, in the experiments of Prévost and Dumas, restored cats and rabbits from excessive hemorrhage which would have occasioned immediate death, but only revived them for a few days. But in ducks a similar injection excited violent and rapid convulsions, followed by death.

[MM. Prévost and Dumas, Dieffenbach and Bischoff, all agree as to the deadly influence of the blood of the mammalia when injected into the veins of birds. See the writer's *Human Physiology*, 5th edit. ii. 167, Philad. 1844.]

Physiology and practical medicine are deeply indebted to Dr. Blundell for his ingenious researches concerning transfusion. Having, in the course of his extensive obstetrical practice, witnessed many distressing deaths after hemorrhage when the flow of blood itself had been arrested, he conceived that by the transfusion of human blood the exhausted energies might be recruited.

Before performing this operation on the human subject, he performed a series of experiments on animals, (Blundell's Physiological and Pathological Researches,) which form a most valuable contribution to medical science. From these experiments it appears, that after respiration has ceased, and the abdominal muscles are relaxed, little time elapses ere an animal becomes irrecoverable by the process of transfusion. Dr. Blundell, however, succeeded in reviving by transfusion a dog which had ceased to respire during five minutes. He also nourished a dog three weeks by the mere transfusion of blood into the external jugular vein, having in this period injected nearly eighty-four ounces of blood from other animals of the same species.

Dr. Blundell's experiments on the transfusion of blood from animals of different species are quite consistent with those of Prévost and Dumas. He concludes that the blood of one genus cannot be substituted, indifferently and in large quantities, for that of another. Dr. Haighton had transfused some ounces of the blood of a sheep into a dog, without producing dangerous symptoms; but several dogs, which might have been revived after copious hemorrhage by the injection of blood from animals of their own species, died when considerable quantities of human blood were substituted for that lost by bleeding. Dr. Leacock had also previously published similar facts in his thesis in 1817. The experiments of the older transfusers, and those of Dr. Harwood, however, show that small quantities of the blood of animals of some species may be introduced into the circulation of animals of certain other species without occasioning death, though the operation is generally followed by unpleasant consequences.

From Dr. Blundell's experiments, it also appeared that blood might be received into a cup and passed through a syringe without being thereby rendered unfit for the purposes of life, though it appeared to undergo some slight deterioration. Practical medicine is thus indebted to Dr. Blundell for reviving the only reasonable application of the operation of transfusion which has yet been proposed,—viz. to replenish the system in cases of severe and sudden hemorrhage, when the larger vessels have been drained of blood, and death is imminent. These cases most frequently occur in obstetrical practice, when from the partial separation of the placenta, or imperfect contraction of the uterus, and other similar accidents, sudden and violent hemorrhage hurries the patient to the brink of the grave. When great quantities of blood have thus been lost, though the hemorrhage has ceased, the pulse is generally quick and thready, the face becomes Hippocratic, the animal heat is greatly reduced, jactitation supervenes, and stimulants and food are frequently rejected; the patient rallies for a moment, only to sink into deeper collapse, and often little chance of recovery remains. Though in some extreme cases of this kind the patients have been known to struggle through, they remain long afterwards in a state of miserable weakness, suffering from diarrhœa, dyspepsia, and distressing nervous maladies, and the constitution not unfrequently receives a shock which is ultimately fatal. Generally they have no such respite; and, at this last crisis, when life seems about to ebb away, Dr. Blundell proposes to replenish the system by transfusing blood from a healthy man.

For this purpose Dr. Blundell has invented an apparatus which he has denominated an impellor, consisting of a syringe and tubes, and another called a gravitator. Dr. Blundell has contrived to impel, by this instrument, blood rushing from an artery into the venous system of an animal for twenty or thirty minutes, during which period nearly all the blood in its body must have passed through the apparatus. Yet the animal did not appear to suffer materially in consequence of the operation. Care ought to be taken to prevent the entrance of air or clots into the instrument or tubes, and the blood ought to remain as short a time as possible in the basin. Performed by a cautious and skilful surgeon, the operation is simple and not attended with great danger, and is certainly justifiable in cases of extreme collapse from loss of blood.

Since Dr. Blundell has revived this operation, it has not unfrequently been performed for the relief of persons sinking from excessive hemorrhage. Among the earliest and most earnest of its supporters, Messrs. Waller and Doubleday are distinguished, and to their fearless support the degree of credit which the practice has attained is in a great degree to be attributed. Other surgeons in this country and on the continent have since successfully performed it, and evidence has at least been given that the dangers attending it have been exaggerated. Doubtless it has been applied to some cases which might have recovered without such interference, but every operation in surgery is liable to the same imputation. The examples on record prove, at least, that in cases of extreme exhaustion from hemorrhage, which without such interference might have terminated fatally, the operation has produced a more rapid restoration than could have been attained by ordinary means, and that without the production of any materially unpleasant symptoms. Cases, which were apparently in the last stage of a fatal exhaustion, have been revived, when, in the opinion of practitioners of skill and experience, they

could have been restored by no other agent. The distressing secondary consequences of extreme exhaustion from hemorrhage are said to have been avoided, and a more rapid restoration of health to have occurred, when the operation has been resorted to, than could otherwise have been expected, even had the patient eventually recovered.

In the present state of our knowledge, however, transfusion ought never to be performed excepting when all other remedies have failed, and the danger has become extremely great. So many hidden dangers are discovered by experience, that prudence is one of the chief signs of wisdom, and rashness of ignorance and folly. An astute practitioner will be careful also not to expose a practice of such moment to unmerited reproach, by employing so powerful an agent in cases in which a favourable termination is, without its aid, still within the legitimate limits of hope.

The shock communicated to the nervous system by a great loss of blood is so great, that even if transfusion be performed before sensibility is extinguished and respiration has ceased, it is sometimes incapable of restoring the patient. In such extreme collapse the mechanical supply of blood to the large vessels cannot restore the powers of the exhausted brain, and the patient inevitably sinks. If the last agony of life has commenced, there are no facts to prove that in man transfusion can restore its phenomena, though it appears probable, from the testimony of those practitioners whose names are associated with the operation, that when such a state was certainly approaching, patients have been rescued even from its verge.

The operation is reported to have been successful in cases of extreme exhaustion from hemorrhage which threatened speedy death. It is, however, greatly to be regretted that the reports of some of these cases are not sufficiently minute, and do not always include a description of the whole plan of previous treatment, and of the progress of the symptoms. Without such information, the number of those who regard the operation with distrust will not rapidly diminish.

Large bleedings, followed by the injection of water into the veins, were proposed by M. Magendie as a remedy for hydrophobia, and this method has been tried both by himself and by M. Dieffenbach of Berlin, but without success. Saline injections in the collapse of cholera seem, even more notoriously than other experiments for the relief of that disease, to have fallen into disrepute, and no other reasonable plan of injection has been proposed.

When the operation is decided upon, Dr. Blundell is of opinion that a moderate transfusion only is necessary to restore the equilibrium of the trembling balance, which vibrates with the patient's fate. What is the average quantity of blood required for this purpose has not yet been determined by experience; but, in the absence of such a test, Dr. Blundell's opinion is of the utmost value. He thinks that half a pint or a pint of blood "may be considered a very ample supply," and feels persuaded that many females have sunk from uterine hemorrhage, who would not have died could they have retained the last ten or sixteen ounces of blood which they lost.

The syringe and basin invented by Dr. Blundell, and improved by various instrument-makers, (Weiss, Reid and Scott, Laundy) should be used in this operation, care being taken that it is perfectly clean, air-tight, free from rancid oil, or any other impurity. One or two persons should be ready to supply blood from the arm, and, if possible, individuals not likely to be much disturbed by the operation should be selected for this office. The arm of the patient should then be prepared. The vein into which it is proposed to transfuse the blood, should be laid bare by an incision with a scalpel. When this vessel is fully displayed, a probe should be passed beneath it at the lower portion of the incision. A small opening should then be made with a lancet in the vein immediately beyond the probe, of sufficient size to admit the beak of the syringe or the extremity of the tubule which is to be inserted in the operation. The whole apparatus should be warmed to the temperature of the human body, and the various joints should be adjusted with the utmost care, so that the operator, having confidence that no air can be admitted into the apparatus, may proceed with caution, but with decision, when transfusion is commenced. These preliminary arrangements concluded, the arm of the person who is to supply the blood should be bound up, and a free incision having been made into the vein, the blood should be permitted to flow into the brass basin attached to the extremity of the syringe. As the blood accumulates in the basin, it should be absorbed by raising the handle of the syringe, and should then be propelled onwards through the tubule attached to it. When the air has all been expelled from the tubule, and blood unmingled with any bubbles of air issues from it, the beak should be inserted into the vein, and blood should be constantly drawn up from the basin and propelled into the vein, not more than one ounce and a half of blood ever being permitted to accumulate in the basin. This process should be steadily performed, with a calm and unembarrassed mind, the operator watching the expression of the countenance and the state of pulse.

In the extreme feebleness to which the vital action of all the tissues is reduced in cases of severe hemorrhage, it is desirable that the supply of blood should be very gradual, lest the action of any vital organ should be impaired by a sudden congestion of its tissue. The heart is especially liable to this danger; and Dr. Blundell advises that, if unpleasant symptoms occur after two or three ounces of blood have been transfused, the operation should be suspended for a moment, and a certain interval permitted to elapse, during which the patient may recover. When these symptoms have passed away, the operation may be resumed. A few ounces of blood may be sufficient to save a patient from immediate death, and Dr. Blundell thinks that even four or five ounces may sometimes accomplish this; but if the secondary consequences of severe hemorrhage are to be avoided, and a more rapid restoration is desired, these happy results cannot be anticipated with propriety, unless a more copious supply be administered. The syringe to which a tubule and basin are adapted is much to be preferred to the syringe invented by Dr. Blundell, and also to the gravitator. The

use of these latter instruments will, we think, be entirely superseded by the excellent apparatus which may be procured at several of the instrument-makers' establishments.

J. P. Kay.

TUBERCLE.—The term tubercle is employed to designate a peculiar morbid product, which pathologists describe as occurring in various organs in the form of a small round body, said by some to consist at first of a firm grey, somewhat transparent substance, which afterwards becomes opaque and of a dull yellow colour, and may then be broken down between the fingers like a morsel of cheese. These characters are said to represent what is called the first period or crude state of tubercle. At a subsequent but indefinite period, the crude tubercle loses its primitive consistence, in virtue, it is believed, of certain inherent properties, by means of which it is converted into a liquid mass of the consistence of cream. It is further stated that this process, which constitutes the period of softening, is perceived always to take place in the centre of the crude tubercle, and proceeds from thence to its circumference. Such is the description of tubercle given by Laennec, (Traité de l'Auscultation Médiate, Paris, 1826), but which is considered by several eminent pathologists to be inaccurate. Andral (Précis d'Anatomie Pathologique, Paris, 1829), in particular describes tubercle at its origin as a pale yellow, opaque, small, round body, of various degrees of consistence, and in which no trace of organization can be detected. He denies that the grey semitransparent corpuscule described by Laennec and since by Louis, (Recherches sur la Phthisie, Paris, 1825), constitutes the primitive state of tubercle, or that the process of softening takes place invariably in the centre of this substance. The latter change he ascribes to the admixture of pus secreted by the tissues subjected to the stimulus of tubercle as a foreign body, and not to any change originating in the tubercle itself.

Definition of Tubercle.—The following is, we conceive, a correct definition of tubercle, or rather of the tuberculous matter which constitutes the essential anatomical character of those diseases to which the term tubercular is now exclusively restricted. Tuberculous matter is a pale yellow, or yellowish grey, opaque, unorganized substance, the form, consistence, and composition of which vary with the nature of the part in which it is formed, and the period at which it is examined. To comprehend fully the manner in which the latter circumstances modify the physical characters of tuberculous matter, it will be necessary to make a few remarks on the seat of this morbid product in general; a circumstance in the history of tubercle, which, notwithstanding its importance and the frequent anatomical researches of which it has been the object, has not, we believe, been satisfactorily determined.

The prevailing opinion among pathologists is, that the seat of tuberculous matter is the cellular tissue of organs;—that it may, however, be formed on secreting surfaces, as in the mucous follicles of the intestines; perhaps in the air-cells and bronchi; the surface of the pleura and peritoneum; and likewise in false membranes or other accidental and new products; and in the blood itself.

Seat of Tuberculous Matter.—1st. In the *mucous system* of organs.—Considered in a general point of view, and in relation to the different tissues, systems, and organs of the body, the mucous system is by far the most frequent seat of tuberculous matter. In whatever organ the formation of the tuberculous matter takes place, the mucous system, if constituting a part of that organ, is, in general, either the exclusive seat of this morbid product, or is far more extensively affected with it, than any of the other systems or tissues of the same organ. Thus the mucous system of the respiratory, digestive, biliary, urinary, and generative organs, is much more frequently the seat of tuberculous matter than any other system or tissue which enters into the composition of these organs.

It is, however, much more easy to detect the presence of the tuberculous matter in the mucous system of some of these organs than in that of others. Thus it is at once conspicuous in the Fallopian tubes and uterus in consequence of the extent of the mucous membrane which lines their internal surface, and where it may be so abundant as to fill or even distend the cavity of either. Its presence in the ureters and pelvis of the kidney, in the lymphatics and lacteals, is ascertained with the same degree of facility as in the former organs. But in those organs in which the organization of the mucous system is very minute, as the liver, prostate, lymphatic glands, intestinal follicles, and pulmonary vesicles, it is sometimes very difficult to demonstrate the presence of the tuberculous matter in this system. The seat of the tuberculous matter in the mucous system of these latter organs is always rendered more palpable and more easy of demonstration, the more slow the progress of the disease, and the more the tuberculous diathesis has been developed and free of complication, as under these circumstances the mucous canals or cells into which the tuberculous matter is deposited, often acquire an increase of bulk which renders them capable of being submitted to accurate anatomical inspection.* On the contrary, the difficulty of determining the seat of the tuberculous matter in the mucous system of the same organs increases with the more rapid progress of the disease, and more especially with the degree of inflammation, as a complication with which it has been accompanied. For when the deposition of the tuberculous matter takes place under such circumstances, for example in the lungs, the minute bronchi and air-cells are rendered more or less obscure in consequence of this matter being effused not only into their respective cavities, but also into the cellular tissue which separates their walls the one from the other. Great congestion, the presence of coagulable lymph or pus, induration or softening of the pulmonary tissue, render it either extremely difficult, or impossible to determine satisfactorily the seat which we assign to the tuberculous matter in the lungs. The more minute but more solid texture

* Dilatation of the air-cells in emphysema has enabled Dr. Alison to perceive distinctly the tuberculous matter contained in these cells. Edin. Medico-Chir. Trans. vol. i. p. 427.

of the lungs in children than in adults, and more particularly than in old persons, renders it also much more difficult to ascertain the seat of the tuberculous matter in these organs in the former than in the latter. We would therefore recommend those who may be desirous of investigating this point for themselves, to choose a portion of lung free from those complications to which we have alluded, from an old person, containing only a small quantity of tuberculous matter, and to submit it to careful dissection by means of fine scissors, and a sharp-pointed scalpel, or lancet. A single bronchus should be selected, and laid bare to its terminal extremity before being opened. A common lens may be useful, but injection and maceration create obstacles rather than afford assistance.

2. *On serous surfaces.*—The deposition of tuberculous matter on serous surfaces is often observed, as in the cellular tissue in general, and on the free surface of serous membranes in particular. In those organs into the composition of which the serous and mucous tissues enter, the tuberculous matter may be seen in both at the same time, as in the bronchi and air-cells, and in the interlobular cellular tissue; but in such cases it will be found, as we have said, to predominate in the former. And in those organs, such as the brain, muscles, bone, &c., in which there is no mucous tissue, we find the tuberculous matter deposited in the cellular tissue which unites their fibres or lamellæ.

3. *In the blood.*—It very rarely occurs that tuberculous matter can be detected in the blood contained within its proper vessels, but it is frequently met with in this fluid in the cells of the spleen. This organ is particularly favourable for ascertaining the presence of the tuberculous matter in the blood. Its spongy structure admits of the accumulation of the blood in such quantity, that the tuberculous matter can be seen forming in this fluid at some distance from the walls of the cells in which it is contained. Thus, we can perceive the blood coagulated in one cell, coagulated and deprived of its red colouring matter in another, and in a third converted into a mass of solid fibrine containing in its centre a small nodule of tuberculous matter. It also sometimes happens that the blood is effused in consequence of rupture of some of the cells of the spleen, and an opportunity afforded of witnessing its successive or simultaneous conversion into fibrine and tuberculous matter.

Repeated, careful, and minute anatomical researches have led us to regard these, the mucous and serous surfaces and the blood, as the exclusive seats of the tuberculous matter. In no instance is this morbid product deposited in the molecular structure of organs. It always makes its appearances on free surfaces as a product of secretion. We must, however, again repeat, that although it may form on serous surfaces, its *seat of election* is the *free surface of mucous membranes*. There, as into the great emunctuary of the system, it appears to be separated from the blood, and becomes visible to us under a variety of forms afterwards to be described. As a morbid constituent of the blood, we can take no cognizance of the existence of tuberculous matter, otherwise than through the medium of the secretions, or until this fluid has ceased to circulate. Then it is seen to separate from the other constituents, the serum, fibrine, and colouring matter of the blood, and is distinguished from them by the peculiarity of its physical characters.

External Configuration or Form of Tuberculous Matter.—The *round* form which this substance is said to present is a purely accidental circumstance, is common to many other morbid products, and expresses one only, and perhaps the least important, of the many forms which this matter assumes in the several organs in which it is found. Thus, from the homogeneous nature of the cerebral substance, and the equal resistance which at every point it opposes to the accumulation of the tuberculous matter, the form of the latter must be nearly round. Such, also, and for similar reasons, is its form in the cellular tissue. But in other organs the form of this morbid product is as various as that of the parts in which it is contained. It assumes the form of a shut or open globular sack if confined to the secreting surface, and of a solid globular tumour of various sizes, if it fills completely the cavity of the air-cells; and, for similar reasons, it presents in the bronchi a tubular or cylindrical form, having a ramiform distribution, terminated by a cauliflower arrangement in the air-cells. In the mucous follicles its form is similar to that which it receives from the air-cells. In the biliary system it has a ramiform distribution, from its being contained in the ducts and their dilated bulbous extremities. In the cavity of the uterus and Fallopian tubes, the infundibula, pelvis, and ureters, it is moulded to the respective forms of each of these parts; and such also, it is obvious, must be the case when it is contained in the seminiferous ducts and prostate gland, in the lacteals, lymphatics, and their glands. On the surface of serous membranes, whether natural or accidental, it may have either a globular or lamellated form, as the secretion in which it originates may have taken place in distinct points, or from a continuous surface of greater or less extent. When the secretion of tuberculous matter takes place in such a manner as to become disseminated throughout a considerable extent of an organ, as when it is said to be infiltrated, it has then no definite form, unless it occupies, for example, the whole of the lobe of a lung, when it assumes that of the affected lobe. The granular arrangement of the tuberculous matter in the lungs is owing to the accumulation of this morbid product in a small number of contiguous air-cells; and the lobular character which it sometimes presents in the same organ is produced by its being deposited in the air-cells of a number of lobules, the neighbouring lobules being healthy.*

Consistence and Colour of Tuberculous Matter.—Tuberculous matter does not acquire its maximum of consistence until an indefinite period after its formation. It is frequently found in its primitive state in the bronchi, air-cells, biliary ducts, and their dilated extremities, in the cavity of the uterus and Fallopian tubes, &c., that is to

*Coloured representations of all these varieties of form, as well as of the seat of tuberculous matter on the free surface of mucous and serous surfaces and in the blood, may be seen in the First Fasciculus of the *Illustrations of the Elementary Forms of Disease*, now publishing by the author of this article.

say, resembling a mixture of soft cheese and water, both in colour and consistence. But when much resistance is offered to its accumulation, as in the lymphatic glands, and even sometimes in the air-cells of a whole lobule, it may feel as firm as liver, or even pancreas. These extreme degrees of consistence of tuberculous matter depend not only on the resistance which the tissues of these and other parts oppose to its accumulation, but also on the removal of its watery part some time after it has been deposited. Hence it follows that tuberculous matter may, when first perceived, be either very soft or remarkably firm. In the first case it is pultaceous, and feels somewhat granular when rubbed between the fingers; in the second, friable; and in both it is of a pale yellow colour and opaque.

The grey semitransparent substance already alluded to by no means necessarily precedes the formation of the pale yellow or opaque tuberculous matter. Thus it is never seen in the cavity of the uterus or Fallopian tubes; in the uterus, pelvis, or infundibula of the kidneys, &c.; nor do we recollect to have seen it in the cerebral substance. We have never met with it in the bronchi, unless in some of their minute or terminal branches. On the contrary, this semitransparent substance is frequently seen in the air-cells, and on the free surface of serous membranes, particularly the peritoneum; and in both it is certainly sometimes observed to *precede* the formation of opaque tuberculous matter; because, first, a number of cells of the same lobule are seen filled with the former, whilst the remaining cells contain the latter substance; secondly, because on the peritoneum the grey semitransparent substance is generally more abundant than the pale yellow opaque matter; and, thirdly, because a small nucleus of the latter is frequently enclosed in a considerable quantity of the former. The following is the explanation which we would offer of these exceptions to the regular and ordinary formation of the tuberculous matter. But it is necessary to remark that the formation and manifestation of this matter as a morbid product cannot take place unless the fluid from which it is separated—the blood—has been previously modified. We have already noticed this important fact, and shown that the tuberculous matter is contained in the blood; and hence it follows, that a healthy secreting surface may separate from this fluid not only the materials of its own peculiar secretion, but also those of tuberculous matter. Such is, indeed, what takes place in the air-cells. The mucous secretion of their lining membrane accumulates where it is formed; but it is not pure mucus; it contains a quantity of tuberculous matter mixed up with it, which after a certain time is separated, and generally appears in the form of a dull, yellow, opaque point, occupying the centre of the grey, semitransparent, and sometimes inspissated mucus. This process of separation of tuberculous matter from secreted fluids is strikingly exemplified in tubercular peritonitis. When we examine the peritoneum in this disease, the three following stages of the process are frequently extremely well marked: first, on one portion of this membrane there is seen a quantity of recently effused coagulable lymph; secondly, on another we find the same plastic semitransparent substance, partly organized, and including within it, or surrounding a globular mass of tuberculous matter; and, lastly, on another part, the coagulable lymph is found converted into a vascular or pale cellular tissue, covered by an accidental serous membrane, beneath which, and external to the peritoneal or original secreting surface, the tuberculous matter is seated, having the form of a round granular eminence, resembling in colour and consistence pale firm cheese. In this as well as in the preceding case, we cannot but perceive that the formation of the tuberculous matter originates in a process similar to that of secretion; that its separation from the blood may be accompanied with that of natural and also other morbid secretions; and hence the reason why its physical characters are sometimes obscured, particularly in the first stage of its formation.

[The minute texture of tubercle has been examined of late by numerous observers, and, amongst others, by Mr. Gulliver, (in Gerber's *Elements of the General and Minute Anatomy of Man and the Mammalia*, &c., with Notes, by Mr. Gulliver, Lond. 1842,) who considers it to be composed of granular matter, corpuscles, and cells. The granular matter is seldom or never absent, and is composed of infinitely minute particles, and of minute spherules remarkably variable in magnitude, and generally from the $\frac{1}{3000}$ to the $\frac{1}{8000}$th of an inch in diameter. This is the most prevalent ingredient in tubercle. It is almost always mixed with the other constituents, and frequently forms the entire mass of caseous tubercle. The corpuscles are generally more or less globular, or oval, but are often either very irregular in form, or shapeless. They generally vary from the $\frac{1}{8000}$ to the $\frac{1}{2000}$th of an inch in diameter, and are thought by Mr. Gulliver to be probably imperfect, degenerating, or blighted cells and nuclei. The most common size of the cells is from the $\frac{1}{2000}$ to the $\frac{1}{1140}$th of an inch in diameter. They may be frequently recognised in greyish miliary tubercles; but as the tubercles increase in size, the well-marked and complete cells disappear,—probably, according to Mr. Gulliver, degenerating into the corpuscles and granular matter. From all his histological observations, Mr. Gulliver thinks it highly probable, that tubercle, like the most highly organized tissues, has its origin in cells, generally mixed, at a very early period, with granular matter. It seems, however, to differ essentially from the matter of plastic exudations, inasmuch as the cells of the latter not only grow into a higher organization, but increase also in number towards the centre; in other words, plastic matter has an inherent power of multiplying and evolving organic germs, but tubercle has no such power; for it would appear, that its primitive cells can only retrograde and degenerate, since they are wholly destitute of the plastic force, or—to use the language of Dr. C. J. B. Williams, (*Principles of Medicine*, Amer. edit. by Dr. Clymer, p. 313, Philad. 1844)—are "aplastic," from the beginning. It must be admitted, however, as elsewhere remarked, (*Practice of Medicine*, 2d edit. i. 342, Philad. 1844,) that the histology of tubercle is by no means settled. (For some recent observations on the subject, see *Amer. Journ. of the Med. Sciences*, Oct.

1844, p. 461, cited indirectly from *Gaz. Méd. de Paris.*)]

Composition of Tuberculous Matter.—The composition of this matter, when examined anatomically and chemically, presents considerable variety. We have already said that it is composed essentially of a cheesy-looking material, without any trace of organization. It has, in fact, no definite internal arrangement, and the changes of bulk, consistence, and colour which it undergoes, are entirely dependent on the influence of external agents. In some animals, but more particularly in the cow, it is frequently found to present a concentric lamellated arrangement, which, however, does not belong to the tuberculous matter. It is owing to the presence of albumen, and sometimes even of fibrine, which, as in the cases referred to, are secreted along with the tuberculous matter. These substances, intermixed with tuberculous matter, are found lining the bronchial tubes, or filling their entire cavity, and forming masses sometimes an inch in diameter. They often assume the form of globular membranous cysts when they are contained in dilated air-cells, and then have a striking resemblance to hydatids. Or, they present the form of detached tubes or globular membranes, rolled up and mixed with tuberculous matter, like layers of boiled albumen or dead hydatids, a circumstance which has been taken advantage of to support the theory of the hydatic origin of tubercles; a theory which, if not founded in error, must obviously be regarded as extremely limited in its application, since we have shown that tuberculous matter is, in general, formed *ab origine* on the secreting surface of hollow organs, where it is often seen as distinctly as if it had been thrown into them from a syringe.

[The researches of recent histologists appear to show that—in the language of Gerber, (*Op. cit.*)—albuminous or organized tubercles can only be produced from exudations abounding in albumen and poor in fibrin; and such exudations, it need scarcely be said, are more likely to occur from blood which possesses less of the plastic or fibrinous material. Hence the important practical indication, in such cases, is to modify the condition of the circulating fluid by improving its plastic or vitalizing power.]

The chemical composition of tuberculous matter varies not only at the different periods at which it is examined, but also in different animals, and probably in different organs. In man it is chiefly composed of albumen with various proportions of gelatine and fibrine; and in the cow in particular, it contains a large proportion of the earthy salts, in which the phosphate of lime is said either to predominate or to exist in the same proportion, along with the carbonate of the same earth, as in bones. The following are the proportions of these ingredients found in six grammes (a gramme is nearly equal to 15½ English grains,) of firm tuberculous matter by M. Hecht of Strasburgh. (Lobstein, Traité d'Anatomie Pathologique, t. i. p. 378.)

	Gramme.	Decigrammes.
Albumen	1	4
Gelatine	1	2
Fibrine	1	8
Water (or loss)	1	6
	6	0

One hundred parts of crude pulmonary tubercle were found by Thénard to contain (Andral, Précis d'Anatomie Pathologique, t. i. p. 417)—

Animal matter	98,15
Muriate of soda, Phosphate of lime, Carbonate of lime	1,185

and some traces of oxide of iron.

The most important fact connected with the chemical composition of tuberculous matter is, that, either from the nature of its constituent parts, the mode in which they are combined, or the conditions in which they are placed, they are not susceptible of organization, and, consequently, give rise to a morbid compound, capable of undergoing no change that is not induced in it by external agents.

Softening of Tuberculous Matter.—When the process of softening takes place in tuberculous matter, it is clear, from what we have just stated, that it cannot, as Laennec believed, be owing to any change originating in its morbid product. Besides, when speaking of the consistence of this matter, we showed that in many organs it is always in a state of fluidity, and consequently does not require to undergo the change in question, supposed to be necessary to, or at least to facilitate, its expulsion. When the tuberculous matter has become firm, owing to the circumstances already explained, it may, and generally is, at some future period converted into a granular-looking pulp, or grumous fluid of various colours, from the admixture of serosity, pus, blood, &c., which have been effused or secreted by the tissues subjected to its irritating influence. The pus and serosity pervade the substance of the tuberculous matter, loosen, and detach it. These changes are further promoted by atrophy, ulceration, or mortification of the surrounding or enclosed tissues, the blood-vessels of which have been compressed or obliterated by the tuberculous matter. If these changes take place slowly, for example, in the lungs, the tuberculous matter is expectorated in the form of a grey, somewhat puriform-looking fluid; but if they are effected speedily, it is often detached and expelled in masses of various sizes, resembling fragments of cheese that have been left some time in water.

The process of softening of tuberculous matter is said always to commence in the centre, not only of masses of this substance, but likewise of every individual portion of it which has assumed the round or tubercular form. This opinion is extremely incorrect; and, indeed, the explanation which we have just given of this process, when it does take place, shows that such cannot be the case. However, there must be some real or apparent circumstance connected with this *central* softening, so minutely described by Laennec, which has not been understood by this ingenious author, nor even by those who disagree with him on this particular point. The facts which we have pointed out regarding the mode of formation, the seat and forms of the tuberculous matter, enable us now to offer a satisfactory explanation of the appearances which led Laennec and others into error, respecting the commencement of softening of this substance. We have already stated that when tuberculous matter is formed in the

lungs, it is generally contained in the air-cells and bronchi. If, therefore, this morbid product is confined to the surface of either, or has accumulated to such a degree as to leave only a limited central portion of their cavities unoccupied, it is obvious that when they are divided transversely, the following appearances will be observed: — 1st, a bronchial tube will resemble a tubercle having a central depression or soft central point, in consequence of the centre of the bronchus not being, or never having been occupied by the tuberculous matter, and of its containing at the same time a small quantity of mucous or other secreted fluids; 2d, the air-cells will exhibit a number of similar appearances, or rings of tuberculous matter grouped together, and containing in their centres a quantity of the same kind of fluids. When the bronchi or air-cells are completely filled with tuberculous matter, no such appearances as those we have just described are observed; and hence the reason why tubercle, in such circumstances, has been said to be still in the state of *crudity*, or that state which is believed to precede the softening process.

Softening begins most frequently at the circumference of firm tuberculous matter, or where its presence as a foreign body is most felt by the surrounding tissues. Hence the reason why softening is also frequently seen making its appearance in several points of an agglomerated mass of this substance, which has included within it portions of the tissues in which it was formed. This is frequently observed in the lungs, and in cellular tissue in other parts; whereas in the brain, the substance of which has, from the commencement, been separated and pushed outwards by the tuberculous matter, the softening process begins, and is always most marked on the circumference or surface of this morbid product.

There is another circumstance which should have been noticed before, and which requires some explanation,—viz. that state of tuberculous matter which is said to be *encysted*. Encysted tubercle has generally been described as existing in the lungs, but the result of numerous researches fully satisfies us that the term encysted, whether applied to pulmonary tubercle or to tubercle in any other organ, is almost always incorrect. In the lungs, encysted tubercle is a deception; the distended walls of the air-cells having, in all probability, in almost every case been taken for cysts. In like manner the extremities of the biliary ducts, when dilated and filled with tuberculous matter, have been described as encysted tubercles; and we have already said that the dilated air-cells, particularly in the cow, which may vary from the size of a pea to that of a cherry, have frequently been regarded as hydatids. We do, however, meet with encysted tuberculous matter, but not until it has undergone important changes which precede its ultimate removal from the organ in which it was formed. We shall explain these and other changes connected with them when treating of the progress and termination of tuberculous matter.

Locality of Tuberculous Matter.—When treating of the seat of tuberculous matter, we endeavoured to show that this inorganizable substance is separated from the blood after the manner of secretion, and is collected on the free surface or in the cavities of mucous and serous tissues: and farther stated, that in no instance, so far as our researches had extended, had we been able to detect its presence in the molecular structure of any of the elementary tissues of the body. Hence, by the term *locality* of tuberculous matter, we mean only to imply a certain relationship between the existence of this matter and particular organs, including an enumeration of the organs in which it is found, the relative frequency of its occurrence in different organs and in portions of the same organ, its extent, and the number of organs which it affects.

Organs of Respiration. — Of all the organs of the body, those of respiration occupy the first rank, both as regards the extent and the frequency of the tuberculous deposition. The quantity of the matter deposited in the lungs, when compared with their bulk, presents great variety. In some instances only a few minute granular masses of the tuberculous matter are observable, either collected together and limited to a circumscribed portion of the pulmonary tissue, or separated from one another and scattered throughout the whole of a lobe, of one or both lungs. In other instances this matter exists in the form of large contiguous masses, and occupies the whole of a lobe, more frequently the greater part of two or three lobes; and, lastly, it has sometimes been met with in such quantity as to occupy nearly the whole of one lung and a great part of the other. The comparative frequency of the tuberculous deposition in each lung and in their several lobes is a circumstance which, as well as the extent of the disease, is of great value in a diagnostic point of view. We shall, therefore, only observe, in regard to this circumstance, that the superior and posterior portion of the upper lobe of either lung, but more frequently of the left, is so generally the situation in which the formation of the tuberculous matter first takes place, that its existence elsewhere may be regarded as a secondary occurrence. From the result of our own experience we should indeed say that there is no exception to this rule when the deposition of the tuberculous matter has not been preceded by local disease, such as circumscribed bronchitis, pneumonia, or pleurisy; for, under such circumstances, any portion of the lung may become the primary seat of the deposition.

The presence of tuberculous matter in the larynx, in the trachea, and its larger divisions, is not often observed. We have met with it in a few instances in the follicles of these parts, and occasionally in the sacculi laryngis.

Organs of digestion. — Of these organs the small intestines are by far the most frequently affected with the tuberculous deposition at every period of life. In the great majority of cases it is confined to the inferior portion of the ileum, more frequently in the glands of Peyer than in those of Brunner. Succeeding to the ileum in the order of frequency is the caput cœcum coli, in the situation of the glands of Brunner. The deposition of the tuberculous matter seldom takes place in the other portions of the colon, and still less so in the rectum. It is equally rare in the jejunum, and we have never met with it in the

duodenum, stomach, œsophagus, pharynx, or mouth. In few cases, even of the most extensive tuberculous diathesis, do we meet with tuberculous matter in the *liver* of the adult; whereas, in children it is by no means rare to find this organ affected, although it seldom contains more than a few small, round, isolated masses scattered throughout its substance. We have never seen this matter in the *pancreas* of the human species, and only once in that of the monkey. Mons. Lombard, however, states that in one hundred cases of tuberculous disease in children which he examined, he found tubercle five times in the pancreas; whereas in the same number of cases he did not meet with a single example of tubercle in the liver (Essai sur les Tubercules)—results very different from those to which we have been led by our own dissections.

Organs of Circulation.—It is seldom that these organs present any trace of tuberculous matter. In the few cases in which it has been found in the *heart*, it was contained in the intermuscular cellular tissue; and we are far from agreeing with Andral in opinion that the plaster-looking matter, or cretaceous substance so often found in the coats of the *arteries*, is a tuberculous deposit. The occurrence of this matter in the arteries almost exclusively in the aged, or at least seldom to any extent until between the ages of forty and fifty, its occurrence, too, indifferently in those who are, or who are not, affected with tuberculous disease, and frequently in those in none of whose organs any trace of tuberculous matter is observed, are circumstances which, notwithstanding any similarity which may exist between the physical and chemical characters of the two substances, would fully warrant the pathologist in regarding them as essentially different in their nature.

Regarding the *spleen* as an appendage to the vascular system, this organ may be said to be frequently affected with the tuberculous deposition in children, but it is seldom so in adults. In the former this organ is also much more extensively affected than in the latter; in some cases we have found it almost entirely filled with tuberculous matter in the form of large masses, but more frequently this matter is grouped into small round masses varying from the size of a pin's head to that of hemp-seed, contained in the cells of the organ, and separated from one another by the elastic fibrous tissue of which it is composed.

Urinary Organs.—The tuberculous matter is found in the kidneys, infundibula, pelvis, and ureters. It may be so great in quantity as to occupy the entire cavity of these latter parts, and thence pass into the urinary bladder. It is generally small in quantity in the kidneys, and appears in the form of small round masses, scattered throughout their substance. Both kidneys are generally affected when the deposition has taken place in their substance, and only one of them when it is contained in the cavity of the infundibula pelvis, or ureter. The kidneys are much more frequently affected with tuberculous diseases in children than in adults.

The organs of reproduction furnish us with occasional examples of tuberculous deposition, occurring in the testes, vasa deferentia, vesiculæ seminalis, and prostate; in the uterus, Fallopian tubes, ovaries, and mammæ. It seldom occurs in these organs before the age of puberty; is more often observed in the male than in the female, in the testes and prostate than in the ovaries and Fallopian tubes; more frequently in the testes than in the prostate, in the Fallopian tubes than in the ovaries or uterus, and less frequently in the vesiculæ seminales and mammæ than in any of the former organs. The deposition of the tuberculous matter seldom takes place in both testes at the same time. It generally commences in the epididymis of one of them, and extends from thence to the body of the organ, which in some cases it entirely occupies. The quantity of the tuberculous matter is also not unfrequently very considerable in the uterus and Fallopian tubes; we have found the cavities of both filled with it, and the Fallopian tubes distended to the size of the finger or thumb.

The brain, cerebellum, and spinal cord, are not unfrequently affected with tuberculous deposition. The brain is more frequently affected than the other portions of this system, and sometimes to a considerable extent. In some instances we have seen the tuberculous matter collected in the form of round masses, varying from the size of a pin's head or pea to that of a cherry or hen's-egg, situated in various parts of the brain, sometimes in several parts at the same time, as in the medullary substance, in the cortical substance of the convolutions, and in that of the corpora striata or thalami of one or both hemispheres. It may occupy, also, the medullary and cortical substance of the cerebellum and spinal cord. It may be contained in one or both lobes of the former, and sometimes forms a tumour as large as a hen's-egg. The tuberculous matter has been found to occupy, in the great majority of cases, the cervical portion of the latter. In a few instances only has it been found in the lumbar portion; in one case we met with it in both portions, forming two tumours, one of which was as large as a pea, the other nearly twice as large, and situated in the central brown substance of the cord. Tuberculous deposition is oftener observed in the brain and cerebellum in infants than in children, and in the latter than in adults.

Having already noticed the formation of tuberculous matter in the *absorbent system*, we have now chiefly to mention the frequency of its occurrence in the several divisions of this system, viz. in the glands, lymphatics, and lacteals. The following may be regarded as the relative frequency of the occurrence of tuberculous matter in these glands in the order in which they are named:—the bronchial glands, the mesenteric, the cervical, submaxillary, lumbar, axillary, and inguinal. The bronchial and mesenteric are far more frequently and more extensively affected than any of the other glands; the bronchial in both these respects much more so than the mesenteric in children, the mesenteric, perhaps, more frequently than the bronchial in adults. In some cases we find all these glands affected in the same individual, but the quantity of the tuberculous matter is generally greatest in the bronchial or mesenteric; and those of the former, situated at the bifurcation of the trachea, are always most extensively diseased, and frequently contain tuberculous matter when those

of the large bronchi and neck contain none. Although it is reasonable to conclude, judging from the frequency and extent of the disease in these two latter systems of glands, that they are also those first affected, there are certainly cases in which the tuberculous deposition not only commences, but is also most extensive in those glands situated on the external parts of the body, particularly in those of the neck. Hence great enlargement of the glands in this situation in scrofulous subjects is not always to be considered as evidence of extensive disease of those of the bronchi or mesentery.

The lymphatics and lacteals contain tuberculous matter much less frequently than their respective glands. Indeed, the former are not unfrequently found to contain no tuberculous matter when the latter are filled or even distended with it,—a circumstance which shows that the tuberculous matter is not necessarily absorbed and carried into the glands, but, on the contrary, is originally deposited within them.

The deposition of tuberculous matter in the *osseous system* is a much more rare occurrence than in any of the organs already named. The bodies of the vertebræ and spongy extremities of the long bones are the situations in which this matter is generally observed. The deposition takes place in the cellular structure of the bones in which it accumulates, and often terminates in the production of caries, circumscribed necrosis, and generally in perforation. In such cases the bony system is that in which the deposition generally commences, and is also that which is chiefly affected. When the tuberculous affection begins in any of the organs already mentioned, and exists in them to a great extent, the bones are seldom affected: at least, in a number of cases of tubercular phthisis, tabes mesenterica, &c., in which we have examined the bones, we have only in a few instances found them to contain tuberculous matter.

We have never found tuberculous matter in *cartilage, fibrous tissue, serous, synovial, or mucous membranes, tendon, or muscle.* When tuberculous matter has been found in the serous, synovial and mucous membranes, the morbid condition of these membranes which always accompanies the presence of the tuberculous matter in them, has not been properly appreciated; for in such cases these membranes, particularly the mucous and synovial, are completely disorganized by inflammation, and converted into a reddish brown pulp. It is in this substance that the tuberculous matter is deposited, as may be ascertained by examining the mucous membrane of the intestines, and the synovial membrane of the knee-joint, when in this state of disease.

What are called *false membranes, or accidental cellular and serous tissue*, become affected with the tuberculous deposition in the same manner as the natural tissues of the same class.

Considerable variety prevails with regard to the *number* of organs affected with the tuberculous deposition in the same individual. It is rare to find the tuberculous matter confined to one organ; it generally is present in two or three organs, as the lungs, intestines, and bronchial or mesenteric glands, and is occasionally met with in all the organs which we have before named, in the same individual. The two organs by far the most frequently affected in the same individual, are the lungs and small intestines, and after these the small intestines and mesenteric glands. Sometimes the lungs alone are affected; sometimes the bronchial glands; and occasionally the peritoneum. It is, perhaps, only in children that the tuberculous affection is confined to the bronchial glands, and in adults that it is limited to the lungs or peritoneum. We have always found tubercles in the lungs when any other organ of the body was affected with them in the adult, except in tubercular peritonitis. In this case the peritoneum may be studded with tubercles, and masses of them may also exist in the adhesions which unite together the intestines and other abdominal viscera, and yet not a single tubercle be found in the lungs. We have seen several examples of this kind, and also of extensive tuberculous disease of the bronchial glands in children with complete integrity of the pulmonary organs, and therefore we are disposed to modify somewhat the law laid down by Louis, viz. that tubercles are *always* found in the lungs when they exist in any other organ of the body. —(Recherches Anatomico-Pathologiques sur la Phthisie, Paris, 1825.)—It is, however, important to observe that the exceptions to this law are not very numerous, and, besides, seem to us to admit of satisfactory explanation; for in every case in which we have found the tuberculous affection confined to the peritoneum, it was obvious that this was the consequence of previous inflammation of that membrane.

[MM. Rilliet and Barthez, (*Traité Clinique et Pratique des Maladies des Enfants*, iii. 48, Paris, 1843,) give the following table of the comparative frequency of tuberculous deposition in different organs in 314 children:

Lungs,	265
Bronchial ganglions,	249
Mesenteric ganglions,	144
Small intestines,	134
Pleura,	109
Spleen,	107
Peritoneum,	86
Liver,	71
Large intestine,	60
Meninges of the brain,	52
Kidneys,	49
Brain,	37
Stomach,	21
Pericardium, heart,	10]

Inflammation of any organ may be followed by the deposition of tuberculous matter in that organ, in the manner in which we have already explained. We have frequent examples of the subcutaneous glands of the neck and submaxillary glands becoming tuberculous after an acute attack of inflammation, although previously they were neither enlarged, indurated, nor otherwise diseased. It is also, in all probability, owing sometimes to a similar cause that one testicle, one kidney, or one lung only is affected, whilst the corresponding organ of the opposite side remains in a state of perfect integrity. We remember the case of a female, which is highly illustrative of the present question. The patient was twenty-one years of age, and had pneumonia and bronchitis in consequence of sitting during the greater part of the day between an open

door and a fire for several weeks in cold weather. The *left* side was turned towards the door during the whole time, and to this side these two affections were exclusively confined. Nearly the whole of the *left* lung was found after death to be in the state of tuberculous infiltration, and the mucous membrane of the bronchi of the same lung more or less inflamed, as far up as the bifurcation of the trachea. Here the inflammation stopped abruptly. The right lung was healthy throughout, except at the summit of the upper lobe, where there were only a few crude tubercles, just sufficient to attest the existence of the diathesis rendered so peculiarly manifest in the left lung under the influence of a morbid stimulus. But there are other causes besides inflammation which determine the presence of tuberculous matter in particular portions of organs, and more frequently in one portion of an organ than in any other. It is, indeed, easy to conceive that a diminution as well as an increase in the function of an organ may favour the deposition of tuberculous matter. If, as we have endeavoured to show, the tuberculous matter is separated from the blood and deposited on the free surface of mucous and serous tissues, may it not follow that the presence of this substance in one portion of an organ, and its absence in another, may depend in great measure on a greater or less degree of facility afforded for its escape? Considered merely in this mechanical point of view, it is not improbable that we may find an explanation for the localization of the disease in certain portions of organs, and its absence in others. Thus, if we compare the functional activity, or, rather, the extent of mobility possessed by the inferior and superior lobes of the lungs, we at once perceive a most remarkable difference in favour of the former. The inferior lobe ascends and descends throughout a space equal to that which the diaphragm is capable of contracting, and expands in all directions to the fullest extent of the dilated inferior walls of the thorax. The upper lobe, on the contrary, has hardly any motion of ascent and descent, and a very limited lateral expansion. Under these circumstances, what should be the effect produced on a substance such as tuberculous matter effused into the vesicular structure of these two lobes? In the former we should naturally expect that there would be a continual tendency towards the expulsion of this matter, whilst in the latter there would be the same tendency to its accumulation. The result of observation is greatly in favour of this explanation; for, besides the extreme frequency of the tuberculous deposition in the upper lobe, and its rare occurrence in the inferior lobe of the lung, it derives additional support from the fact that the latter is often the seat of inflammation, notwithstanding its immunity from tuberculous disease, whilst the former is obnoxious to this latter disease, although, comparatively speaking, seldom the seat of inflammation. May it not be owing to the facility with which the tuberculous matter escapes, that we do not find it accumulated on the mucous surface of the larger bronchi, or of the trachea, or on that of the intestines? We have no proof that it is not deposited on the free surface of the mucous membrane in these situations. The facts we possess would seem to prove the contrary, since we have shown that its deposition in the mucous follicles and air-cells in the same organs is a frequent occurrence; and in these, in all probability, it accumulates because of the same facility not being afforded to its escape as in the other portions of the mucous membrane alluded to.

There are various other circumstances which appear to us either to determine the locality or favour the extension of the tuberculous deposition in the manner in which we have endeavoured to explain. A narrow conformation of the chest depending on natural causes, or the influence of those mechanical instruments employed by females to accomplish this change in the inferior half of the thorax, may partly account for the great frequency of the disease in both sexes in the former case, and its greater frequency in the female than in the male in the latter case. The influence exercised by all those arts, trades, and professions which limit the free and full expansion of the pulmonary organs, either in consequence of a constrained position of the body, but more particularly of the chest, or from the partial and inefficient action of the respiratory muscles, must operate in giving a tendency to the localization of the disease. It is an important fact that, notwithstanding the greater frequency of tuberculous affections in children than in adults, the lungs are much less frequently affected in the former than in the latter. We do not know that this difference can be fully explained, but we are disposed to believe that it may in some measure be owing to the much greater activity of the lungs in children than in adults: — we mean that kind of activity of these organs in children which is the consequence of almost continued change of place and position of the body: running, leaping, tumbling, wrestling, and the numerous little gesticulations in which the upper extremities and muscles of the chest, shoulders, and neck, are called into play in every possible direction and to the utmost of their extent, demand of necessity the most active co-operation of the lungs; thereby rendering the accumulation of the tuberculous matter in the air-cells and bronchi much less likely to take place in children than in adults, placed as the latter are, both by habit and occupation, in opposite circumstances. Whatever kind of employment or mode of life necessitates or facilitates an active and ample display of the respiratory function, is generally admitted as a powerful means of preventing the occurrence of tubercular phthisis. We are far from believing that such prophylactic means operate merely on the mechanical principle of the localization of the tuberculous deposition in the lungs, inasmuch as when these organs are placed under the favourable conditions just mentioned, the circulation, nutrition, secretion, and innervation of the same organs must acquire a vigour and a harmony of action which will render them the least apt to receive or retain any morbid impression or change whatever.

We have no doubt that the physical explanation of the localization of the tuberculous matter in the lungs applies also to the localization of this deposit in other organs, the structure and functions of which do not afford a ready exit to foreign substances contained within them which are not in a state of fluidity. The follicular structure of the intes-

tines; the bronchial and mesenteric glands; the biliary system of the liver; the infundibula and pelvis of the kidneys; the Fallopian tubes, and even the cavity of the uterus, present in a greater or less degree, those conditions of structure and function which, under a variety of circumstances, must prevent the free exit of the tuberculous matter when deposited within them. All these facts would go for nothing were we to admit the generally received opinion that the *cellular tissue is the almost exclusive seat* of the tuberculous deposition; for if it were so, we should, in accordance with the principle which we are now endeavouring to establish, find this tissue much more generally affected with the disease than it is. If the tuberculous matter accumulates on the free surface of mucous canals, it should, *à fortiori*, do so in the cellular tissue, — a circumstance which rarely occurs except in those organs in which the mucous tissue is present.

The much greater frequency of the tuberculous deposition in the spleen in children than in adults seems to admit of explanation on physical principles. We have already given it as our opinion that the presence of the tuberculous matter in this organ at any period of life is the direct consequence of its separation from the blood, when this fluid is brought to a state of stagnation, and undergoes spontaneous decomposition. This is not a mere assertion, for we sometimes find the quantity of the tuberculous matter greater in this organ than in any other organ of the body in children; and in the monkey this is not only the case to a much greater extent, but the masses of this substance contained in the spleen of this animal are even sometimes found softened and large excavations formed, whilst in other organs, as the lungs and bronchial glands, no such changes have taken place. From these facts, viz. the greater quantity of the tuberculous matter in the spleen than in other organs in the same animal, and the existence of those changes which follow the presence of this matter in the former and not in the latter, we should conclude that the disease originated in the spleen in such cases, or that it was not the consequence of the absorption of the tuberculous matter from a remote part, and its subsequent deposition in this organ. The localization of the disease, therefore, may be determined by all those causes which give rise to an inordinate accumulation of blood in the spleen. The extremely active habits of children, the hurry and violence which they carry into many of their amusements, often produce such a degree of sanguineous engorgement of the spleen as to arrest them in the midst of their pursuits, from the severity of the pain which it excites. If under these circumstances an inordinate accumulation of blood is thus so obviously produced in the spleen in children, it should be still greater and more frequent in its occurrence in the monkey, from the reckless and almost incessant gambolling in which this creature indulges, even within the narrow limits usually allotted to it during its captivity in this country. Finding this correspondence between the frequency and extent of the tuberculous deposition in the spleen and the state of the circulation, or rather the *remora* of the blood in this organ, we should not expect to find the same results if the conditions to which we attribute the localization of the disease in the present case were absent. Let us, therefore, take a case of an opposite kind, in an animal obnoxious to tuberculous disease, as the cow, yet in which the spleen is hardly ever affected, whilst the lungs are often and extensively so. Confined in a dairy, and condemned to an almost absolute state of rest for years, the circulation in this animal is never in a condition to produce congestion of the spleen, and this organ escapes the disease, which in the lungs occurs in all its severity, because of the function of respiration being reduced to its minimum, and thereby favouring, on the principle already explained, the accumulation of the tuberculous matter in these organs. We might cite numerous examples of tuberculous diseases succeeding to local accumulations of blood produced mechanically, or originating in a state of debility, such as that which is induced by the sedative effects of cold; but those already brought forward seem to us to afford sufficient evidence in favour of the position which we laid down at the commencement of these remarks,—viz. that there are other causes besides inflammation which determine the presence of tuberculous matter in particular organs, and more frequently in one portion of an organ than in another. We are, however, desirous that it be clearly understood that the influence of the causes which we have enumerated is confined merely to the *localization* of the disease, and that a marked distinction should be made between the *actual presence* of a disease in a *tangible form*, and that *general condition of the economy* whence it originates and derives the peculiarity of its local characters: for we are as fully warranted in believing that a tendency to the deposition of tuberculous matter, or that the tuberculous diathesis may exist, without the deposition of this matter actually having taken place, as we are justified in admitting the existence of a calculous diathesis, without the accompanying formation of calculi in the urinary organs of those persons in whose urine the elements of these foreign bodies are daily observed. It is in this latter affection that the distinction between the localization of, and the tendency to, a disease, is so conspicuous and beneficial in its practical application; and if the theory of tuberculous formations which we have endeavoured to elucidate be founded in fact, it may not be too much to hope, that by means of a more intimate knowledge of organic chemistry, we may yet be able to detect in the mucous secretions or in the blood those changes which indicate the existence of the tuberculous diathesis, and thus perhaps be led to discover a remedy for the disease before it has effected its localization, and produced changes in themselves incurable.

Physical characters of the Tissues in which the Tuberculous Matter is contained.—The tissues in which tuberculous matter is contained may present unaltered all those physical characters which they possess in the physiological state; or they may present those which belong to various pathological states. It is an important etiological fact, that the mucous and serous tissues in immediate contact with the tuberculous matter, and even when this matter is considerable in quan-

tity, may be found of their natural colour, consistence, thickness, and of that degree of transparency which is natural to them. Such is the state in which we have often found the mucous membrane of the bronchi and air-cells, when filled with tuberculous matter, and also the lymphatics, lacteals, and absorbent glands when similarly affected. It is, however, more common, even at any early period of the deposition of the tuberculous matter, or at least before it has acquired considerable extent, to find the tissues in contact with it or in its neighbourhood, more or less and variously affected. *Dilatation* is a frequent occurrence, and the obvious and necessary consequence of the accumulation of the tuberculous matter in the air-cells and bronchi, follicles of the mucous membrane, Fallopian tubes, absorbents, &c. and is sometimes carried to a great extent, without being accompanied by any other very obvious change. In such cases there is often produced *obliteration* of the cavities, ducts, or canals in which the tuberculous matter is contained, and consequently cessation of their respective functions. It is chiefly to this mechanical effect, the obliteration of the lacteals, that the emaciation which accompanies tabes mesenterica is owing, and also that which accompanies the first and second stages of phthisis pulmonalis, together with the difficulty of breathing in this disease, both of which symptoms are often in proportion to the extent of the tuberculous deposition in the lungs.

There are two forms of phthisis to be here observed; in one of which the chief symptom is difficulty of breathing, on account of the tuberculous matter being deposited and collected throughout a multitude of points of the whole of both lungs, in the form of small round masses, varying from the size of a pin's head to that of a hempseed. The pulmonary tissue around these masses soon becomes infiltrated with serosity, thereby increasing the obstacle to the admission of the air, and consequently the difficulty of the breathing. In this manner death may be produced by asphyxia in the course of a few weeks, before softening of the tuberculous matter or ulceration of the pulmonary tissue has taken place. In the other form of phthisis a rapid deposition of the tuberculous matter follows an attack of bronchitis or pneumonia, and is diffused in such quantity throughout the whole of a lung as to convert it into a solid substance resembling boiled liver. This, we believe, never occurs except in a lung affected with tuberculous disease previous to the attack; and if the respiration has not been embarrassed before, it now becomes greatly so, continues rapidly to increase, constitutes the most distressing symptom of the disease, and hurries on its fatal termination.

A diminution in the capacity of the bronchi is also not unfrequently produced by the presence of tuberculous matter situated external to these tubes. We have met with several examples in children, of compression of the large bronchi, which was the obvious cause of the difficult breathing observed during life. The tuberculous enlargement of the bronchial glands has appeared to us the sole cause of this change in the capacity of the large bronchi, and in some cases the difficulty of breathing which they occasion by compressing one or both divisions of the trachea, is very great. Such cases puzzle the physician extremely; for a clear sound may be elicited by percussion from every part of the chest, and by means of the stethoscope the respiratory murmur may be distinctly heard, although feeble, throughout the whole of both lungs. Being unable to discover the existence of any organic lesion of these organs, the nature of the disease and the cause of the chief symptom equally escape his researches, and the patient is perhaps treated for asthma or angina pectoris. Judging, therefore, from our own experience, and from the fact already noticed, viz. the great frequency of tuberculous disease of the bronchial glands in children, and particularly at the origin of the bronchi, we should not hesitate to give it as our opinion, that if a patient, say of four, six, or ten years of age, were affected with considerable difficulty of breathing without any lesion of the lungs or other obvious cause capable of giving rise to this modification of the function of respiration, such a patient had tuberculous disease of the bronchial glands with compression of the bronchi near the bifurcation of the trachea. When we consider the frequency and extent of tuberculous disease of the bronchial glands, it is surprising that the large bronchi are not found more frequently compressed than they are, and that cases should not have occurred even of their obliteration. The only case of the latter kind which we have seen (and so far as we know there is no similar case on record), occurred in a monkey, which, from its singularity and the possibility of its occurrence in the human species, deserves to be noticed in this place. A group of bronchial glands in the form of a round tumour about the size of a chesnut, very firm, and entirely composed of tuberculous matter, surrounded the left division of the trachea, the walls of which were so compressed as to prevent entirely the passage of the air through it. A section carried through the middle of the diseased bronchial glands exposed the left bronchus lodged in the centre of the tumour formed by these bodies, in the form of a narrow band, the opposite surfaces of its mucous membrane being brought into immediate contact. The corresponding lung was greatly diminished in bulk and void of air, such, in fact, as it is found in the case of extensive effusion into the cavity of the pleura. But this cavity presented no trace of effusion of any kind, adhesion, or other morbid state. The left side of the chest was, however, contracted, as it is observed to be after the cure of chronic pleurisy. From the striking resemblance between the physical signs of a case of this kind, and those to which the cure of chronic pleurisy gives rise, it would certainly be difficult even for the best practical pathologist to distinguish the one from the other. The details of this singular case will be found in an interesting paper on the tuberculous affection of monkeys, (De l'Affection Tuberculeuse des Singes, &c. Archives Générales de Médecine), by our amiable friend Mons. Reynaud, an able pathologist, to whose kindness we are indebted for the opportunity of examining this case, and the most of those contained in his memoir.

Thickening and *induration* of the tissues containing tuberculous matter are changes which occur in consequence of pressure or the deposition of coagulable lymph. The former, when combined with dilatation, renders parts extremely conspicuous which in the natural state are just perceived by the naked eye, such as the air-cells, minute bronchi, or mucous follicles, and by means of which we are enabled to ascertain the precise seat of the tuberculous matter in these parts. But of all the changes which succeed to the presence of the tuberculous matter, the most important are those which depend either on the degree of irritation or mechanical pressure to which this substance gives rise—such are inflammation, softening, ulceration, mortification, congestion, hemorrhage. *Inflammation* is the most frequent and dangerous result of the presence of the tuberculous matter, and is probably excited by the mechanical effects of this substance on the contiguous tissues. The occurrence of this pathological state and the degree of its severity do not depend altogether on the quantity of the tuberculous deposit, although it is generally observed to be most extensive in the vicinity of the largest masses, and certainly always commences in that portion of organs in immediate contact with these masses. This is best seen in the substance of the brain in contact with large tumours formed of tuberculous matter. The cerebral substance becomes red and vascular, softens, and is sometimes converted into a creamy-looking pulp. The inflammatory congestion excited by large masses of tuberculous matter in the lungs is a very frequent occurrence; but instead of being succeeded by softening, as in the brain, it is followed by induration or consolidation of the pulmonary tissue from the deposition of coagulable lymph into the cellular texture, generally producing that state called grey hepatization. Inflammation of the pleura pulmonalis and intestinal peritoneum is often observed as the direct effect of the presence of tuberculous matter situated beneath them, and the redness and vascularity is frequently found to be limited to that portion of these membranes directly opposite to the accidental deposit. We allude to these rather minute anatomical details in order to show the connection, as cause and effect, between the presence of tuberculous matter and inflammation of the tissues in which it is found; for it has been asserted that the tuberculous matter does not give rise to inflammation from irritation as a foreign body,—an assertion which is not only contradicted by daily observation, but is at variance with the law, that all inorganizable substances foreign to the part in which they are contained, excite that pathological state which, from its nature, tends either to eliminate such substances, or to protect the injured part from their irritating effects by the formation of a tissue of the lowest grade of organization. It is because we know that tuberculous matter gives rise to inflammation, that we are often able to predict the occurrence of this pathological state at a certain state of the progress of tuberculous affections of the brain, lungs, intestines, absorbent glands, &c. to explain some of the most dangerous symptoms and complications of these affections, and not only to combat them on rational principles, but sometimes even to prevent their occurrence. It is also from a knowledge of this circumstance, together with that derived from the locality and comparative frequency of the tuberculous deposition in different organs, that we attribute the occurrence of cephalitis, meningitis, or myelitis, &c. in a phthisical patient, to the presence of this accidental product in the brain, its membranes, or spinal cord. In the present state of our knowledge there is, perhaps, no practical rule regarding the local treatment of tuberculous affections of equal importance with that which is founded on the pathological fact of inflammation being the frequent, if not the necessary consequence of the mere mechanical presence of the material by means of which we recognise the local existence of these affections. To protect the individual and the affected organ from the influence of all those agents, internal and external, which tend to create an inordinate degree of excitement, or favour the development of active congestion or inflammation, is the rule to which we allude, and to which there can be no exception in the treatment of tuberculous diseases.

The frequency of inflammation as the consequence of the presence of the tuberculous matter, is sufficiently attested by the increased vascularity, *red softening*, and *ulceration* of the mucous follicles and mucous membrane of the intestines and bronchi. The inflammation thus produced is not, however, always followed by the same result. In the brain it proves fatal by the general disturbance of the functions of this organ, and before any other change than softening of the cerebral substance has taken place. In the lungs and intestines it gives rise to extensive solutions of continuity termed tubercular excavations and ulcerations, which always occupy those situations in which the tuberculous matter is most frequently deposited in these organs. The direction in which these solutions of continuity are propagated, as their extension in breadth and depth in hollow, and towards the surface in solid, organs; the peculiar characters of these solutions of continuity; the nature of their contents, and the pathological conditions of the tissues which enter into the composition of their walls, are subjects of great interest in the history of tuberculous affections, but do not require to be discussed in this place.

The occurrence of *mortification* is sometimes the consequence of the inflammation excited by the presence of the tuberculous matter, but more frequently of the pressure which it occasions, the subsequent obliteration of blood-vessels, and the cessation of nutrition in a limited portion of an organ. For an explanation of the manner in which the death of tissues and portions of organs is produced by this cause, we beg leave to refer the reader to the article MORTIFICATION.

Mechanical *congestion* and *hemorrhage* are pathological effects to which the tuberculous matter generally gives rise to a greater or less extent. They are not, however, observed to occasion any sensible modification of function, except when they occur in the lungs. The congestion may be partial or general, according to the situation and the quantity of the tuberculous matter contained in these organs. Should this substance be situated towards the root of the lungs, the congestion may be general, from the trunks of the pulmonary veins

being compressed and opposing a free passage to the return of the blood to the heart. When, on the contrary, the tuberculous matter occupies the substance of the lungs at a distance from the large veins, the congestion is seldom general, because the lungs are seldom generally affected with the tuberculous deposition, and consequently the venous circulation is not interrupted to any great extent. This is by far the most frequent form of congestion, and often occurs during the first stage of tubercular phthisis, aggravating the usual symptoms of the disease, and occasioning hemorrhage from the mucous membrane of the air-cells and bronchi,—a circumstance, the occurrence of which is not unfrequently followed by considerable relief from the oppression and difficulty of the respiration occasioned by the congestive state of the lungs. It is to this mechanical state of congestion that we are disposed to ascribe the occurrence of hemoptysis, which so frequently announces the early existence of tubercular phthisis. We are aware that this variety of hemoptysis is believed to be the consequence of active congestion excited by the presence of the tuberculous matter; but we are the more disposed to reject the opinion that irritation is the cause of the hemoptysis, by reason of the state in which we find the blood-vessels in those parts of the lung containing crude tuberculous matter. In these situations the veins are more or less compressed, or several of them are even obliterated, either in consequence of the compression alone, or the formation of fibrinous coagula within these vessels. Such a state of the veins must be followed by greater or less congestion and hemorrhage in an organ such as the lungs, in which the vascular system predominates, and the blood is effused on the surface of the mucous membrane from the greater facility afforded to its escape. Hemorrhage from the mucous membrane of the digestive canal seems to us to afford an apt illustration of that which takes place from the mucous membrane of the bronchi, for congestion of the chylopoietic viscera is a necessary consequence of obstructed circulation of the liver, either from disease of the heart or the presence of tumours in the liver itself; and even hemorrhage from the bowels may be the ultimate effect of these causes, although it more frequently follows the sudden obliteration of the trunk of the portal vein or its hepatic branches. It is, however, right to observe that we have had only one opportunity of examining the lungs of a phthisical patient, who died of a concomitant affection, and who had several slight attacks of hemoptysis during the short time he lived in the hospital. The greater part of the upper half of both lungs contained a great number of masses of crude tuberculous matter, occupying here and there a single lobule, or two, three, or more lobules, between which veins, some of them as large as a crow-quill, were compressed or obliterated. The pulmonary tissue was red, vascular, and œdematous, but not otherwise diseased; and a great number of the bronchi were filled with fluid and coagulated blood even to their terminal extremities.

There is a fatal form of hemorrhage which occurs in phthisis pulmonalis, and also in tuberculous disease of the bronchial glands, and which takes place in consequence of a communication being formed between a large blood-vessel and a neighbouring bronchus or a tubercular excavation. We have seen a remarkable case of the former kind, in which a communication was formed between the left division of the trachea and that of the pulmonary artery, in consequence of a tuberculous gland situated between them. The patient, a child, perished in the course of a few minutes. The lungs were healthy. Hemorrhage from excavations is by no means common, from the well-known fact of the vessels which traverse them being seldom pervious. Hemorrhage of this kind may be extremely deceptive, as the quantity of blood effused may be in a great part retained in one or more excavations, and be followed by extreme prostration and even death, although only a small quantity of blood has been ejected.

Progress and Termination of Tuberculous Disease.—In the preceding pages we have endeavoured to describe the more remarkable and important changes which take place in the tissues which are the seat of the tuberculous matter, in those more remote from it, and in this morbid product itself. The length of time required for the production of these changes; the average duration of the disease in both sexes at different periods of life; under the influence of temperament, occupation, locality or climate; of the various complications to which we have alluded, and of acute and chronic affections of various organs, are subjects which could not be treated with advantage in a general article such as the present, and more especially as the results of researches on these subjects will have a more immediate practical application, by being introduced into the special divisions of tuberculous disease. For these reasons, also, we would beg leave to refer the reader to other articles for information on the symptoms, diagnosis, prognosis, and treatment of tuberculous disease in its various stages and complications. We shall, therefore, confine ourselves to a statement of those facts, more especially those of an anatomical nature, which demonstrate the favourable termination or cure of tuberculous disease, and the necessary dependence or origin of this affection in a morbid condition of the economy, hereditary or acquired.

The *cure* of a disease is indicated—1st, by the cessation of those symptoms which are peculiar to it, or the restoration of those modifications of function to which its existence gives rise; 2d, by the disappearance of the local cause of the disease, or by the presence of certain lesions which are known to follow as the consequence of such local cause, and of no other. Such indications of the cure of tuberculous disease have been observed, even in those organs, the lungs, in which this disease was long considered, and still is by most medical men, to prove inevitably fatal. There are few physicians who will hesitate to give their assent to the fact, that scrofulous swellings are curable, even without ulceration or suppuration having taken place in them. Such cases, we are aware, are regarded by some as simple, chronic, inflammatory swellings of the lymphatic glands; but this opinion we by no means believe to be correct, for among the great number of cases which we have examined, we have never found these glands, when generally affected, exempt from the

presence of tuberculous matter; and even when the cutis is pale (if they are situated beneath this tissue), we have sometimes found them almost completely filled with this morbid product. When, therefore, enlarged glands in a scrofulous patient ultimately disappear, we may almost with certainty conclude that we have witnessed the cure of a tuberculous disease. Tabes mesenterica, which consists in a similar diseased state of the mesenteric glands, has also been known to terminate favourably. We are not, however, aware that a single case of this kind has been published by any pathologist, and in which the mesenteric glands were found, at some remote period, to furnish anatomical evidence of the previous existence of the disease and of its cure. We ourselves have had only one opportunity of determining these two important points. The patient, who, when a child, was affected with tabes mesenterica, and also swellings of the cervical glands, some of which ulcerated, died, at the age of twenty-one, of metritis, the seventh day after delivery. Several of the mesenteric glands contained a dry cheesy matter, mixed with a chalky-looking substance; others were composed of a cretaceous substance; and a tumour, as large as a hen's-egg, included within the folds of the peritoneum, and which appeared to be the remains of a large agglomerated mass of glands, was filled with a substance resembling a mixture of putty and dried mortar, moistened with a small quantity of serosity. In the neck, and immediately beneath an old cicatrix in the skin, there were two glands which contained in several points of their substance (which was healthy) small masses of hard cretaceous matter. We have also been able to trace the several steps of the same curative process in the bronchial glands, in individuals who had recovered from scrofula and pulmonary phthisis, but who died some time after of other diseases. We have found these glands situated at the bifurcation of the trachea, where they are most frequently and most extensively affected with the tuberculous deposition, as well as some way up the trachea, containing a greater or less quantity of a substance resembling putty or dry mortar, the consistence of which was sometimes equal to that of sandstone or bone. This substance has generally a stellated form, or presents a number of sharp spiculæ projecting from a central mass, which sometimes excite inflammation, ulceration, and hence perforation of the walls of the trachea or bronchial tubes with which they come in contact. A direct communication is thus formed between the cavity of these tubes and the diseased glands, through which the cretaceous bodies pass; and they are rejected along with the expectorated fluids. We have seen several examples of cure of tuberculous disease of the bronchial glands, effected in this manner. The patients were generally advanced in years, and had frequently observed the cretaceous matter in their sputa, portions of which we have examined and found to present all the physical characters of that which was afterwards detected in the bronchial glands. When these diseased glands have evacuated the whole of their contents, they are found atrophiated, and converted into a fibrous tissue, which fills up the external orifice of the perforated air-tube. The accidental opening now contracts, becomes obliterated, and leaves in its place a puckered depression or cicatrix, seen on the internal surface of the air-tube.

Similar appearances indicating the removal of the serous and albuminous parts of the tuberculous matter, and the condensation of its earthy salts, have frequently been observed in the lungs of persons whose history left no doubt as to their having, at some former period of their lives, been affected with tubercular phthisis. The important fact of the curability of this disease has, in our opinion, been satisfactorily established by Laennec. (Traité de l'Auscultation Médiate, &c. 2d edit. Tome premier, p. 580.) All the physical signs of tubercular phthisis have been present, even those which indicate the existence of an excavation, yet the disease has terminated favourably, and its perfect cure has been demonstrated by the presence of a cicatrix in that portion of the lung in which the excavation had formerly existed. In the few remarks which we think it necessary to make on this important part of our subject, we shall confine ourselves to a short description of those changes which take place in the tuberculous matter, pulmonary tissue, and bronchi, which indicate that a cure of tubercular phthisis has taken place. The tuberculous matter, whether contained in a bronchial tube, the air-cells, or cellular tissue of the lungs, has assumed a dry, putty-looking, chalky, or cretaceous character. If these changes in the tuberculous matter are observed in an excavation, the surrounding pulmonary substance is generally dark-coloured and firm; and if the excavation exists in the course of large bronchial tubes, those situated between the excavation and the surface of the lungs are obliterated, whilst those in the opposite direction terminate either in a shut extremity near the excavation, or are continuous with the lining membrane or accidental tissue which incloses the altered tuberculous matter. The existence of this accidental tissue is an important circumstance as regards the cicatrization of tubercular excavations. It is formed by the effusion of coagulable lymph on the internal surface of the excavation, or into the substance of the contiguous pulmonary tissue; it has, in the former situation, so long as a ready exit is afforded to its secretion, the character of simple mucous tissue; but at a later period, and especially when the latter condition is wanting, it becomes gradually and successively converted into serous, fibrous, fibro-cartilaginous, and cartilaginous tissues. The cartilaginous and the osseous transformations of this accidental tissue, are, however, rare, particularly the latter. It much more frequently presents and retains the fibrous character, and possesses the property of contracting so as to diminish the bulk of the excavation, and carry with it the pulmonary tissue with which it is connected. The diminution of bulk which accompanies the removal of the tuberculous matter, and the contraction of the accidental tissue, give rise to a puckering of the lung, which is best seen where the pleura has been forced to follow the retrocession of the pulmonary tissue beneath it, and around what is called the cicatrix: for there sometimes remains only a small globular, oval, or even linear portion of fibrous or fibro-cartilaginous

tissue in a part of the lung, where, from the extensive puckering of the lung around it, there must have formerly existed an excavation of considerable extent.

When the tuberculous matter is contained within the bronchi, or a cavity formed by the dilatation of the air-cells, it does not appear that any accidental tissue is formed during the cure. This matter appears to be gradually removed by expectoration, if the bronchi remain pervious, or by absorption, if they have become closed; and then we have the same obliteration of the terminal branches already noticed, and the same puckering of the surrounding tissues. So complete is sometimes the cicatrization of a tuberculous excavation, that the fibro-cartilaginous substance by which it is generally recognised has entirely disappeared, and there remains only a small nucleus of cretaceous matter not larger than a pin's head. Even this, the remains of the tuberculous matter, may also have disappeared; so that, to a common observer, the pulmonary tissue appears to be in all respects healthy. But when more narrowly examined, we perceive that there is a central point towards which the course of several blood-vessels and bronchi is directed. These blood-vessels and bronchi can be traced terminating in this point, either by dissecting them with care, injecting, or inflating them. There are many circumstances, into the details of which we cannot enter, which prove most satisfactorily that the obliteration of the blood-vessels and bronchi in such cases is the consequence of the entire removal of a quantity of tuberculous matter, and the cicatrization of the cavity in which it was contained.

There are two circumstances of importance connected with the changes which take place in the tuberculous matter, in the blood-vessels and bronchi, during and after the cure of tubercular phthisis, which require to be mentioned, viz. the *situation* and *extent* of the lung in which these changes are observed to occur. We formerly stated that the upper and back part of the superior lobe of the lungs is by far the most frequent situation of tuberculous deposition in these organs. It is also in this situation that the changes we have described are generally found. Indeed, it may be said that it is in the upper lobes alone that they are observed, for we have met with them only in two or three cases in the upper part of the middle lobe of the right, and inferior lobe of the left lung; whereas we have seen them so often in the upper lobes, that, not having *counted*, we shall not venture to name the probable number of cases, lest we should be accused of exaggeration. It is a curious fact that we have seen them oftener in *females* than in *males*, in the former of which the greater frequency of tubercular phthisis is also generally admitted. But a much greater difference in the frequency with which these changes occur, is observed relative to *age*. Thus we have met with them almost exclusively between fifty and seventy, having found them only in two or three cases at an earlier period, and never in children.

The *extent* of the upper lobe of the lung, occupied by cretaceous matter and cicatrices, varies considerably. Most frequently the presence of one or both is confined to a circumscribed portion of the summit or back part of the lobe. Sometimes cretaceous matter, and cicatrices in various stages of their progress, occupy the upper half or two-thirds of this lobe, and the bronchial glands may, at the same time, present similar appearances. The upper lobe of one lung, or of both lungs, may present these appearances; or, being present in this lobe on one side, they may be accompanied with tuberculous deposition and excavations on the other side. Lastly, cretaceous matter, cicatrices, or both, may be accompanied by the presence of tuberculous matter and excavations in the same or neighbouring lobe; thus indicating, when the other circumstances already mentioned are taken into account, the dependence of the former on the previous existence of the latter. There must be few practical pathologists who will not consider these anatomical facts as evidence that tubercular phthisis is a curable disease. No objection has been brought forward calculated in the slightest degree to invalidate the conclusion to which we have been led by the repeated observation of the changes we have described, viz. that these changes are positive indices of the removal of the *material* element of the disease, and also of the cure of those lesions of structure to which it gives rise, even at an advanced period of its progress. We feel all the importance that would deservedly be attached to an accurate statement of the conditions under which the cure of tubercular phthisis was effected, in the great number of cases in which we have found these anatomical proofs of this happy termination of the disease. On this point, however, our information is too vague and incomplete to be of any practical utility; but we cannot avoid repeating the fact that pathological anatomy has, perhaps, never afforded more conclusive evidence in proof of the curability of a disease than it has in that of tubercular phthisis.

[The author has met with several cases in which a cure was accomplished; and the details of the case of an eminent practitioner of this city, Dr. Parrish, have been published, (A Memoir of the Life and Character of the late Joseph Parrish, M. D., by Dr. G. B. Wood, p. 32, Philad. 1840,) in whose lungs there were marked evidences of cicatrization. He had suffered in early life from manifest symptoms of tubercular phthisis, which had yielded to a regimen to be mentioned hereafter. (See Tubercular Phthisis).

M. Boudet has affirmed, before the *Académie Royale des Sciences*, of Paris, that in 197 cases, taken indiscriminately, he found 10 examples of caverns completely cicatrized, without any trace of recent tubercles; and 8 examples of complete or partial cure of caverns coinciding with recent tubercles; and he concludes, that recovery is possible at any period of pulmonary consumption; and that nature generally works the cure.

A recent writer, M. Fournet, (*Recherches Cliniques sur l'Auscultation, &c.*, Paris, 1839,) whilst he admits that pulmonary phthisis is, in extremely rare cases, susceptible of cure in the stage of excavation, considers it to be by no means demonstrated that the cure depends upon complete cicatrization of the excavations; nor is the mode, he maintains, in which the cure is effected yet understood, although he thinks it more likely to be by conver-

sion of the excavations into fistulæ than by their closure.]

The cure of tuberculous disease in other organs has not been satisfactorily demonstrated. We have, however, as was before done by Jenner, and since by Dr. Baron, frequently produced tubercles in the liver of the rabbit, and afterwards ascertained that their complete removal was effected by absorption and excretion. When this is accomplished by the latter process, which is most commonly the case, no trace of the disease remains; and when effected by absorption, we have found the surface of the liver marked by irregular furrows or depressions, apparently produced by atrophy of the organ around the seat of the tuberculous matter.

The *origin* of tuberculous affections in a morbid condition of the economy is the last, and perhaps the most important part of our subject, but on which we propose to make only a few observations.

In a former part of this article we endeavoured to show the necessity and importance of making a broad distinction between the localization or actual presence of a disease in an organ, and that general morbid condition of the economy in which it originates and derives the peculiarity of its local characters. The absolute necessity of this distinction is obvious as regards all those diseases which consist essentially of two elements—a local or general modification of function, and the actual presence of an organic lesion or product. The presence of tuberculous matter constitutes the material element of the disease now under consideration, and like every other morbid product of the same class, has its peculiar and distinctive characters. It is in consequence of the tuberculous matter presenting these peculiar characters, that we consider it to be a disease *sui generis*; and it is also in consequence of this matter being formed in particular organs, as it were indifferently (at least as regards the rapidity and extent of its formation), under every variety of morbid agency to which these organs may have been subjected, that we cannot admit its formation to be the necessary consequence of any of those local causes to which it has been ascribed. Were we to examine these causes in detail, we should find that there is no necessary connection between any of them and the formation of the tuberculous matter. The most obvious of these causes, and that to which by far the greatest importance has been attached, is inflammation, or certain real or imaginary modifications of it. Now it is well known to every practical pathologist, whose mind is not biassed by preconceived theory, that inflammation, whatever may have been its degree, extent, or duration, whatever may have been the tissue or organ affected with it, is not necessarily followed by the formation of tuberculous matter or any other product of a similar kind, inasmuch as in such cases we often meet with no trace of this particular product in the affected organ after death; and, on the contrary, the formation of tuberculous matter is found to take place in organs, the functions of which were never observed to have been deranged, and in which, after death, none of those lesions could be detected which are known to follow the presence of inflammation. Under such circumstances, it would be absurd to ascribe the origin of tuberculous matter to inflammation—an effect and its cause are always inseparable under conditions of a similar kind. Applying this law to the solution of the question before us, we arrive at a fact which of itself is sufficient to overthrow every argument which has been brought forward in support of the local origin of tuberculous disease, and which supersedes the necessity of those researches which have been made to prove or disprove such a theory, by determining the relative frequency and order of succession of local lesion and functional derangement, observed in the affected organ, viz. *that the products of inflammation are always the same under conditions of a similar kind.* These products are *coagulable lymph* or *pus*; and that inflammation has *always a tendency* towards the formation of one or both of these products, is proved by the infinitely more frequent occurrence of these than of any other morbid product, consequent on this physiological change. We are therefore entitled to conclude that pus and coagulable lymph are the *natural products* of inflammation, and that, were the conditions under which this pathological state takes place always the same, its products would be so also. Hence it follows that when other products than these make their appearance in inflammation, the legitimate conclusion is, that some other morbid condition besides inflammation is present, and to which morbid condition alone must be owing the essential and distinctive characters of such products.

In what this morbid condition consists we have no means of ascertaining. The etiology of tuberculous disease [tuber calosis] furnishes the strongest proofs, independently of those which we have brought forward, of the reality of its existence, and the certainty of its origin under the influence of circumstances which effect a general change, perhaps more especially in the function of nutrition in general, and which is made manifest to us by the presence of a particular morbid product, through the medium of secretion. The production of the tuberculous disease in the rabbit, by changing as it were the conditions of its existence, that is to say, by forcing it to live on food not suited to its species, and by confining it in a cold, dark, damp, and narrow habitation, strongly illustrates the influence of those physical agents to which the origin of the disease in the human species is attributed by the generality of pathologists, and also the general character of the change thereby induced. The production of the disease in the cow takes place under similar circumstances, with the exception of cold; the treatment of this animal when confined within the walls of a dairy being, in point of fact, an experiment of the same kind, and followed by similar results, but to a far greater extent. Such, also, is the treatment of the monkey in this country, an experiment of a more decided kind, in which animal the extent and fatality of the disease is seldom equalled, even in its worst forms, in man.

The conditions under which tuberculous disease prevails in the human species, are so similar to those to which we have just alluded, that their influence in its production must be admitted to operate on the same general principle. These remarks apply to the formation of tuberculous disease under circumstances where there is no reason

to suppose that it has been favoured by any original tendency or disposition. For more ample information on the *acquired* origin of this affection, and also on its *hereditary* origin, we again beg leave to refer the reader to the article TUBERCULAR PHTHISIS.

[See an interesting summary of the existing knowledge on Tubercle and Tubercular Phthisis, in the Retrospective Address delivered in 1843 to the Provincial Medical and Surgical Association by Dr. James Black, an extract from which is given in the *American Journal of the Medical Sciences*, April 1844, p. 446.]

R. CARSWELL.

TUBERCULAR PHTHISIS, OR CONSUMPTION, PHTHISIS TUBERCULOSA, PHTHISIS PULMONALIS.

The term phthisis (φθίσις, from φθίω, *corumpo, consumor, to waste or decay*) was introduced into medicine when there existed little precise knowledge of the morbid condition upon which the emaciation and other characteristic symptoms of the disease depended. It was first used as a generic term to signify consumption of every kind, and was afterwards more distinctly specified according to the organ in which it was supposed to originate, as phthisis pulmonalis, phthisis hepatica, phthisis mesenterica, &c.; indeed it has even been applied to the wasting attendant on various diseases, as phthisis rheumatica, phthisis syphilitica, phthisis scorbutica, and many others. These indiscriminate appropriations of the term gave rise to much vagueness and confusion in its practical application. But as the knowledge of morbid anatomy became more precise, disease of the lungs was found to be more frequently connected with consumption; and hence phthisis pulmonalis not only attracted far greater attention than any other form of the disease, but a large proportion of the other species were found to resolve themselves into this, having been discovered to be mere complications of it. Phthisis pulmonalis was now divided into various species, according to the real or imaginary nature of the pulmonary disease upon which the symptoms were supposed to depend.

At length, Laennec, finding, in the course of his extensive researches into pulmonary diseases, that tubercles formed almost the universal cause of consumption, proposed to restrict the term phthisis to the disease produced by tubercles in the lungs; and since the publication of his great work in 1819, (an important era in our knowledge of pulmonary disease,) the term has been so restricted in France. The accuracy of Laennec's opinions has been confirmed by the subsequent investigations of Louis and Andral, whose minute and laborious researches have given a precision to our knowledge of the subject which was unknown before their time. But, notwithstanding the advantages which have resulted from the adoption of these views, they have tended to keep alive the idea that pulmonary phthisis is a local disease, referable to a local cause: and thus the constitutional origin of tubercles, by far the most important part of the subject, has been neglected.

Before we can hope to acquire an accurate knowledge of consumption, we must carry our researches beyond those morbid alterations which constitute the pulmonary disease and are only a secondary affection, — the consequences of a pre-existing constitutional disorder, which is the necessary condition that determines the production of tubercles.

An imperfect acquaintance with the nature of tubercles and with the morbid state of the system in which they have their origin, has led to great discrepancy of opinion concerning the nature and causes of phthisis pulmonalis. There are many, even at the present day, who regard tuberculous disease of the lungs, as the result of inflammation; an opinion which we consider as not only erroneous, but as having been productive of a very mischievous practice. Inflammation of the respiratory organs may, and we believe often does give rise to tubercles, and unquestionably accelerates their progress; but we also believe inflammation to be incapable of producing tubercles in a healthy constitution.

Chronic inflammation of the different tissues of which the lungs are composed, is often accompanied with symptoms closely resembling those produced by tuberculous disease. Chronic bronchitis and chronic pleurisy afford examples of this kind; and the distinction between these and tuberculous disease of the lungs, becomes, in some cases, very difficult. Hence they have been, and still are often confounded, and considered, as regards each other, in the light of cause and effect. This error originates not in the nature of the subject, but in a want of correct observation; and we are of opinion that when the history of these inflammatory affections is carefully investigated, they may, in a very large proportion of cases, be discriminated from pure tuberculous disease. That the distinction is not more frequently made is owing more to our own imperfect and careless inquiries into the history of the cases which come before us, and to our negligence in examining minutely all the signs and symptoms which they present, than to any real obscurity in the nature and characters of the diseases themselves. The truth is, that in the highly tuberculous constitution, tuberculous disease of the lungs very often occurs in a slow, insidious manner, and, in a large proportion of such cases, has made considerable progress before it manifests itself by any remarkable local symptoms, or is even suspected to exist by those who regard consumption as originating in inflammatory diseases of the lungs. In such examples of latent tuberculous disease, an attack of catarrh, a slight inflammation of the pleura or of the lungs, or hemoptysis, is not unfrequently the first circumstance which excites the attention or awakens the fears of the patient and his friend; and to this accidental occurrence, to which the presence of tubercles in the lungs renders the person peculiarly liable, the origin and cause of all the future mischief is attributed. Nor is it surprising that an ordinary observer should arrive at such a conclusion; and, ascribing the disease to that which was first cognizable by his senses, should consider the "neglected cold," the "inflammation of the lungs," or the "breaking of a blood-vessel," the original cause of all the subsequent evil. But, after all the light which modern pathologists have thrown upon the nature, the diagnosis and prognosis of tuberculous disease, it may well excite surprise that medical men should still

regard these affections as the chief causes of phthisis. In a vast proportion of cases of this nature, a more minute inquiry into the patient's previous state of health, and a closer investigation of the symptoms, would have led to the conviction that long before the pneumonia, the hemoptysis, or even catarrh, tuberculous disease of the lungs existed, and that those affections were consequent upon, or at least subsequent to, the existence of pulmonary tubercles, or had occurred in a tuberculous constitution by which their effects were modified. In another part of this article we shall state the grounds upon which this opinion rests, and at the same time endeavour to show that tuberculous disease of the lungs may be detected long before it generally is;—that what is usually considered the early is in reality an advanced stage of the disease;—and that tubercle, even in its nascent state, is, as has just been stated, a secondary affection, originating in, and dependent upon, a morbid condition of the general system, viz. tubercular cachexia.

Our principal object in this article is to take a comprehensive view of tuberculous phthisis as originating in a morbid state of the constitution; to inquire into this nature, origin, and causes as an hereditary affection; to point out those circumstances which are capable of inducing it at the different periods of life; and to attach the proper value to those pulmonary diseases which are considered by some as the real causes of consumption, but by others, more correctly in our opinion, as merely determining causes, and often only complications. If we succeed in giving a satisfactory exposition of this, the most important, but hitherto most neglected part of our subject, we may hope to lay the foundation of a sounder pathology of tuberculous disease, and to establish a more rational and more effectual mode of prevention and treatment during that period of its progress in which medical treatment is of much avail, and a cure can be considered possible. For no physician, acquainted with the morbid anatomy of phthisis, can for a moment indulge the hope that we shall ever be able to cure what is usually termed "confirmed consumption," if we except the small proportion of cases in which the tuberculous deposit is confined within narrow limits. The state of the lungs in the advanced stage of phthisis is to be regarded as the result of a series of morbid processes which have terminated in the destruction of the organ; and we might as reasonably expect to restore vision when the organization of the eye is destroyed, or the functions of the brain when the substance of that organ is reduced by disease to a pultaceous mass, as to cure a patient whose lungs have been extensively destroyed by tuberculous disease. "Quelle est la maladie qu'on guérit," asks Portal, "quand l'organe dans laquelle elle réside a souffert une désorganization complete?" (*Sur la Phthisie*, Introduction.)

Had the labour and research that have been wasted in fruitless experiments to cure an irremediable condition of the lungs been directed to the discovery of the causes and nature of tuberculous disease, with the view of deducing rules for its prevention and treatment, consumption would be regarded in a light very different from that in which it is looked upon at the present period. Our view of tuberculous consumption comprehends not merely the period succeeding the actual development of pulmonary tubercles, but the whole course of the disease from the very commencement of the constitutional disorder. By a knowledge of this constitutional disorder, we may reasonably hope to prevent, in many cases, the occurrence of the disease, and, in a small proportion, to arrest its progress in its nascent state and even to remove its local effects: and if we go a step further back, and investigate the causes which give rise to the tuberculous diathesis in the parent, we may also hope to diminish the hereditary disposition in the offspring. This is, no doubt, opening a very wide field of inquiry; but it is most certain that, unless we enter into the subject in its fullest extent, we shall do little effectual towards diminishing the frequency, or reducing the mortality of this very prevalent and most destructive malady.

It is not, we believe, advancing too much when we state that, among the whole range of human infirmities, tuberculous diseases are the most deserving the study of the physician, whether we regard their immense frequency or appalling mortality. Confined to no country, age, sex, or condition of life, they destroy a larger proportion of mankind than all other chronic diseases taken together. In this country, and over the whole temperate region of Europe and America, tuberculous disease of the lungs causes probably a fifth part of the whole mortality; and in some districts, and even in whole countries, the proportion is much larger. It has been calculated by the late Dr. Young, Dr. Woollcombe, and others, from the best data which the bills of mortality afford, that in Great Britain and Ireland, consumption causes one-fourth part of the deaths that occur from disease. If, then, we add to consumption, tuberculous disease of the glandular system, of the brain, of the large joints, of the spinal column, &c. and deduct the mortality which occurs during the first months of life, we shall probably be within the truth in stating that one-third part of the mortality of this country arises from tuberculous diseases: and if to this frightful destruction of mankind we add the numerous crippled and disfigured sufferers whom we daily meet with, the blind, the deaf, and the maniacal, (for mania is not an infrequent consequence of this disease,) and, above all, the painful reflection that the predisposition to this destructive class of maladies is transmitted from the parent to the offspring,—we shall surely have no need to press upon medical practitioners the claim which tuberculous disease has, above all others, upon their earnest consideration.

A very important question in the history of tuberculous diseases naturally presents itself to our consideration in this place, viz. their increasing or decreasing frequency. Every member of the profession has too ample opportunities of satisfying himself of the extensive prevalence of strumous diseases; but some doubts may exist as to their being comparatively more prevalent at the present time than they were some fifty or a hundred years ago. By the bills of mortality, it would appear that the number of deaths from consumption in this country is less at present than

thirty years since (Elements of Medical Statistics, by F. Bisset Hawkins, M. D.); but the known inaccuracy of records of this kind should render us cautious in giving too implicit faith to conclusions drawn from such sources. The labouring classes of the population in this country are at present in a more comfortable state than they were half a century back: they fare better, are better clothed, and more comfortably lodged;—circumstances which are all favourable to health, and consequently to the diminution of tuberculous disease. Although we can in these circumstances perceive a probable cause of such diminution of tuberculous disease in the lower orders, we confess we have our doubts whether their more general indulgence in the use of ardent spirits has not prevented such abatement. But whether tuberculous diseases have diminished or not during the last half century among the labouring part of our population, we are of opinion that they have increased in the upper and middle ranks of society. This is an inquiry of great moment. If it were clearly shown that the disease is gradually abating among all ranks of the people, we might perhaps leave it in the hope that its diminution would keep pace with the improvement of society. But if, on the contrary, we arrive at the conclusion that scrofulous disease is on the increase, or, in other words, that the health of the middle and upper ranks of society is progressively declining, we shall have the strongest reasons for inquiring into the causes which lead to such deterioration of health, with a view to obviate it.

That a general delicacy of constitution and a proneness to scrofulous diseases are on the increase, is a conclusion, the accuracy of which we leave to be decided by the experience of the profession. We have all an opportunity of observing and comparing the state of health of the rising generation with that of their fathers and grandfathers. On taking a survey of the constitution of these three generations, we think it will be found, in a large proportion of instances, that the deterioration of health is progressive from father to son. We are far from believing that this is invariably the case; but we do believe that it will be found generally so: at least, such is the conclusion to which we have been led from personal observation.

It is unnecessary in the present article to enter upon the consideration of the whole series of tuberculous diseases, as part of the subject has been already treated in this work. (See Scrofula, Tabes Mesenterica, and more particularly the admirable article Tubercle.) But, although our chief object will be to enter more particularly into the history of pulmonary tubercle, our observations will apply to the whole class of tuberculous affections, more especially when treating of the nature, the causes, and treatment of the disease.

Sect. II. — Of the tuberculous Constitution and tuberculous Cachexia.

As we shall have frequent occasion, in the course of the present article, to refer to that morbid condition of the system which precedes and attends tuberculous disease, we shall commence by giving a brief view of the characters by which it may generally be recognised. It is right, however, to premise that these are so variously influenced by the age, complexion, temperament, and other circumstances of the individual, that it is a matter of considerable difficulty to describe them. It must also be observed that this morbid condition itself is progressive, and therefore varies in intensity.

The tuberculous constitution, when of hereditary origin, is manifested by a peculiar appearance of the countenance, by the form and development of the body, by the anormal state of various important functions, and by a peculiar disposition to certain diseased actions. The aspect of the countenance generally affords decisive indications of the presence of the affection: in early childhood it has a pale, pasty appearance, the cheeks are generally full and the upper lip and alæ nasi large. If the complexion be dark, the colour of the skin is generally sallow; if fair, it has an unnatural white appearance, resembling blanched wax rather than healthy integument; and the veins are large and conspicuous. At a more advanced period of youth, the indications exhibited in the countenance are more clearly marked. The eyes, particularly the pupils, are generally large, the eye-lashes long; and there is usually a placid expression, often great beauty of countenance, especially in persons of a fair, florid complexion. On the other hand, the features are generally less regular in those of a dark complexion, and the skin is commonly coarse and of a sallow dingy colour; although there are many exceptions to this, in the fine dark eye, regular features, and delicate skin of such persons. Still, it is difficult to describe with accuracy the tuberculous physiognomy, as it varies in every intermediate shade, between the pale, faded, but changing colour of persons little under the influence of this morbid condition, and the peculiar cast of countenance which attends the confirmed cachectic state.

In early infancy there is little remarkable in the form of the body; it is generally large, but wants the firmness of health. As the child increases in age, we find for the most part that it is not well proportioned; the different parts are rarely in keeping, and there is a want of symmetry in the whole. The head is often large, the trunk small, the abdomen tumid, and the limbs are unshapely, being either large and clumsy, or disproportionately slender, with large joints: but this is only the case in the more perfect examples of the tuberculous constitution. The growth of the body is also generally unsteady in its progress; very frequently it is slowly and imperfectly developed: it may increase for a time in the usual manner, and then remaining stationary for years, again proceed, especially towards puberty, with extraordinary rapidity. This last circumstance in the growth of all young persons, but more particularly in the tuberculous, is frequently observed after any acute disorder, such as fever, measles, &c.

The functions most evidently deranged, are those more immediately connected with nutrition, particularly those of the digestive organs. The dyspepsia of the scrofulous constitution has peculiar characters by which it may generally be known. These have been accurately described by Dr. Todd in the article Indigestion, (vol. ii.) under the name of *strumous dyspepsia*, a condition of the digestive organs which is not

only present in the hereditary strumous constitution, but is capable, we believe, of generating this constitution, and of leading ultimately to tuberculous cachexia. In Dr. Todd's opinion, "it presents a more characteristic feature of this habit of body than any physiognomical portrait which has yet been drawn of it. In this respect it is more to be depended on than either the fine skin, the clear, delicate complexion, the light hair, large blue eyes, and dull sclerotica of one variety; or the foul, dull, swarthy-coloured skin, the sallow complexion and swollen countenance, the dark hair, and tumid upper lip of the other." Again, "upon whatever temperament the disordered habit which we call scrofula may engraft itself, we venture to say that this form of dyspepsia will also there be found; and, therefore, being constantly present with it, preceding and accompanying the various symptoms which issue from it, it would be contrary to all reason to refuse to it an important share in the development of this disordered habit, and in the production of the local affections which have hitherto too much engrossed the attention, to the exclusion of a proper consideration of the constitutional disease." We have cited Dr. Todd's observations, although forming part of this work, because they cannot, in our opinion, be too strongly pressed upon the consideration of the profession, so much importance do we attach to this disordered state of the digestive organs as a source of tuberculous disease. We shall return to the consideration of this subject when treating of the causes.

The intellectual functions are often performed with a preternatural degree of activity, a premature development of the mental faculties being a frequent accompaniment of the tuberculous habit; a circumstance which demands our attention, on account of the practical rules to be founded on it in regulating the education of such persons. But this state of the intellect is by no means a constant attendant on the scrofulous constitution; indeed, the very reverse often prevails. Hence we have two opposite states of the mental as well as physical constitution; the one, attended by a florid complexion, thin, fair skin, and great sensibility to impressions, along with a corresponding acuteness of mind; the other, characterized by a dark complexion and coarse skin, with a languid, torpid condition of the bodily functions, and a like dulness of the mental faculties.

If we take a more particular survey of the functional derangements of the tuberculous constitution, we shall find that digestion is rarely well performed; that the bowels are irregular, more frequently slow in their action than the reverse, and that the evacuations are not of the natural appearance which they are known to possess in healthy persons. The urinary secretion, also, often deviates from the healthy standard, being generally turbid, particularly when the bowels are costive. The cutaneous functions are rarely in a healthy state; the skin is either pale, soft and flaccid, or dry and harsh, and frequently affected with eruptions. In general, the insensible perspiration is defective, although copious partial perspirations are not uncommon, particularly in the feet, where they often have a fetid odour. The physical powers are generally below the usual standard. The limbs, though full, are soft, and want both the form and firmness of health. The circulation is generally feeble, as is indicated by a weak pulse, cold extremities, and inability to bear much bodily fatigue. This state of the circulating system forms an essential element in the tuberculous constitution, at least we have rarely or never found it wanting, and we regard it as affording an explanation of many of the most important phenomena of the disease. A full development of the body and great muscular power are not, however, incompatible with the tuberculous constitution. Several of our celebrated pugilists have died tuberculous; and very lately one died of phthisis, within our knowledge, a short time after an obstinately contested fight, which proved fatal to his antagonist. Independently of their bearing on the present subject, such examples deserve attention, as showing the effect of training in increasing the strength even of the tuberculous system.

The tuberculous constitution is, also, further characterized by a peculiar liability in the subjects of it to certain diseases affecting in a special manner the mucous surfaces. We have already noticed the irritation of the digestive organs; there exists also, in general, a strong disposition to catarrhal affections, generally confined in early youth to the nasal cavities, often very tedious, and not unfrequently attended with a copious and long-continued discharge of thick yellow mucus. Epistaxis is also common in young children of the strumous constitution. The eyelids and the ears also are very liable to chronic inflammation, which is often attended in the latter organs by a discharge of puriform matter. Inflammation and a chronic congestive state of the mucous membrane of the internal fauces is likewise common, frequently terminating in chronic enlargement of the tonsils. The bowels are easily deranged, and often discharge large quantities of mucus upon slight causes of irritation. Slight febrile attacks are also common, being generally connected with irritation of the digestive organs. Eruptions on the hairy scalp are very frequent; and the external lymphatic glands become readily enlarged from slight irritation of the neighbouring mucous surfaces or of the skin, and from exposure to cold, &c. The catamenia in young females are also very often tardy in appearance and irregular in their return.

By the term Tuberculous Cachexia, we designate that particular condition of the system which gives rise to the deposition of tuberculous matter, on the application of certain exciting causes which will be noticed in a future part of this article, but which have no such effect on a healthy system. This morbid constitutional affection has been noticed by various authors under different names, (*latent scrofula, scrofulous diathesis*, &c.) and described under the present appellation in our work on "Climate." It is a state which may exist from birth, or be acquired at almost any period of life, from infancy to advanced old age. When thus acquired, the characters by which it is recognised are less clearly marked and less easily distinguished than when it occurs as an hereditary affection, or is engrafted on the tuberculous constitution. We want in a great degree

the external features and form which characterize the hereditary disease. But even when the disease has been acquired after maturity, the peculiar pallid hue approaching to a sallow tinge, together with the sunk and faded state of the features, are in general sufficiently well-marked to indicate the patient's condition. In persons of dark complexion this is accompanied by an unvarying sallow, or rather leaden hue of skin, and a dull pearly appearance of the sclerotica; and in the fair and florid, by a pasty aspect of the countenance, alternating with the irregular red and white mottled appearance of the cheeks, passing often from the paleness of death to a dark purplish hue, in a way more easily recognised than described. In more advanced life, the deep sallow cast of countenance, varying occasionally to a tinge of yellow, predominates and marks the slowly acquired but deeply-rooted constitutional disorder.

SECT. III.—OF TUBERCULOUS DISEASE OF THE LUNGS, OR PHTHISIS, PROPERLY SO CALLED.

In describing the course of tuberculous consumption, we shall endeavour to trace the connection between the external symptoms, local and general, and the progressive morbid changes in the lungs; as it is only by keeping this connection constantly in view that we are able to detect the pulmonary disease in its commencement, or distinguish it even in its more advanced stages, when rendered latent or obscured by the presence of other diseases.

Although a certain group of symptoms accompany tuberculous disease of the lungs, the order in which they present themselves and the degree of their severity vary remarkably in different individuals. In some cases the symptoms are so prominent as to excite the attention of the most careless observer, while in others they are so slight as scarcely to be observed by any but the medical attendant, and they even occasionally escape his observation.

We shall, in the first place, describe the more usual form and progress of phthisis, and afterwards notice the less common but not less certain forms which it assumes. We shall also adopt the mode of dividing the subject into stages, as it will enable us the more easily to connect the progress of the pulmonary disease with the symptoms by which it is accompanied.

1. Of the more common or general form of Phthisis.

First stage.—It is natural to suppose that the symptoms of any disease should be expressive of impeded or disordered function of the organ in which such disease is seated, and hence in the present instance cough is generally the earliest symptom by which tuberculous disease of the lungs is indicated. It is first observed in the morning on getting out of bed, but is for some time so slight as scarcely to deserve the appellation, consisting of little more than one or two imperfect efforts to cough. After a longer or shorter period, this symptom occurs occasionally during the day, especially after slight exertion, and also at night on getting into bed. By degrees, the morning cough is accompanied with the expectoration of a transparent ropy fluid, resembling the saliva, and apparently originating in the posterior fauces. The cough soon becomes attended with the same kind of expectoration during the day; but at this period of the disease, as well as through its whole course, the expectoration is generally most abundant in the morning.

Along with the cough, sometimes indeed preceding it, but much more generally occurring only after it has existed for some time, a degree of oppression of breathing is remarked on ascending stairs, or making any active exertion; and a tightness of chest or transitory pain is also frequently experienced on these occasions.

Soon after the appearance of the cough and dyspnœa—the first direct indications of the morbid condition of the lungs, the general system begins to sympathise with the local disease. The pulse becomes quicker than natural, especially after meals and towards evening. At this period of the day there is also frequently experienced a slight degree of chilliness, followed by some heat of skin, particularly in the palms of the hands and soles of the feet, which continues during the night. When this state of things has lasted for some time, perspiration succeeds the heat, occurring generally towards morning. Yet this febrile paroxysm is often so slight as to be overlooked by the patient, particularly its two last stages; the evening chill attracts more attention, as the sensations which accompany it are very unpleasant, but it rarely occurs without being followed by a degree of febrile heat. The sleep is now less sound and refreshing, and is occasionally disturbed during the night by cough.

[Along with these symptoms, pain in some part of the thorax is often experienced, sometimes constant, at others intermittent, and occasionally so regularly intermittent, that, as it has occurred with the paroxysms of hectic, it has been mistaken for intermittent fever, and treated accordingly. This pain often occupies the scapulo-humeral articulation, and is accompanied with tenderness of the subclavicular region, and often with irritation of the muscular fibres, which causes their contraction on percussion. The combination of this pain in the shoulder, with quickness of pulse—according to Dr. Stokes (*on the Diagnosis and Treatment of Diseases of the Chest*, Amer. edit. Philad. 1844), should always excite alarm.]

While these symptoms of local disease are engaging our notice, those indicating the general state of the system are no less deserving of our attention. The aspect of the patient gives evident indications of tuberculous cachexia; the countenance is paler than usual, or changes colour frequently,—being at times, more especially early in the day and after a little fatigue, faded and expressive of languor; which indeed exists in a greater or less degree, the patient being little inclined or able for exertion, either bodily or mental: on examination at this time the skin will also be found to have lost its natural elastic feel, and the flesh its firmness, while a degree of emaciation is generally evident.

These symptoms may continue for a considerable period without any remarkable increase, varying in degree according to the state of the weather and the circumstances in which the patient is placed. If they have made their first appearance in the spring, they often diminish and may even

cease as the summer advances, especially if the patient is put upon a judicious regimen and is sent to a healthy part of the country. The tubercular disease is interrupted by the amendment of the general health, and the patient may even improve so much as to lead him and his friends to think the danger is past; but the following season too often undeceives them. If the symptoms have occurred early in the winter, the amelioration produced by the succeeding summer is seldom so evident; because in general the disease has made considerable progress during the winter. Still the state of the patient may undergo great amendment; the symptoms may almost disappear, and he may gain both flesh and strength; but the cough rarely ceases, and the first approach of cold weather, or the first attack of autumnal catarrh brings back the symptoms and feelings of the preceding winter with remarkable rapidity.

As the symptoms which have just been enumerated generally characterize the *first stage* of tuberculous consumption, it is a matter of great importance to determine the condition of the lungs with which they are associated. We have seen that cough, some dyspnœa, slight hectic fever, languor, debility, and commencing emaciation constitute the external or visible phenomena of the disease. Morbid anatomy informs us that the lungs at this period contain a greater or less quantity of tuberculous matter, the whole or a large proportion of which is still in what is called the state of crudity; that is, more or less firm, of a greyish colour, and somewhat transparent; or partly of a pale yellowish colour and opaque. The pulmonary tissue and bronchial membrane in the immediate vicinity of the tuberculous deposits may have undergone no perceptible alteration, or both may present a degree of redness and vascularity.

The *physical signs* afforded by an examination of the chest during life, under such circumstances, are unfortunately often obscure; though this will depend on the extent of the tuberculous matter and the manner in which it is deposited. If it be in small quantity, or diffused pretty generally through the lungs, little light will be thrown on the disease by auscultation; but when it is more abundant, and deposited, as it generally is, in the summit of the lungs, auscultation assists us greatly in detecting the real nature of the disease in doubtful cases. The sound elicited by percussion, when delicately performed, will often be found clearer under one clavicle than the other; the respiratory murmur, heard through the stethoscope, will be less soft and free where the duller sound exists, and the resonance of the voice greater at the same place. Unless, however, there is an obvious difference between the sounds heard in the relative situations on both sides, the signs afforded by auscultation are not much to be depended on at this early stage of the disease; and in many cases we have to form our opinion of the patient's condition from the local and constitutional symptoms only. In other instances, however, with the same symptoms, the physical signs afford the most unequivocal indications of the existence of pulmonary disease. The sound elicited by percussion is evidently less clear under one clavicle; the respiration less soft and easy, and the voice decidedly more resonant than under the opposite clavicle; and, even at this early period, the motions of the upper parts of the chest, carefully observed during inspiration, may often be remarked to be unequal; one side of the chest being more fully expanded during inspiration than the other. When this is the case, it will generally be found that the side least elevated is that which gives the most evident signs of the existence of tubercles.

[In the very early periods, however, Dr. Chambers, according to Dr. Walshe, (*The Physical Diagnosis of Diseases of the Lungs*, Amer. edit. p. 167, Philad. 1843), has observed an enlargement in the antero-posterior diameter of the summit of the chest, doubtless owing to increase in the size of the lung produced by the tuberculous formations. When these have taken place freely, the subjacent arteries are often heard unusually clear below the clavicles; and in cases of tuberculous deposition in the upper portion of the right lung, the sounds of the heart are frequently heard more loudly in this situation than under the left clavicle. When the subclavian arteries are heard with unusual distinctness, it may be owing to a partial obstruction of the arteries by the pressure of indurations at the apex of the lung. This has been esteemed a sign of incipient phthisis, but it cannot be diagnostic, as the same sounds are produced in some healthy persons under slight excitement, probably, as suggested by Dr. C. J. B. Williams, (*Lectures on the Physiology and Diseases of the Chest*, Bell's Lib. edit. p. 235, Philad. 1839), owing to the artery pressing on the clavicle or upper rib.]

When the tuberculous matter is diffused over a large portion of the lungs, puerile respiration occasionally indicates its presence. A marked inequality in the sound of the respiration in different parts of the chest also affords strong suspicion of tuberculous disease, when such inequality cannot be otherwise accounted for.

By a careful inquiry into the state of the patient's health, previously to the period now under consideration, and by attention to the various symptoms which have been enumerated, the physician who has been accustomed to trace the connection of symptoms with the morbid changes of the organ, of which they are merely the external manifestations, will rarely fail to arrive at a correct opinion in such a case; and if he has availed himself of the evidence derived from the physical signs, he will have the positive assurance that his diagnosis is correct in a very large proportion of cases. Yet it often happens that a patient presenting all the indications of tuberculous disease which have just been stated, is said, and believed to be, merely *threatened* with disease of the lungs, or to have an affection of the trachea or bronchi; and it is commonly added that, "with care all will do well." This arises from the habit of trusting to symptoms alone for a knowledge of disease, neglecting pathological anatomy, by which the physician is enabled to connect the external phenomena of disease with the morbid condition of the organ.

Second stage. — The circumstance which has been considered as marking the passage from the first to the second stage of phthisis, is a remarkable change in the expectoration. The colourless

frothy expectoration, which had hitherto attended the cough, is observed to contain small specks of opaque matter of a pale yellowish colour; the proportion of which gradually increases, forming patches surrounded with the transparent portion in which it seems to float. Specks or streaks of blood are also often observed in the expectoration at this time.

With this change in the expectoration the other symptoms generally increase; the cough becomes more frequent and troublesome, the evening chills more constant and severe, the succeeding heat of skin greater and more general, and the morning perspirations more regular in their occurrence and more copious. The hectic fever is now established; the pulse is frequent at all times, and the respiration hurried, even when the patient is at rest. The sense of languor and weakness also increases; the patient or his friends remark that he is losing flesh, and that what remains is soft and flabby; and he feels himself quite unequal to the degree of bodily or mental exertion to which he has been accustomed. The face is generally pale during the day, while a circumscribed flush of the cheek is often remarked towards evening. About this period also, if not earlier, pains which are usually considered rheumatic, are often experienced in the side and in the neighbourhood of one or both shoulders. Hemoptysis is likewise a frequent occurrence, amounting in some cases merely to a slight streak in the expectoration, while in others a considerable quantity of pure unmixed blood is brought up.

These symptoms are accompanied by a corresponding change in the morbid condition of the lungs. The tuberculous deposit has undergone that process which is called *softening*; that is, it has been softened and diluted by a morbid secretion from the surrounding pulmonary tissue; and the change in the character of the expectoration indicates at once the softening of the tuberculous matter, and its passage into the bronchial tubes. While this process of softening is taking place in the tuberbulous masses of earliest formation, the pleura covering the diseased portion of lung generally becomes adherent to that of the ribs, by the effusion of lymph which is subsequently converted into cellular tissue. The extent and firmness of these adhesions are generally proportionate to the extent and duration of the tuberculous disease. The pains which are very commonly experienced in the upper and lateral parts of the chest are, no doubt, partly the consequence of the slight pleuritic inflammation which precedes the uniting process; and accordingly we have generally found, on inquiry, that the pains were either confined to, or more frequent and severe on that side of the chest where the most extensive tuberculous disease was manifest.

While the tuberculous matter is being thus softened and expectorated, leaving excavations of a greater or less extent in the superior lobes, the lower portions of the lungs are gradually becoming tuberculous, the progress of the disease being usually from above downwards.

A careful examination of the chest at this period affords positive evidence of the internal mischief. The upper parts are less freely raised during inspiration than in the healthy state; and this is frequently more evident on one side than the other. The sound on percussion is dull under both clavicles; and on applying the stethoscope or ear to the chest, a slight crackling noise (*crepitating rhonchus*) is heard, while a gurgling sound (*cavernous rhonchus*) is frequently produced by coughing. The voice is more resonant, amounting generally to bronchophony; and distinct pectoriloquy is often heard in one or more points of the clavicular or scapular regions. All these indications are very generally more evident on one side than the other; and hence, in obscure and complicated cases, arises the advantage, and even the necessity, of attending more particularly to this circumstance, in order to enable us to establish our diagnosis with more certainty and precision.

[It is proper to remark, that the tuberculous deposition and development may have proceeded to the extent of rendering the greater portion of the upper lobes impervious to air, and of considerably solidifying those lobes; yet, as Dr. Graves has remarked, (*Clinical Lectures*, Dr. Gerhard's edit., p. 379, Philad. 1842,) the solidified portions may be so divided from each other by laminæ of healthy lung, and may be so covered by a stratum of vesicular tissue, that the general result of percussion is to elicit a clear sound over the whole of the parietes of the chest corresponding to the affected lobes.]

The extent to which the lungs have become tuberculous in the stage of phthisis now under consideration, varies remarkably in different cases, without a corresponding difference in the severity or duration of the symptoms. Two patients having symptoms exactly similar, may, on examination of the chest, present a very striking difference in the extent of the pulmonary disease; hence, by trusting to the symptoms alone, without having a due regard to the physical signs, we shall often be led into error in estimating this important point.

The length of time during which a patient may continue in the state which we have described, also varies remarkably. In some cases a few weeks suffice to bring him to the brink of the grave, while in others many months, and even years may pass away without any remarkable increase or diminution of the symptoms, or, there is reason to believe, of the pulmonary disease. In a small proportion of cases a curative process is established, by which the effects of the disease are in a greater or less degree obliterated; and if the patient's general health is maintained in a good state, there may be no return of tuberculous disease.

In the stage which we have been considering, the symptoms do not often indicate the presence of tubercles in any other organ; although during the progress of the disease there is scarcely an organ or part of the body that may not become tuberculous.

Third stage.—This has been termed the colliquative stage, from the copious perspirations, the frequent attacks of diarrhœa, and the abundant expectoration by which it is usually attended. With these symptoms, but more especially with the diarrhœa, the emaciation and debility generally keep pace: the cough also becomes more distressing during the night as the disease advances, and

the patient frequently suffers greatly from pains of the chest; while his breathing is much oppressed on the slightest exertion. The feet and ankles become œdematous towards evening; the swelling at first disappearing in the course of the night.

The chest examined at this advanced period of the disease is found to be remarkably changed in its form: the shoulders are raised and brought forward; the clavicles are unusually prominent, leaving a deep hollow space between them and the upper ribs; and the chest is flat in place of being round and prominent. The clavicular regions are nearly immovable during respiration; and when the patient attempts to make a full inspiration, the upper part of the thorax, instead of expanding with the appearance of spontaneous ease peculiar to the healthy state of the lungs, seems to be forcibly dragged upwards at each effort to accomplish it. Percussion gives a dull sound over the superior parts of the chest, although the caverns which partially occupy this part of the lungs, and the emaciated state of the parietes render the sound less dull than in the preceding stage. The stethoscope affords more certain signs: the respiration is obscure and in some places inaudible, while in others it is particularly clear, but has the character of the bronchial, or tracheal, or even the cavernous respiration of Laennec. Coughing generally gives rise to a gurgling sound (*gargouillement*); and pectoriloquy is more or less distinct, for the most part on both sides, although more marked on one than on the other. In this state the patient may still linger for many weeks, or even months, reduced to a perfect skeleton, and scarcely able to move in consequence of debility and dyspnœa.

With the loss of physical strength, the energy of the mind generally undergoes a corresponding diminution; the reasoning faculty remains, but evidently diminished in its powers. Though inwardly conscious of his decay, the patient does not absolutely adopt the conclusion, but founding hopes chiefly on the uncertainty of our art, seldom excludes the possibility of recovery, until at last he becomes indifferent to what is passing around him and to his own state; and this even when he had been hitherto remarkably alive to every symptom.

During the last weeks of existence an aphthous state of the mouth usually occurs, and is a sure forerunner of approaching dissolution. Delirium, generally of a mild character, likewise occurs at intervals at this period, although in some cases it is entirely wanting. In a few instances we have observed violent delirium during several days preceding death.

Such is the more common progress of tuberculous disease of the lungs, and the phenomena by which it is accompanied and characterized: we shall presently enter into a more full examination of the different symptoms.

It has often been stated that pulmonary consumption is a mild disease, by which the patient is imperceptibly wasted away, without pain or suffering, indulging the hope of recovery to the last. They must have witnessed but little of the disease who could state this to be its general progress. The miserable sensations produced by the frequent chills during the day, and by the more distressing and death-like chills which follow the copious perspirations in the night and morning; the harassing cough and expectoration; the pains of the chest; the frequent dyspnœa, amounting often to a threatening of suffocation; the distressing sense of sinking produced by the diarrhœa,—all increasing as the strength of the unfortunate patient is failing;—and, more than these, that "contention de l'esprit," that inward struggle between hope and fear, which, whether avowed or not, is generally felt by the patient in the latter stages,—make up an amount of suffering which, considering the protracted period of its duration, is seldom surpassed in any other disease.

But as phthisis differs remarkably in the rapidity of its progress, and the severity of its symptoms, so does it also in its mode of termination. In many cases the patient's sufferings cease and give place to a state of tranquillity during the last days of life; and he sinks gradually without a struggle. In other cases (and most frequently in young subjects) the struggle continues to the last.

Duration of Phthisis.—Tuberculous consumption is essentially a chronic disease, the range of its duration being very considerable. Cases have been recorded which have terminated in eleven days, (*Portal*, t. ii. p. 262, and *Andral*, Archives de Méd. t. ii.); while others have lingered for twenty and even forty years. (*Portal*, t. ii. p. 251; *Bayle*, *Andral*, &c.) These, however, are extreme cases, and of rare occurrence; and in endeavouring to fix the average duration of phthisis, we must exclude these very acute as well as the very protracted cases.

The following tables, extracted from the works of Bayle and Louis, give an accurate view of the duration of phthisis in three hundred and fourteen cases. In the first table the numbers of cases which came under the observation of each physician are given separately, in order to show how closely they correspond.

TABLE I.

Duration of Disease.	Number of Cases.		Number of Cases.			Total.
Months.	Louis.	Bayle.	Louis.		Bayle.	
1	1	1				
2	4	6	8	+	16	= 24
3	3	9				
4	5	12				
5	11	14	25	+	44	= 69
6	9	18				
7	9	18				
8	9	14	25	+	44	= 69
9	7	12				
10	4	8				
11	3	7	12	+	20	= 32
12	5	5				
13	2	6				
14	4	10	12	+	21	= 33
15	6	5				
16	0	3				
17	2	4	3	+	9	= 12
18	1	2				
19	1	2				
20	1	3				
21	0	6	10	+	18	= 28
22	0	3				
23	0	2				
24	8	2				

TABLE I.—(*Continued.*)

Duration of Disease.	Number of Cases.		Number of Cases.			Total.
Years.	Louis.	Bayle.	Louis.		Bayle.	
3	6	6	14	+	14	= 28
4	6	5				
5	2	3				
6	0	1	1	+	9	= 10
7	0	3				
8	0	1				
9	0	3				
10	1	1				
12	2	1	4	+	5	= 9
14	1	0				
20	1	4				
40	0	0				
	114	200	114	+	200	=314

The mean duration of phthisis calculated on this table is twenty-three months, that is, including the extreme cases; but it will be observed that one hundred and sixty-two, or more than one-half of the cases, terminated in nine months, and the greatest proportion of these between the fourth and ninth months. By excluding those cases which terminate within four months and those that exceed four years, the average duration of the remaining cases is eighteen months.

TABLE II.

Time.	1	2	3	Time.
	Dead.	Alive.	Die.	
Months				Months
in 3	8	92	8	from 1 to 3 inclu-
6	30	70	22	4 " 6 [sive.
9	52	48	22	7 " 9
12	62	38	10	10 " 12
15	72	28	10	13 " 15
18	76	24	4	16 " 18
24	85	15	9	19 " 24
Years				Years
5	94	6	8	3 " 5
10	97	3	3	6 " 10
40	100	0	3	11 " 40

This table is constructed from the first. The numbers are reduced to proportions of one hundred, and placed so as to exhibit the law of mortality in phthisis. Supposing one hundred persons to be attacked with phthisis at the same time, the first column shows the number who will die by the end of the third month, sixth month, &c., the second column shows the number living, and the third how many die in the various periods of the disease.

These tables are calculated on fatal cases which occurred in hospital practice. The duration of the disease in private life, with its many advantages and comforts of which hospital patients are necessarily deprived, is considerably greater. M. Andral's experience at La Charité led him to fix the average duration of the disease in that hospital at two years, which is very near the average deduced from the tables of Bayle and Louis, when the extreme cases are taken into the account; but it is evident, from an inspection of these tables, that much the larger proportion of cases die considerably within this period.

Various circumstances affect the duration of phthisis;—the age, the sex, and constitution of the patient, as well as the external circumstances in which he is placed, such as the occupation, the season of the year, climate, &c., have all, no doubt, their influence. Louis considers age as having little effect on the duration of phthisis, except in very acute cases, which are more frequent in early life. Our experience in this respect differs from that of M. Louis, at least in our private practice; but we admit that we cannot refer to our cases with the numerical precision of that accurate physician. Among females, Louis found the mortality greater within the first year than among males, in the proportion of forty-two to thirty; after this period the ratio of mortality as to time was the same in both sexes. In the upper ranks of society, where such patients have all the advantages that a proper regimen, change of air, and good medical treatment can afford, the medium duration of phthsis is probably not much short of three years; under other circumstances it is less. We fear the cures occur in so small a ratio that we are not entitled to bring them into the calculation in estimating the duration of phthisis.

2.—**Of the more marked varieties of Phthisis.**—Although tubercular phthisis is essentially the same in its anatomical characters and constitutional origin, it varies so remarkably in the duration of its course and the external features which it assumes, as almost to appear a different disease. We shall, however, endeavour to describe these different and less usual forms, so that they may be recognised even in their earlier stages.

Five forms of phthisis, differing from the ordinary course of the disease, appear to us worthy of notice; and we must be allowed to observe that such distinctions are not mere pretensions to refinement, but, on the contrary, are of great utility both as regards the diagnosis and treatment of the disease; for, as we shall find, each of these forms has something in its character which it is important to mark, in order to distinguish the nature of the disease at an early period of its course.

1. *Acute Phthisis.*—The usual duration of phthisis has been already stated to range from nine to eighteen months; in the present variety it frequently runs its course in three or even two months, and occasionally in five or six weeks.

The acute form of phthisis admits of a useful division into two varieties, in one of which the short duration of the disease appears to depend chiefly on its violence, or the activity of the morbid process; and in the other, on the feeble powers of the constitution, which sink under the pulmonary disease long before it has reached the degree in which it usually proves fatal. This last variety is observed chiefly in delicate young persons, and more frequently, according to our observation, in females than in males. The ordinary state of health of such persons is far below the common standard; they are possessed of the highest degree of the tuberculous constitution or temperament; they are weak, easily fatigued, and have generally a languid circulation, indicated by a feeble pulse and cold extremities, even in their best health, and before any suspicion exists that these general phe-

nomena are connected with tuberculous cachexia. The symptoms of consumption in such persons are often little marked; so little indeed that these cases might almost be ranked under the latent or occult form of the disease,—the real condition of the patient often escaping observation till phthisis is far advanced. But, although the symptoms are slight, they are generally sufficient to enable the physician to distinguish the disease, especially when the general aspect and constitution of the patient are taken into account. There is a slight cough with some shortness of breathing; and the pulse is frequently or easily rendered so by the slightest exertion. The patient is weak, but scarcely considers herself ill; there is no pain of chest, no hæmoptysis, and perhaps no expectoration. Debility is usually considered the cause of these symptoms, and even when they are accompanied with morning perspirations and well-marked emaciation, the friends are scarcely alarmed. They tell us that she was always short-breathed and liable to cold; and the cough seems of so little consequence that they think the lungs must be sound. In this way the patient continues to become rapidly worse; the cough is more troublesome, and is by degrees accompanied with some expectoration, in which a tinge of blood occasionally appears. The breathing is now also observed to be quick, even when the patient is at rest; the pulse is rapid, and there are frequent and often very copious morning perspirations. The countenance of the patient alone, at this time, is very often sufficient to indicate the danger: it is generally pale and of a leaden hue, the lips are often of a bluish colour, and the albuginea of a peculiar dull pearly tint; the whole features are sunk and the countenance faded. Without any increased activity of the symptoms, such a patient may sink rapidly under an attack of diarrhœa, and a fainting fit unexpectedly terminate the scene.

This is an insidious form of the disease and requires the closest attention of the practitioner, because it is one which he is liable to overlook, both on account of the obscure character of the local symptoms, and the little attention given to them by the patient's friends. The feeble persons who fall victims to this form of phthisis are, as we have already remarked, merely valetudinarians in their best state of health: their natural state is one of weakness, they are incapable of much exertion, are easily fatigued and even exhausted, and are oppressed by a high, and chilled by a low temperature: they have the lymphatic constitution of the child without the power and activity of the child's circulating system, and yield to the ordinary causes of disease with remarkable facility. The transitions from health to a state of tuberculous cachexia, and from this to the development of tubercles in the lungs, are easy and almost imperceptible in such persons, except to a close and experienced observer.

The other variety of acute phthisis presents itself in more striking characters. All the symptoms of phthisis are present in an unusual degree of severity, and succeed each other with great rapidity. The cough increases daily, and the expectoration goes through its various changes in the course of a few weeks; the hectic fever is violent, the morning perspirations are copious, and diarrhœa usually contributes its share in the destruction of the patient, who sinks rapidly in the course of six or eight weeks, dying of what is expressively termed by the public, "a galloping consumption." M. Andral has given four cases of this rapid form of phthisis, three of which occurred in young subjects, and varied in duration from twenty-one to thirty-five days. (Archives Générales de Médecine, vol. ii. p. 205.) Indeed, young persons are generally the subjects of this variety; and it frequently occurs soon after the cessation of acute febrile diseases, as fever, scarlatina, measles, &c. The manner in which these diseases determine and modify phthisis we shall have occasion to show when treating of the exciting causes.

There are two modes in which this rapid progress of phthisis may be explained. It often occurs in persons of a constitution so highly tuberculous, that it only requires the application of some exciting cause to determine the deposition of tuberculous matter in the lungs. In other cases this rapid course of the disease is more apparent than real. The tuberculous disease of the lungs, though latent, has been making silent progress, until an attack of catarrh or hæmoptysis occurs, from exposure to cold or violent exertion, producing pulmonary congestion: the disease henceforward puts on its usual symptoms, and, owing to the previous advanced state of the tubercle, proceeds with unusual rapidity in its course. This view is supported by minute inquiry into the history of such cases, and by the fact that they generally occur in the members of families of a strongly marked tuberculous constitution.

The error into which this variety of acute phthisis is calculated to lead an inexperienced or careless practitioner, is that of considering and treating it as a purely inflammatory disease, and using much more active measures, and giving a more favourable prognosis, than the real nature of the case justifies. An inquiry into the previous health of the patient and careful observation of the symptoms will soon unveil the real nature of such cases. It is true that inflammation in some part of the respiratory organs often exists, complicating the tuberculous disease; but it requires to be treated with much more delicacy than a simple inflammation, and a very different prognosis should be given.

2. *Chronic Phthisis.*—As opposed to the acute form of the disease which has just been noticed, the present variety may well be termed chronic, since it often occupies more years than the former does weeks. Bayle and Laennec were the first who described the nature of these protracted cases, and showed the identity of the disease, whether it occupied the greater part of a long life, or proved fatal in the course of a few weeks.

The acute form of phthisis occurs most frequently, as we have remarked, in young subjects; the present form commonly takes place at a more advanced period of life, from the fortieth year upwards; though it is occasionally met with at a much earlier age.

In the acute form, the tubercular diathesis is generally hereditary and strongly marked; and the application of those causes which usually call it

into action speedily produces their effect. In this form, on the contrary, the tubercular diathesis, if hereditary, is not strong, or has been kept in check by the favourable circumstances in which the individual has been placed; or it has been induced, in the progress through life, by causes which we shall have occasion to notice in another part of this article. However this may be, the tuberculous disease of the lungs at a late period of life is often slower in its progress, whether this depends on the minor degree of constitutional affection, or on the greater powers of the system to resist its destructive influence.

The disease in its chronic form is little marked in its early stages; the patient looks out of health; he is languid and capable of little exertion; he has occasionally a slight cough, but it scarcely attracts attention; he has no fever, and his appetite is even good. As it very generally occurs in persons whose situation in life or occupations give rise to dyspeptic complaints, the stomach is the organ blamed for the patient's indisposition. The friends and patient himself are often confirmed in this by the effects of fine weather, a visit to the country, or a summer tour; by means of which the patient recovers his looks and his lost flesh and strength, and his cough ceases. In the succeeding winter and spring the cough returns, he loses flesh again, and his looks indicate internal disorder, while he is more than usually susceptible of the impressions of cold. Still the succeeding summer improves his health. At times during this state of things his disease puts on a more serious aspect: during an attack of catarrh the cough becomes severe, and is attended by fever and a copious expectoration — symptoms which appear to threaten his life. But even from this state he may recover more than once, till the disease shall at last put on the form of a chronic catarrh, aggravated from time to time by slight exposure to cold during the winter and spring; while he may still enjoy a very tolerable state of health during the summer, and in this way may continue to linger on in a miserable state of existence for years, yet little aware of the real nature of his disease.

Under such circumstances, the person is generally able to go on with his usual avocations, though not with his wonted energy; and if they are of a nature that require much bodily exertion, or expose him to the inclemencies of the weather, they are often interrupted by attacks of acute catarrh, of pleurisy, or pneumonia. Under more favourable circumstances a person in this state may escape such attacks, but he is more easily fatigued, is rarely free from cough a week at a time, and his breathing is generally oppressed on using any bodily exertion. Although his appetite is generally good and he eats heartily, he remains thin, is generally pale, and is equal to little exertion, bodily or mental. In short, though capable of performing his usual duties, he does them in a very different manner from that which was his wont before his present complaint, and yet his friends are scarcely sensible that he is labouring under any local disease beyond a common chronic catarrh. This is a state of things which is not uncommon in persons living in easy circumstances, and who are not required to make much exertion, or expose themselves to the vicissitudes of the weather, or to other exciting causes. They are considered delicate; they find it necessary to take care of themselves, but the nature of their ailments frequently remains long unsuspected. The cough is little regarded, because it does not increase and gives very slight trouble, and even abates so much during the summer as to be scarcely remarked. The breathing is short, but the dyspnœa has come on so slowly that the patient is hardly aware that it is a new complaint, and often deceives himself in thinking that he was always short-breathed. Invalids of this description are rarely free from dyspepsia in a greater or less degree; they are liable to an increase of the catarrhal symptoms from slight exposure to cold, and are frequently subject to attacks of diarrhœa, from which their recovery is often tedious and protracted.

An examination of the chest under the circumstances which we have just now noticed, will generally leave no doubt of the existence of tubercular disease of the lungs. The respiratory movement of the upper part of the chest will be found to be much more limited than natural, especially when the patient makes a full inspiration. One or both of the clavicular regions will give a dull sound, and the voice will be more resonant, and occasionally there will even be perfect pectoriloquy. In such cases, not only does tubercular disease exist, but the tuberculous matter has become softened, and been expectorated, leaving cavities in the summit of the lung, some of which have been emptied of their contents, and are either in the progress of cure or actually cicatrized.

We have already observed that such a patient may exist for many years, if his habits of life are temperate and regular, and he avoids exposure to causes capable of inducing inflammatory affections of the lungs. But even with these precautionary measures, his situation is most perilous; the lungs are already partially diseased, they are diminished in capacity, and are in a state of constant congestion, and are consequently far more liable to take on diseased action. An attack of catarrh, bronchitis, or pneumonia, that would otherwise have easily passed over, frequently proves fatal to such a person, or leaves him in a state of great debility, during which the tuberculous disease makes more rapid progress; and he soon sinks under it, often with all the symptoms of well-marked consumption, which, even under all the circumstances we have stated, is not unfrequently attributed, both by the patient and his attendants, to the inflammatory attack, which was merely a superadded and accidental occurrence. The same effects will often be produced by a severe attack of rheumatism, or fever, or any other disease which is accompanied with fever, or leaves the patient in a debilitated state. The influenza which prevailed in this country in the summer of 1832, and still more severely and generally in the spring of 1833, proved fatal to many such invalids, either during its attack, or in consequence of the debility which it left behind it, from the effects of which the patient never rallied. To persons labouring under the earlier stages of tubercular disease, the influenza proved equally, though not so speedily fatal; and it was in such patients that the origin of the

disease was, with a greater appearance of truth, attributed to the influenza.

We can only account for this slow progress of tuberculous diseases of the lungs by the supposition that the constitutional disposition to such an affection has been slowly induced during the person's advancement through life, without having ever acquired the force or pervading influence of hereditary disease. This view is supported by the fact that such protracted cases are most frequently observed in the upper ranks of society, where the person enjoys all the comforts of life, and though often engaged in an unhealthy occupation, is enabled to recover his health from time to time by country air and relaxation from the cares of business. On the other hand, the laborious part of mankind are much more rarely affected by this prolonged form of phthisis. The disease often occurs late in life among the lower ranks, but its progress in them is more rapid, and more closely resembles its course at an earlier age; although in females, and some men, such as coachmen and grooms, when they are not addicted to the use of spirits, the disease often runs on for years.

Among the poor Irish labourers in London it is very common. In this class of persons, one attack of catarrh, or pneumonia, or pleurisy, is succeeded by another, until the greater part of the lungs becomes diseased, and the surfaces of the pleura are adherent over their whole extent, the patient scarcely moving his chest during respiration. After death, the lungs are found to present such a mass of disease, partly tubercles and partly the effects of inflammation, that it is difficult to say which had the greater share in determining the patient's fate. Of the nature of the primary disease of the lungs, little is to be learned from such examinations.

This chronic form of phthisis deserves the particular attention of the physician. First, because its nature is liable to be overlooked till it has made considerable progress, and the opportunity of doing good may be lost; and secondly, because medicine often accomplishes much more in this form of the disease than in those which are more rapid in their course. Indeed, in many of these chronic cases we believe the progress of the pulmonary affection may be often checked, and the patient's life not only prolonged, but his health even improved. Time is given for the adoption of such measures as are calculated to amend the general health, and even to remove, or at least check the tuberculous cachexia, and other derangements which increase the local disease. We allude especially to irritations of the digestive organs, to congestion of the liver, and the abdominal circulation generally; pathological conditions which play an important part in the production of the disease, as we shall endeavour to show in the proper place.

3. *Phthisis in Infancy and Childhood.* — Since morbid anatomy has been more sedulously cultivated, tuberculous disease has been found a more frequent cause of death in childhood, and even infancy, than was formerly imagined.

Phthisis at this early period of life differs somewhat from the disease in adults, both in its situation and symptoms. The cough which attends the consumption of childhood is very often of a different character from that which accompanies the disease in persons of mature age; it frequently occurs in paroxysms resembling hooping-cough, and is rarely attended with expectoration till a late period of the disease, and very frequently this latter symptom is entirely wanting, from the matter being swallowed; so that we are deprived of the light which the character of the expectoration might throw upon the nature of the disease. Hæmoptysis is also a rare occurrence; at least, we do not recollect to have met with any case in which it was present. The hectic fever is likewise less perfectly formed, and the perspirations are generally less than in the adult.

The disease, however, is not usually difficult of detection, if we attend to the other symptoms. The tuberculous aspect of the child, the rapid pulse and breathing, the frequent cough, and the gradually increasing emaciation, commonly afford sufficient evidence of its existence. Phthisis in children is often accompanied or preceded by considerable derangement of the digestive organs; the abdomen is tumid, the bowels are irregular, at one time constipated, and affected by diarrhœa at another; the evacuations under both circumstances being generally of a pale, unnatural colour. This deranged state of the functions of the abdominal viscera has often led to the belief that the mesenteric glands were the chief seat of the disease; whereas in reality the bronchial glands and lungs are its most common seat, even at this early age. It is true that the mesenteric glands are more frequently tuberculous in infancy and childhood than at a later period of life, but by no means so frequently, nor to so great a degree, as is generally supposed.

Pulmonary consumption is of far more frequent occurrence in early life than is commonly believed in this country. In France, where the extent and constitution of their hospital establishments have enabled the medical officers to investigate the morbid anatomy of disease upon an extensive scale, the tuberculous affections of children have of late occupied particular attention, and much valuable information has been collected on the subject. Dr. Guersent, one of the physicians to the 'Hôpital des Enfans Malades,' (an institution appropriated to the treatment of patients between the ages of one and sixteen years,) gives, as the result of his observations, that five-sixths of those who die in that establishment are more or less tuberculous. (*Le Blond*, Sur une espèce de phthisie particulière aux enfans. Paris, 1824.)

At this early age the most frequent seat of tubercle is the bronchial glands. Here the disease commences, and occasionally proves fatal without affecting the lungs or any other organ. This form of the disease has been denominated bronchial phthisis (*phthisie bronchique*); and the name is unexceptionable, if the term phthisis be confined to the disease arising from tubercles.

This form of phthisis is almost peculiar to childhood; at least it is much more frequent at this period of life, and it is at this age only that tuberculous disease is confined to the bronchial glands. The following table, from Papavoine's excellent memoir on tuberculous diseases, will show the ratio of its occurrence in early life. It is the

result of fifty careful post-mortem examinations of children, made with the view of determining the relative frequency of tubercles in different organs. (Journal de Progrès des Sciences Médicales, t. ii. p. 93.)

TABLE III.

Bronchial glands	49	times
Lungs	38	„
Cervical glands	26	„
Mesenteric glands	25	„
Spleen	20	„
Pleura	17	„
Liver	14	„
Small intestines	12	„
Peritoneum	9	„
Large intestines	9	„
Brain	5	„
Cerebellum	3	„
Membranes of the brain	3	„
Pericardium	3	„
Kidneys	2	„
Stomach	1	„
Pancreas	1	„
Vertebræ, radius, tibia,	1	„

A comparison of this with the result of Louis's observations, as given in the following table referring to persons above the age of fifteen, who died of phthisis, will show the relative occurrence of tubercles in different organs in the two periods of life. (*Louis*, Recherches sur la Phthisie. Rapport, pp. 4, 5.)

TABLE IV.

Small intestines	about	$\frac{1}{3}$
Large intestines	„	$\frac{1}{9}$
Mesenteric glands	„	$\frac{1}{4}$
Cervical glands	„	$\frac{1}{10}$
Lumbar glands	„	$\frac{1}{12}$
Prostate	„	$\frac{1}{13}$
Spleen	„	$\frac{1}{14}$
Ovaries	„	$\frac{1}{15}$
Kidneys	„	$\frac{1}{40}$

M. Andral, in noticing the greater frequency of tuberculous disease of the bronchial glands in children than in adults, observes that this is in accordance with the affections of the other lymphatic glands. The bronchial membrane in the neighbourhood of the diseased glands was, for the most part, found by this physician in a state of inflammation, just as is frequently remarked in the intestines of children when the mesenteric glands are tuberculous. But although M. Andral generally found the bronchial membrane red in the vicinity of these glands, it was not invariably so: in some instances they were found in a tuberculous state where there were neither symptoms of catarrh during life, nor the least trace of inflammation, old or recent, after death. (Clinique Médicale, t. ii. pp. 254-55.) Still the connection of inflammation in the mucous membrane of the intestinal canal and bronchi with tubercular disease of the neighbouring glands, seems more intimate in early life than after puberty.

The symptoms which indicate the presence of tuberculous disease in the bronchial glands are generally for some time obscure; hence these organs may be tuberculous to a considerable extent without this being detected, as it is not until they acquire a considerable size, and irritate the bronchi mechanically, that the local symptoms become evident. The child coughs and is very liable to catarrh, and occasionally it points to the upper part of the chest as the seat of irritation. But the same symptoms may be produced by common catarrh or pulmonary tubercles to an equal degree. When the diseased state of these glands is further advanced, the nature of the case is more easily detected. When there is cough, hectic fever, and emaciation in a child, and when a careful examination neither discovers tuberculous disease in the lungs nor in the mesenteric glands, we may feel tolerably certain of its existence in the bronchial glands. In some cases these glands are so much enlarged as to fill up a great portion of the posterior mediastinum, and even to produce a swelling by the side of the trachea, which is visible externally; but this is rare. If the child is old enough to expectorate, and tuberculous matter is brought up, while we can discover no cavity in the lungs, the diagnosis is almost certain.

Tuberculous disease, however, does not, in general, remain long isolated in the bronchial glands; other organs, especially the lungs, become tuberculous, and the symptoms are then of course complicated. Still there are some cases in which the disease proves fatal while confined to these glands: an interesting case of this kind is given in Dr. Alison's excellent paper on scrofula, in the Transactions of the Edinburgh Medical Society: — "J. S., æt. five, a boy of ordinary stature, and pretty stout, but somewhat rickety, and with a small scrofulous sore on his leg, was attacked in the end of November 1815, with well-marked pneumonic symptoms. While these were recent, he was seen by different medical men, who had no doubt of their nature, and he was bled twice at the arm, and used the other usual remedies, with very imperfect success: the heat of skin, febrile oppression, and dyspnœa abated somewhat, but his breathing continued short, his cough very troublesome and dry; and he passed gradually into the state of perfect hectic, the rigors in the afternoons and morning sweats being unusually severe. He died, considerably emaciated, in the end of January 1816. On dissection, the lungs were found of the natural spongy texture throughout, and the disease appeared to have been confined to the bronchial glands, which were enormously enlarged, and all converted into the usual cheesy or tubercular matter. There was no other disease in the thorax or abdomen." (p. 425–6.) Had the previous history of this case been better known, it would in all probability have been found that the bronchial glands were diseased long before the attack of pneumonia; and had the tuberculous disease been seated in the lungs in place of those glands, it might have been considered the consequence of the inflammation, which, it is worthy of remark, had existed and disappeared without leaving a trace of its presence behind, even in a tuberculous subject.

It is not quite a matter of indifference whether the seat of the tuberculous disease be the bronchial glands or the lungs. In the former situation the progress of the disease is slower, continuing in some cases for years, during which the little

patient may enjoy pretty good health. The disease being seated in organs much less essential to life than the lungs, interferes less with the general functions of health, and gives time for the application of remedies which its situation in the lungs does not allow. In this respect it resembles a similar affection of the external glands, and like it also is susceptible of cure.

The termination of this disease is various. That the tuberculous state of the bronchial glands may be removed by absorption, as we see occur in the lymphatic glands of the neck, we have every reason to believe; but this is probably the less frequent termination. Another mode of cure is that by which the softened tuberculous gland empties itself into the bronchial tube with which it is in contact, by ulcerative absorption of the walls of the tube, as is shown in Dr. Carswell's beautiful plates. The matter being evacuated, the cavity in which it was contained gradually contracts till it is obliterated; and the cure, as far as this gland is concerned, is complete. The less frequent cure is that in which a portion of the gland, or rather of the tuberculous matter, remains in a cretaceous form: but we are encroaching on another section of our subject.

The prognosis of this form of phthisis must always be doubtful, inasmuch as it depends on a circumstance which we are unable to ascertain, namely, the extent to which the bronchial glands are diseased, and on the complications which so often accompany this affection. The prognosis, however, will be more favourable than when the disease exists in the lungs.

4. *Febrile Phthisis.*—The acute form of phthisis already noticed differs materially in its symptoms from that which we are now about to describe. In that, the disease was seen to differ from the usual course of phthisis, chiefly in the rapidity of its progress; the symptoms and morbid appearances being the same in both cases. In the variety which we are now considering, we shall find peculiarities which mark its character as differing essentially from the acute as well as from the usual form of the disease.

This variety occurs suddenly, is accompanied by a train of symptoms dissimilar, to a great extent, from all other forms of phthisis; and even the morbid appearances discovered after death are somewhat peculiar. The degree of fever with which it is usually ushered in and attended during its whole course is one of its most remarkable features, and that one from which we have ventured to denominate it *febrile phthisis*.

Its attack, as we have just stated, is generally sudden, occurring in a state of apparent health, after exposure to cold, or even without any very evident cause. We say apparent health, because we believe that the disease never occurs in a healthy constitution. It attacks persons of a tuberculous diathesis; and the most marked cases which have come under our observation have occurred in persons having a strong hereditary disposition to phthisis,—in members of families, several of whom had already fallen victims to the disease in its usual form.

It commences with shivering, followed by heat of skin, quick pulse, and the other symptoms of fever, which often continue for several days with little or no indications of pulmonary disease. In some cases it puts on the characters of bilious fever, and in others of catarrhal fever, for both of which it is sometimes mistaken; indeed we believe it would have been such in a healthy constitution, but occurring in a person labouring under tuberculous cachexia, the rapid deposition of tuberculous matter in the lungs is the consequence of the disturbance created in the system by the febrile attack. Cough, however, soon appears, and the breathing is noticed to be particularly rapid, which is one of the most marked and constant symptoms of this form of phthisis. The cough, when it has once occurred, becomes speedily more frequent, and is soon accompanied with some expectoration, which is at first colourless, afterwards assuming a yellowish or greenish hue, and occasionally being streaked with blood; but it rarely puts on the character of the expectoration in the advanced stages of ordinary phthisis. Pain of one or both sides frequently occurs, and occasionally diarrhœa is present. The fever, in the meanwhile, continues without abatement, and is so much out of proportion to the other symptoms of pulmonary affection, that the true character of the disease is liable to be overlooked. In the course of from three to six or seven weeks, the patient sinks.

The indications of the pulmonary disease generally become more evident as the case advances; but still they are often so little marked as to render it doubtful whether the disease is not acute bronchitis or even pneumonia; and when one or other of these affections complicate (as they often do) the tuberculous disease in its progress, the diagnosis becomes extremely difficult. In some cases auscultation assists us materially in distinguishing this form of acute tubercular disease from the two inflammatory affections just mentioned. The upper parts of the chest often give a dull sound on percussion, although the tuberculous matter is less frequently confined to the summit of the lungs in this form of phthisis than in any other; a circumstance which constitutes one of the pathological characters of the disease. The whole of one side of the lungs, and even a large portion of both, appears to be attacked almost at the same time, giving a dull sound on percussion and bronchial respiration. Under such circumstances, it is difficult to distinguish the disease from pneumonia. The negative symptoms assist us: we have neither the crepitant rhonchus which precedes the dull sound and bronchial respiration, nor the characteristic sputa of pneumonia. When, on the other hand, this sudden deposition of tuberculous matter does not take place in the pulmonary tissue, but occurs in the minute terminations of the bronchi and air-cells to a great extent, the disease resembles acute bronchitis more than pneumonia. Here again we derive assistance from the negative symptoms. The bronchial sputa are wanting, and the whole progress of the disease differs from that of bronchitis; there is also, for the most part, an extreme rapidity of breathing, which is not observed in any other disease of the chest. But we repeat that these are cases in which the most attentive observer, aided by all our means of diagnosis, may be in doubt respecting the real nature of the disease.

The morbid appearances presented after death

have been well described by the accurate Louis as consisting of the grey granulations over a greater or less extent of the lungs in some cases; in others, large portions of the lungs appear to be converted into a mass of cheesy-like tuberculous matter, the pulmonary tissue being completely infiltrated with it; a form of tuberculous deposit which Louis considers peculiar to this variety of the disease, that is, when it exists to a great extent. Tuberculous cavities are also found in some cases, but they are generally of small size, only partially evacuated, and have no lining membrane, as occurs in cavities of long duration in the ordinary form of phthisis.

Notwithstanding the rapidity of this febrile form of the disease, it is often attended with those morbid affections of other organs which accompany the common form of phthisis, such as ulceration of the intestines, larynx, and trachea, and the diseased states of the mucous membrane of the stomach and the liver; all which show that the present form of the disease is true to the general character of phthisis.

The diagnosis in the early stage of the disease is often attended with difficulty. The sudden attack of fever with rapid respiration and some cough, occurring in a person of tuberculous constitution, should excite suspicion; and the continuance of the symptoms despite the remedies employed, together with the absence of those symptoms which characterize the common acute diseases of the chest, will greatly assist us. Percussion and auscultation will also lend their aid in many cases. As far as our own experience enables us to determine, this form of phthisis occurs chiefly in young subjects from eighteen to thirty years of age; though it is not confined to this period. Louis gives a case, the subject of which was in the forty-sixth year.

The febrile occasionally supervenes upon the common form of phthisis. In this case the breathing becomes very difficult and rapid; still the chest preserves its resonance, the respiratory sound being accompanied with a slight rhoncus. On examination after death, we find, in addition to the tuberculous excavations existing previously to the acute attack, a large quantity of grey granulations diffused over a great part of the lungs.

It is proper also to remark that the disease which we have described has been considered as a form of pneumonia, the grey granulations being regarded by Andral as the result of acute inflammation of the air-cells; and there will be equal propriety in considering the tuberculous infiltration of the lungs in the other form of acute disease as merely the result of pneumonic inflammation in a tuberculous subject. We do not think it of much consequence to dispute this point. We believe that inflammation in a tuberculous constitution may give rise to the deposition of tuberculous matter in place of lymph, which is its usual product in healthy subjects; and this may be one of the sources of tuberculous disease; but it does not follow that it is the constant or even most frequent cause of tuberculous deposits. A striking objection also occurs to this view of the case, in the fact that pneumonic inflammation is no unfrequent occurrence during the progress of the disease, and that this is characterized during life by its proper symptoms, and after death by the usual morbid appearances; one part of the lungs presenting the usual results of pneumonia, while in others we find the tuberculous infiltration which has just been noticed.

5. *Latent Phthisis.*—The presence of tuberculous matter in the lungs gives rise, in a large proportion of cases, to those symptoms which are usually considered to indicate the commencement of phthisis; there are, however, cases in which this accidental product may exist for a long time and even to a considerable extent in the lungs, without giving rise to any local symptoms indicative of its presence, such as cough, expectoration, or hæmoptysis, but nevertheless effecting its silent work of destruction. It is to cases of this kind that we apply the term *latent*.

Latent phthisis presents itself in two different forms. In one, we have constitutional symptoms, such as fever, night-sweats, emaciation, diarrhœa, &c. without any local indications of the pulmonary disease; or if they be present, they are of so slight a character as to pass unnoticed. The other form of latent disease is still more important, because it is more insidious; being attended neither by constitutional nor local symptoms, until the tuberculous disease has made extensive progress. This form of latent phthisis, therefore, claims our closest attention; because, from the slowness of its course, and the more limited extent of the tuberculous disease for a long period, we may possibly be able in many cases to check its further extension, if not to arrest its progress entirely, should we detect it at an early stage.

Of one hundred and twelve cases recorded by Louis, eight belonged to this class; a smaller proportion, we believe, than really occurs. From the history of these cases, and an attentive and minute examination after death, not only of the lungs but of all the other viscera, Louis entertained no doubt of the existence of tubercles during a period varying from six months to two years in different cases, prior to their presence being indicated by cough, the most common local symptom. This perfectly corresponds with our own observation. In tracing back the history of many cases of phthisis, we have obtained satisfactory evidence that tuberculous disease had commenced in the lungs from one to two years before the disease was properly attended to, or its nature understood.

When constitutional symptoms, such as fever and emaciation, occur, there is enough to excite the suspicions of the practitioner, since they cannot exist unless local disease is present; and by an accurate examination of the chest, we shall most probably ascertain that the lungs are the seat of the disease. There is less difficulty in the detection of such cases than of those unaccompanied with either constitutional or local symptoms; but these cases are very likely to escape notice until they arrive at an advanced stage. Still, we cannot easily believe that an attentive observer will not see, in the aspect of his patient, sufficient alteration to arouse suspicions of the existence of the tuberculous diathesis, and lead him to inquire minutely into the condition of the respiratory organs. By means of such inquiries and an examination of the chest, he will seldom, we believe,

fail to detect the real nature of the patient's state; but it is the misfortune of such patients that they do not complain, nor give the physician an opportunity of discovering their disease, until it is far advanced. They feel themselves out of health, are weaker, perhaps thinner than usual, they have less energy of mind and less bodily strength; still they are unable to specify any particular ailment. They rally from time to time, and often go on in this way till their looks of ill health fix the attention and excite the fears of their friends, by whom they are at last persuaded to have professional advice.

The physician will often find that his opinion is asked for the first time at a very critical period, both for the patient and himself. If, from the fear of giving alarm, carelessness in his examinations, or ignorance of the patient's real condition, he fails to adopt effectual measures to restore the general health, to prevent tuberculous disease if it has not already shown itself, or to check its progress if it has already taken place, the sufferer is irrevocably lost. In a large proportion of cases, this will, no doubt, occur in spite of all that human art is capable of performing; but there are many instances where the further progress of the disease may be stayed and life prolonged for a considerable time, and others where the usual term of existence will not be much abridged. We are acquainted with some striking examples of persons now living, a considerable portion of whose lungs is incapable of performing its functions, and yet with care they enjoy a reasonable share of health. Under such circumstances lives may be preserved that are of vast importance to their families and to society. Indeed, we are satisfied that there are far more individuals in this state than is generally believed; and it is well known that tubercles are frequently found after death in the lungs of persons in whom their existence had not even been suspected.

As far as our own observation enables us to determine, we think that latent phthisis is most frequently met with after the middle period of life, but no age is exempt from it. Examples are met with in which an attack of phthisis in early life ceases, and years elapse before another attack destroys the patient. We have known recovery from two such attacks, the third proving fatal; the interval between the first and third attack was twelve years. The opinion of Laennec on this subject of recovery from the first attack of phthisis is so important, that we shall here cite his words: "We may indeed say, that the greater number of cases of phthisis are latent at the beginning, since we have seen that nothing is more common than to find numerous miliary tubercles in lungs otherwise quite healthy, and in subjects who had never shown any symptoms of consumption. On the other hand, from considering the great number of phthisical and other subjects in whom cicatrices are found in the summit of the lungs, I think it is more than probable that hardly any person is carried off by a first attack of phthisis. Since I was first led to adopt this opinion on anatomical grounds, it has frequently appeared quite clear to me, from carefully comparing the history of my patients with the appearances on dissection, that the greater number of those first attacks are mistaken for slight colds, and that others are quite latent, being unaccompanied with either cough or expectoration, or indeed with any symptom sufficient to impress the memory of the patients themselves." (Forbes's Translation, 2d edition, page 358.)

We venture, however, to express our firm belief that the disease would be more frequently detected in its early stages, and many valuable lives saved, by a due attention to those signs of tuberculous cachexia which present themselves in such patients. We have already stated our conviction that the great cause of our want of success in the cure of tuberculous disease, arises from the advanced stage at which its real nature is discovered, and from the late period at which the physician is consulted. If Laennec's opinion be correct, that few die in a first attack of phthisis, we have still more reason to hope that the disease may be cured, that is, that a second attack may be prevented by improving the patient's general health, by removing, in fact, the tuberculous cachexia, and by placing him, when possible, under the most favourable circumstances for the prevention of a relapse into his former state.

Tuberculous disease is rendered latent, or is at least masked by a peculiar condition of the system in some cases; and in others by the presence of other diseases. Pregnancy appears to retard if not to suspend the progress of Phthisis, and it is frequently observed that the disease advances with great rapidity immediately after parturition. The catamenia generally cease when the disease has made some progress, although they continue in a few rare cases until death. An attack of mania in a phthisical patient has been followed by the suspension of the pulmonary disease; which, however, rarely fails to carry off the patient ultimately, whether the attack of mania has ceased or not. The complication of dyspepsia with tuberculous disease is not an infrequent cause of the latter being overlooked, the dyspeptic symptoms being more evident than the phthisical. The aspect of the patient in such cases is pale and unhealthy; he gets thinner and weaker; the food which he takes neither affords him nourishment nor strength; and yet he has no evident ailment but what is referable to the deranged state of the digestive organs. In such cases there may be no cough, no fever nor expectoration to excite our fears for the safety of the patient; while at the same time tubercles are present in the lungs. We have seen a patient of this kind, when asked any question respecting the state of his lungs, strike his chest, and confidently affirm that all was right there; although his lungs were tuberculous to a considerable extent at the time. This is the form of the disease which has been termed "dyspeptic phthisis."

Diarrhœa is another disease which sometimes disguises phthisis, and its effects in suspending all the usual symptoms of pulmonary affection are often remarkable. We have known more than one example of extensive tuberculous disease of the lungs being detected on dissection, when the cause of death has been looked for in the intestines. It is true that these were cases in which the early history of the disease was disregarded, but they serve at least to show the power of diar-

rhœa in masking extensive affections of the lungs.

It is enough, however, that such facts should be known, in order that they may prevent the younger members of the profession from falling into the error of overlooking the disease of most importance, and of mistaking for the chief and primary affection, that which is only secondary both in occurrence and in consequence.

Sect. IV. — Of the Particular Symptoms and Diagnosis of Phthisis.

After the general sketch which we have given of the usual course of phthisis, and of the rarer forms which it assumes, it will be useful to take a more minute survey of the particular symptoms which attend the disease and characterize its different stages. This will enable us more readily to attach the proper value to these symptoms when considered individually, and likewise to determine their importance as a means of establishing the diagnosis of phthisis. We shall then notice the assistance afforded by auscultation, and by certain other physical signs, in attaining the same important end.

I. Symptoms. — We have already seen how variable the symptoms are in different cases, as regards the time of their appearance, the order of their succession, and the degree of their severity. In analysing them more closely, we shall also find that there is scarcely one, even of the leading symptoms, which may not be wanting; and it has even been stated that cases have occurred in which pulmonary disease has proved fatal almost without any indication of its existence as a local disease. This, however, is by no means in accordance with our own experience; certainly we have never met with such a case, nor even with one at all approaching to it; nor can we easily believe that tuberculous disease can run its course without affording sufficient indications of its existence. If there be neither cough nor expectoration to assist us in establishing our diagnosis, we shall find hurried breathing; and if regular hectic be absent, there will still be the rapid pulse, or the frequent chills, the night perspiration, the diarrhœa, and emaciation: more or fewer of these are always present, and, together with the peculiar cachectic character of the countenance, will enable us to detect the real nature and seat of the disease. There will at least be found enough to excite the suspicions of the observing practitioner, and when these are once aroused, the physical signs which disease of the lungs always affords, will soon assure his mind respecting the real nature of the malady.

It is a matter of great importance to be able to mark the commencement of tuberculous disease of the lungs by its external manifestations, and distinguish it from the other diseases with which it is liable to be confounded; since, in a very large proportion of cases, it is only in the early stage that we can hope to effect a cure, or even to arrest the further progress of it. The symptoms by which the first existence of pulmonary tubercle is characterized, are unfortunately very equivocal; added to which, we are often baffled by the unwillingness of the patient and his friends to aid us in our inquiry. Yet, notwithstanding this doubtful character of the early symptoms, and the obstacles which often present themselves to us in our investigations, we fear that our own neglect in acquiring information respecting the past and present condition of the patient's health, and our inattention to the existing indications of disease, lead us, far more frequently than the real obscurity of the case, to allow the early stages to pass on undetected.

When we are consulted by a person whose condition induces us to suspect the existence of tubercles, our examination should be full and complete. The general aspect deserves particular attention; the past health and occupations; the diseases which may have previously existed, and the family disease also (when possible) should be ascertained; while the state of the different functions, but above all the condition of the respiratory organs, should be investigated by all the diagnostic means in our power. The form and motions of the chest, the sounds elicited by percussion, and those produced by the ingress and egress of air into the lungs during inspiration, speech, and cough, must all be taken into account to enable us to estimate the value of particular symptoms,— or, in the absence of these, to form a probable opinion of the state of the lungs.

There is no one local sign or symptom to be depended on in this early period of tuberculous disease; but by a careful analysis of the whole of them, and by availing ourselves also of the negative symptoms, as regards other pulmonary diseases with which phthisis is liable to be confounded, we shall, we believe, rarely err in arriving at a correct diagnosis, even at a very early stage of the disease.

Cough. — This is the first symptom which claims our attention, being, for the most part, the earliest evidence of pulmonary irritation, and the first circumstance which excites the attention of the patient or his relatives. During the first weeks or months, it is usually a slight dry cough, occurring chiefly in the morning on the patient getting up, or on his making any bodily exertion during the day. In this state it is scarcely noticed by the patient; it appears to him to be of no consequence; to arise from some irritation in the region of the larynx; and he rarely suspects that it can have any connection with the state of the lungs. Its continuance in this trifling degree for weeks or even months, without any expectoration, is another circumstance in the history of the tuberculous cough which deserves attention. By degrees, it occurs occasionally during the day, especially after any exertion, such as running up stairs, speaking or reading aloud for some time, laughing, &c. and after a longer or shorter time is attended with the expectoration of a transparent frothy fluid resembling saliva, which at first appears to come from the fauces.

In general, the cough is found to increase as the pulmonary disease advances, being usually in proportion to the rapidity of its course. In some cases, however, it is very slight through the whole disease, and, in a few rare instances, it has only appeared a few days before death, and this in cases where tuberculous excavations of the lungs existed to a considerable extent. Louis gives two well-marked cases of this. Now, if it could be wanting under such circumstances until within a

few days of death, it is reasonable to admit that it might be wanting altogether; and cases are on record in which it has been entirely absent. "It is not sufficiently known," says Portal, "that the disease can exist without the slightest cough: the lungs of consumptive patients have even been destroyed by suppuration, without their having experienced the least degree of cough. (Vol. ii. p. 123.) Lieutaud, Morgagni, and others, have mentioned similar cases. (Hist. Anat. Med. lib. ii. ob. 384; De Sed. et. Caus. Morb. Epist. xix.) We have never found the cough entirely wanting, but have known it so slight that it has failed to attract even sufficient attention to alarm a very nervous patient or his watchful friends.

It occasionally happens in the progress of chronic phthisis, even during the existence of tuberculous excavations, that both the cough and expectoration cease for weeks, when the patient is placed in favourable circumstances; but both are usually brought back again by the slightest attack of catarrh.

The cough, on its first appearance, is observed only in the morning: by degrees it increases, and is then excited by slight bodily exertion: in its later stages it is observed after meals, especially after dinner, on getting into bed at night, or at any time when the horizontal position is assumed. As the disease advances, it is common at all times, and without any evident cause of excitement; but it is most frequent in the mornings and evenings; the sleep is often broken by it during the night, and by day it frequently brings on pain of the chest, and occasionally vomiting. In the latter stages it is followed by a degree of breathlessness amounting in some cases to a sense of suffocation, which is very distressing. Such are the usual characters of the cough which is indicative of tubercular disease of the lungs in its various stages, when not complicated with other morbid states of those organs. To these may be added another circumstance deserving notice, that no cause can in general be assigned for its first occurrence; it is sufficient, however, to know, that while cough is one of the earliest indications of pulmonary tubercle, it is among the most constant attendants during its progress, and one of the most distressing symptoms to the patient and to the feelings of his friends.

The cough which is most liable to be confounded with the tubercular, is that which accompanies catarrh, although in general they may be distinguished from each other. The catarrhal cough is characterized by the following circumstances. Its first attack is well marked, and can on most occasions be traced to evident exposure to a cold or damp atmosphere, checked perspiration, or other causes. The cough is deep, implicating the whole respiratory muscles, and is attended with general soreness of the chest, frontal headach, and other symptoms of catarrh. The difference in the expectoration which attends these coughs is equally well marked. The catarrhal cough, although at first dry and hoarse, is soon accompanied with expectoration, at first colourless, but shortly becoming opaque; then assuming a yellowish, mucous, and even muco-purulent character. From this time the cough and expectoration generally diminish, and under ordinary circumstances soon cease.

Such are the characters and usual progress of the cough of acute catarrh; but when the disease assumes the chronic form, — the principal and almost only remaining symptom being cough with more or less expectoration, — the distinction is attended with greater difficulty; yet still both the cough and the expectoration may in general be distinguished in cases of pure catarrh. It is when they are complicated that the difficulty arises.

When, from the continuance of the cough or its doubtful character, we suspect some cause beyond catarrh, we should inquire carefully into the patient's state before the occurrence of the catarrh. If he had a slight morning cough previously, or shortness of breathing, or hæmoptysis, there are strong grounds to suspect that the continuance of the catarrhal symptoms is partly dependent on tubercular disease, more especially if the patient is young. At a more advanced period of life, we often meet with dyspnœa and a morning cough, the consequence of the dry or pituitous catarrh, complicated with emphysema of the lung.

The cough which comes next in importance to the catarrhal cough in a diagnostic point of view, is one which has not inaptly been termed the "stomach cough." Gastric irritation is frequently attended with cough, in some respects not unlike the early tuberculous cough. A little attention, however, will soon enable us to discriminate them. In general, the cough which attends gastric irritation is louder and harder than the phthisical cough, and frequently comes on in paroxysms or fits. The sensation which excites it is felt deep in the epigastric region; and the irritated state of the stomach is generally rendered manifest by other symptoms. The tongue is red at the point or edges, generally furred in the centre, and often dry on awaking in the morning; there is thirst, some quickness, and a contracted state of the pulse; cold extremities during the day, and often a preternatural heat of the hands and feet during the night; the bowels are generally costive, and the urine is high-coloured. There is frequently joined to these symptoms frontal headach, especially in the evening, with a degree of irritability of temper which is unusual to the patient. If accustomed to mental occupations, he finds himself less disposed and less able to exert his mind. The expression of his countenance also changes remarkably — he becomes pale and sallow, and his features are sunken. He has the aspect of ill health; he feels unwell, and yet, on being questioned, he cannot fix upon any local complaint. This state often continues for a long period, and in many cases without much loss of appetite, — a circumstance which tends to deceive the patient respecting the seat and nature of his malady.

On a more minute examination, we shall find that the disease is seated in the digestive organs, and that the cough and other symptoms will gradually vanish by proper treatment, and the patient's health be frequently restored in a wonderfully short space of time, especially if he happen to be young. A gentle antiphlogistic treatment, and a strict adherence to a mild diet, will soon show

the nature of the disease, by the marked and speedy relief which it will afford; and this, in truth, will be at once the best test of the accuracy of our diagnosis and the soundness of our pathological views as to the cause of the cough, &c. Even when gastric irritation is complicated with incipient phthisis (a very frequent occurrence), our treatment must be directed to the cure of the former, as the best means of enabling us to arrive at a correct knowledge of the patient's condition.

There is another form of cough which properly belongs to the stomach, as it originates in, and is kept up by, a deranged state of that organ. This cough occurs later in life. It is accompanied with a considerable expectoration of tenacious mucus, which, from its occurring chiefly in the morning, has received the name of "morning phlegm." It is produced by too full living, and generally accompanies the last ten or fifteen years of the gourmand's life, and is easily distinguished from the tubercular cough.

Both these coughs, however, deserve attention, not only on their own account, but more especially when they occur in a tuberculous constitution. The first form of the gastric irritation, when of long duration, greatly favours the formation of the tubercular diathesis; and may thus prove fatal from its nature being mistaken and its treatment misdirected. The second occasionally masks tuberculous disease occurring at a more advanced period of life.

Diseases of other abdominal viscera are often attended by a symptomatic cough, which, without attention, may be mistaken for a pulmonary cough. Irritation of the liver and duodenum, intestinal worms, and irritation of the uterus often give rise to it. The cough which is present in chlorotic patients, and which is probably dependent on functional derangement of the uterus, may in general be easily distinguished from the phthisical cough, by the other symptoms with which it is associated, and by the facility with which it yields to a mode of treatment which would have little effect in relieving the latter. It must be kept in mind, however, that young females of a tuberculous constitution are the persons most liable to chlorosis, and on this account their cough must not be treated too lightly, nor a prognosis given without circumspection.*

Another form of cough which has been confounded with the tubercular is that which is termed "nervous cough." The character of this latter, the periods at which it occurs, its mode of attack and disappearance, all differ from those of the tubercular cough. The nervous cough occurs at irregular times throughout the day, and whatever agitates or affects the patient's mind is liable to bring it on. It has a peculiarly sharp, barking sound, is repeated in quick succession at short intervals, and often continues an hour almost without any intermission. It is also in general accompanied with other indications of nervous irritability, and not unfrequently with evident hysteria, of which indeed the nervous cough may in general be considered a modification, especially as young nervous females are most subject to it. In all its essential characters, therefore, the nervous cough differs from the phthisical; and although in pure cases there is little danger of their being confounded, it is far otherwise when they are complicated. In truth, all these coughs have their own peculiar characters, by means of which they may, with ordinary attention, be readily distinguished when they are uncomplicated with each other. It is when they exist in the same individual that the difficulty of discrimination arises, and such combinations frequently occur.

The tubercular cough is very often complicated with the catarrhal. The former may, and sometimes does, exist for some time without attracting attention, when an attack of catarrh produces its usual effects — masking for a time the phthisical cough which preceded it; or the catarrhal may have been the first in occurrence. Whichever is the case, after the catarrhal cough has run through its usual stages, a cough remains which is neither catarrhal nor tuberculous, but partakes of the characters of both; and it is only by careful observation that we are enabled to determine to which it chiefly belongs. Indeed the cough alone will not always enable us to do so. All the other circumstances of the patient must be taken into account: — his previous health, his present state and appearance, his hereditary predisposition, &c., must be considered; as each of them will assist us in determining the nature of the affection, whether it be an unmixed chronic irritation of the bronchial membrane, or an irritation kept up by tubercles.† If tubercles are present, we shall find by attentive observation that the cough varies in its character, being at times more allied to the tuberculous, and at others to the catarrhal cough, especially on any exposure to a cold or humid atmosphere.

The stomach and hepatic cough may in like manner occur in tuberculous subjects; and we may for some time be unable to determine the seat of the irritation which produces it. The gastric cough, however, is generally under control, and is speedily relieved, if not removed, by regimen and such means as are known to relieve gastric irritation.

Again, the tuberculous cough of young hysterical or nervous females is often greatly modified; the cough sometimes assuming the nervous character to such a degree as to pass entirely for that. Both the patient and her relatives are generally willing to believe that the cough is purely nervous, and anxious to impress upon the mind of the practitioner that it is so. We have known mistakes of this kind, and fear that they are not infrequent; we therefore caution our younger brethren not to allow themselves to be deceived by the too favourable report of friends, in their anxiety to make the case appear what they wish it to be; nor to rest satisfied with the cough which they may hear at a forenoon visit, but inquire into its character when the patient gets out of bed in the morning and retires to rest at night, also during exertion, and in a state of perfect quiet. Whenever doubt exists, it is misplaced kindness to omit a full examination from a fear of alarming the friends or depressing the spirits of the patient.

An examination of the chest, when performed

* De Haen has noticed the various abdominal diseases which produce cough. Vid. Rat. Medendi, lib. iii. p. 375.

† We refer the reader to the excellent articles, in the present work, on CATARRH and BRONCHITIS, for the characters of the cough which attends these diseases.

with caution and judgment, will be more easily submitted to by the patient, and prove far more satisfactory at this period of the disease, than when it is further advanced; at any rate, if mischief exists, it cannot be too soon detected, even at the risk of exciting alarm in both the patient and his friends. We have never had occasion to regret insisting upon an examination, though we have regretted its postponement. After such an investigation the physician can speak with decision respecting the measures which it is necessary to adopt; and in place of the lukewarm and vacillating directions which are too often given in such cases, he can impress with firmness upon the minds of the relatives the necessity of a strict adherence to such a mode of treatment, and such prophylactic measures, as the case may require and the circumstances of the patient admit: we say *prophylactic* treatment, because we are supposing the case to be in that stage in which the chief objects of treatment are to correct the tuberculous diathesis by general measures, and prevent a further deposit of tuberculous matter by avoiding those causes which are known to irritate the respiratory organs.

Dyspnœa. — This symptom, although never wanting, varies greatly in the degree of its intensity in different cases. In some instances it occurs early in the disease, being among the first circumstances which attract the patient's attention; and it is one of the most constant and remarkable symptoms in one form of the disease which we have already noticed, viz. *Febrile Phthisis.* More frequently it is not troublesome until the malady is far advanced; and it is generally in the very last stages only that it becomes very distressing. When the tuberculous disease makes slow progress, the dyspnœa is little remarked; and in persons who, from their quiet mode of living, use little exercise, it is scarcely noticed even when the respiration is more than double its usual frequency. We have seen the respiration in a consumptive patient habitually thirty in the minute, although the circumstance was never remarked by the patient himself. In such cases the oppression in breathing experienced during motion is very often attributed to debility. Indeed, it is by no means an infrequent occurrence to find the patient unwilling to admit the existence of dyspnœa until minutely questioned on the subject. There is often among consumptive persons a jealousy of being interrogated on any symptom which seems connected with pulmonary disease; and they not uncommonly conceal such symptoms from the physician, who must, if he desires to arrive at the truth, put his questions with great caution, and without appearing to attach any importance to them.

Although we shall not, we believe, err far in stating that the degree of dyspnœa or hurried respiration (for we class both under the same head) will generally be found proportionate to the rapid progress and extent of the tuberculous disease of the lungs, still this will not always be an invariable occurrence. We are not yet acquainted with all the causes of dyspnœa; but one of them is often to be found in a feeble heart, which is easily oppressed, and in this state gives rise to it. Of the one hundred and twenty-three cases reported by M. Louis, three only presented examples of severe dyspnœa; and a careful examination of the whole contents of the thorax after death, in these cases, detected nothing to explain it. A degree of congestion of the lungs commonly exists, we believe, in persons of a tuberculous constitution, both before and after the formation of tubercles, and may be one cause of dyspnœa; and hence we frequently find that an attack of hæmoptysis, or venesection employed to subdue this, relieves the dyspnœa for a considerable time. On the other hand, it not unfrequently happens that the origin of the short or difficult breathing is dated from an attack of hæmoptysis: we have frequently observed this, but are unable to account for it. We allude to the protracted dyspnœa:— that which immediately succeeds the attack of hæmoptysis most probably depends upon the effusion of blood into the pulmonary tissue, and the consequent compression and obliteration of the air-cells to a greater or less extent.

Dyspnœa, therefore, although not much to be relied on as an indication of the very early stage of phthisis, is frequently present, and should always be a subject of inquiry; indeed it will be found more often, we imagine, than is generally believed. It is chiefly during exertion that the oppression of breathing is experienced, and as it differs little from that which in a slight degree always accompanies such exertion, it seldom attracts attention. Being slow and gradual in its increase, and, like many other morbid states, unattended with pain, it is little noticed until it has become very considerable. But since tubercular disease of the lungs cannot exist to any extent without more or less dyspnœa, the presence of this symptom along with emaciation should lead us to examine the chest with care, even were there no other indications by which phthisis might be detected.

Expectoration.—When the cough has continued for some time, it becomes gradually softer, and a transparent, ropy fluid, resembling saliva, is expectorated, becoming by degrees more stringy and tenacious. After a longer or shorter interval, varying remarkably in different cases, specks of opaque matter appear mixed with the transparent frothy fluid. These specks vary in appearance, being at one time white, at another yellow or even approaching to green, and again very frequently of an ash colour, partly sinking in water in little masses, and partly floating in it in the form of striæ.

Immediately before, or at the time of this change in the character of the expectoration, a little blood frequently appears in it. As the disease advances, the transparent salivary portion diminishes, while the opaque part increases and gives a more homogeneous aspect to the expectoration, which is now of a yellowish colour, and is brought up by the cough with more ease and in more distinct masses. At a later period it is of an ashy colour, and is ejected in separate, rounded, flocculent-looking masses, enveloped in a certain proportion of the transparent ropy fluid. If thrown into water at this period, some of these masses sink to the bottom; others are suspended at different depths, connected together by the ropy, fluid expectoration before mentioned.

The period of the disease at which this last change in the character of the expectoration takes place, varies in different cases, and occasionally occurs a few days only before death. But more generally these ash-coloured, distinct masses are expectorated for many weeks or months before death, accompanied with more or less of the mucous fluid in which they frequently float. Bennet (Theatrum Tabidorum, cap. xxiv.) mentions these ash-coloured sputa as occurring, in hopeless cases, towards their termination. In some cases the expectoration continues to retain the yellowish puriform character; and in a still smaller proportion the semitransparent tenacious expectoration continues till within a few days of death, forming a gelatinous-looking mass, separated with difficulty from the vessel which contains it. During the last days of life, the expectoration appears in a more dissolved state, and sometimes of a darker hue; about this period, also, and often long before, it assumes a very fetid odour; finally it diminishes considerably, and often ceases entirely some days previous to death.

Such are the changes in the character of the expectoration which are generally observed in phthisis; but it is right to state that they are by no means constantly noticed. The periods in the progress of tubercular phthisis at which expectoration commences, and at which occur the various changes we have related, differ, as we have seen, in different cases. The nature, also, of the sputa is greatly changed by accidental causes, as by attacks of catarrh and of pneumonic inflammation.

Few of the symptoms which attend phthisis have excited more notice than the expectoration, or were formerly considered of equal importance in distinguishing it from bronchial disease. Since the real character of tubercles has been more fully demonstrated by modern pathologists, and we have become acquainted with the physical signs by which the existence of pulmonary disease is more certainly determined, the expectoration has been much less regarded as a means of discriminating phthisis. The presence of pus, which was so carefully looked for, and to distinguish which so many experiments were made, is now well known (and indeed has been so since the days of Hoffman and De Haen) to be present when bronchial disease only exists; and we also know that pus in the expectoration does not form an essential character of tubercular phthisis. But although no physician of the present day would think of relying on the appearance of the expectoration as a test of the nature of the pulmonary affection, still it is interesting to know what characters exclusively belong to it when it accompanies tubercular disease. The transparent, frothy, tenacious sputum, though it often indicates the presence of tubercles, is evidently a secretion from the bronchial membrane, and may occur independently of any tubercular disease. The same may be said of the yellowish-green expectoration, which is often discharged in large quantities towards the termination of slight bronchitis or in chronic catarrh; and there is no doubt that the same membranes produce the greater part of the expectoration in tubercular disease of the lungs.

There are two characters, however, which may be considered peculiar to the expectoration attending tubercular disease; the striated state of the expectorated mass with a mixture of whitish fragments in it, and the ash-coloured globular masses which are observed in the more advanced stage of the disease. This last we have never met with unaccompanied with tubercular disease; but even this form of expectoration has been found by Chomel and Louis in two cases during the last days of life, where neither tubercles nor tubercular excavations, nor dilated bronchi, were detected after death. The very circumstance, however, of its having been found in two cases only, by these two accurate observers, shows how very generally it is connected with tuberculous disease. The different characters of the expectoration which we have already noticed present themselves, for the most part, as has been before stated, in the course of pulmonary phthisis. They occurred in all the cases described by Louis, with three exceptions, in which the ash-coloured masses never appeared, the expectoration continuing semitransparent, or of a slightly yellowish hue, to the last.

The quantity of the expectoration varies remarkably in different cases, and is by no means to be considered commensurate to the extent of pulmonary disease. Occasionally the quantity is extremely small, although after death large excavations (of recent formation) are found. On the other hand, and even in the early stages, while the expectoration is still transparent, the quantity is often very great, especially when the disease makes rapid progress. In a few rare cases expectoration has been entirely wanting; Portal says that "sometimes this purulent expectoration is wanting, although the lungs be filled with abcesses."* We have only met with one decided case in which this continued to the last; — the lungs on one side were found, on examination, converted almost entirely into a mass of tubercular disease, containing numerous small tubercular vomicæ and one of considerable size: the upper part of the other lung was also tubercular, and some of the tubercles were softened. The cough in this case was so slight as scarcely to be remarked; but the rapid pulse, the quick breathing, the night-sweats and emaciation were more than sufficient to indicate the nature of the disease, independently of auscultation, which left no doubt on the mind: — there were, however, circumstances in the case which, without the assistance of auscultation, would have thrown a shade of obscurity on its nature. In other instances large excavations have been found communicating freely with the bronchi, although, for a considerable period before death, neither cough nor expectoration were present. (*Andral*, Clinique Médicale, t. ii. obs. xi.)

In regard to the sources of the expectorated matter, it is evident that when the tubercles are still in a crude state, it must be supplied by the bronchial membrane. The chief seat of tuberculous matter has been demonstrated by Dr. Carswell to be the air-cells and extreme terminations of the bronchi; and we can easily understand how this, when accumulated in any quantity, must prove a source of irritation, and that this irritation should be first communicated to the mucous membrane in the immediate vicinity of the tuberculous

* "Quelquefois ce crachement (pus) n'a pas lieu, quoique les poumons soient pleins de foyers de suppuration."

matter. As the small masses of tuberculous matter contained in the air-cells accumulate, the bronchial membrane and the pulmonary tissue become excited and irritated; a degree of inflammatory action most probably takes place, and a sero-purulent fluid is poured out, by which the tuberculous matter is penetrated and softened. The surface of tubercular excavations affords an additional secretion of matter; the quantity supplied from this source would appear in some cases to be great, whereas in others it is extremely small; indeed we have frequently been surprised at the small quantity of the sputa compared with the extent of the caverns.

Reviewing the facts which have been stated in this and the preceding sections respecting the varying characters of the expectoration, the uncertainty of its changes according to the progress of the disease, and its occasional absence altogether, it follows that we must not place much reliance on it, either in a negative or positive sense, as a diagnostic symptom, especially in the early stages of the disease. In conjunction with other symptoms, it has its value in the more advanced stages, in enabling us to ascertain the presence of tubercular disease in complicated cases, and the changes which occur in the ordinary progress of phthisis.

Hæmoptysis. — Hæmoptysis has been long regarded as a frequent cause of phthisis, from its being often observed to precede the more evident symptoms of the disease. A more correct knowledge of the nature and cause of hæmoptysis has placed it among the consequences of the pathological conditions of the lungs which precede and accompany the development and progress of tubercular disease. It is rarely, if ever, a cause of phthisis, except in a tuberculous subject. It may indeed be rendered a *determining* cause, by the debility which it induces when very copious, or by the sanguineous depletion carried to a great extent for the purpose of suppressing it; the effusion of blood also into the pulmonary tissue may become a source of irritation, and even form the nidus for the primary deposit of tubercle, as M. Andral has shown. (Path. Anat. Transl. vol. ii. p. 553.) Although, therefore, hæmoptysis is in general to be regarded as an indication of the presence of tuberculous disease in the lungs, it may in some cases be more intimately connected with its production.

It is certain that pulmonary hemorrhage occasionally occurs in a state of apparent health, being the first cognizable symptom of the approaching mischief. M. Andral relates some cases of hæmoptysis, in which he thinks he had evidence that no tubercles existed in the lungs previous to the hæmoptysis, because the patient showed no appreciable symptoms of their presence; and he cannot without difficulty believe that tubercles can exist to a degree sufficient to give rise to hemorrhage, without being preceded by cough or some other indication. In such cases he considers that pulmonary apoplexy takes place, the effused blood becoming the matrix for tubercular deposits. (Loc. cit.) But to produce this effect the effusion must take place in a tuberculous constitution, which, indeed, M. Andral admits. He gives a case illustrative of his views, which, while it shows that the effused blood may be the primary seat of pulmonary tubercle, supports the opinion that tubercles would only have been formed in a tubercular subject. It is a case where tubercles were found in a mass of effused blood, and in no other part of the lungs; but the patient had tubercular peritonitis at the same time. (Clinique Médicale, tom. ii. p. 39.)

Although, therefore, hemorrhage from the lungs may, in a few rare cases, give rise to phthisis, it is only to be regarded, even in these few instances, as an occasional cause. It is generally to be considered symptomatic of the existence of tubercles, and is, in this point of view, a most important diagnostic symptom.

Hæmoptysis is, no doubt, occasionally idiopathic, or at least totally unconnected with any previous disease of the lungs. In such cases, if not caused by local injury, it is either vicarious of the catamenia, or produced by a plethoric state of the system, the consequence often of suppressed sanguineous discharges, such as the hæmorrhoidal in persons advanced in life, and epistaxis in youth; and it is occasionally dependent on disease of the heart. In all these cases a temporary state of plethora of the lungs most probably occurs, and a free pulmonary hemorrhage may even prove beneficial. In phthisical cases we believe that a general plethora of the lungs often exists, and is the determining cause both of hæmoptysis and of tubercles; and that, even in such cases, the discharge of blood from the overloaded vessels may do good. In a few cases, hæmoptysis appears to be the effect of the severity of the cough.

Portal remarks that those who habitually spit blood rarely become phthisical, and cites the following observation of Baillou: "Magnas excretiones sanguinis ex pulmone minus esse periculosas quam parvas." This remark is most probably founded on the circumstance that idiopathic hæmoptysis, connected simply with congestion of the lungs, is generally abundant; as we have found in the majority of the cases of this kind which have come under our observation. But at the same time it must be admitted that cases of idiopathic hæmoptysis are very rare, compared with those in which it is to be regarded as dependent on, or immediately connected with, tubercular disease of the lungs. M. Louis, from careful and extensive observations on the occurrence of hæmoptysis in different diseases, came to the conclusion that, with the exception of some cases in which the hemorrhage depended on external injury, or where the catamenia were suddenly suppressed, hæmoptysis indicates, with a high degree of probability, the presence of tubercles in the lungs. Our own opinion corresponds with that of M. Louis.

The influence of sex and age in the production of hæmoptysis is not undeserving of attention. In the practice of M. Louis it occurred more frequently in females than in males, in the proportion of three to two. The age of the females was most commonly from forty to sixty-five, that is, after the period at which the catamenia usually cease; the reverse, Louis remarks, of what should have occurred had the hæmoptysis been an effect of amenorrhœa or a substitute for the suppressed catamenia. We shall probably find an explanation of this in the circumstance that females very often become full and plethoric at this age, and hence more liable to attacks of inflammation and hemorrhage than at any other period of life. We

have remarked this particularly in females who had been subject to very copious catamenial discharges. Among men, Louis observed hæmoptysis to occur nearly in the same proportion at all ages. The frequency of its return was generally in proportion to the length of the disease; and when copious, it rarely occurred oftener than twice or thrice in the same individual. In the whole of Louis's cases, it occurred in a greater or less degree in two-thirds; and the numbers in which it was inconsiderable were nearly equal. In some persons it is a frequent symptom during the whole course of the disease; in others it is never present. In the phthisis of advanced life and in young phthisical children it is rare, and occurs generally towards the close of the disease. Hæmoptysis may appear at any stage of phthisis; in a few rare cases it is, as we have remarked, the very first circumstance which excites alarm, occurring even before the cough. When it preceded the other symptoms, M. Louis observed that it came on suddenly in the midst of perfect health and without any appreciable cause; but neither of these remarks is quite in accordance with our own observations. We have found more frequently that the aspect of the patient was by no means indicative of perfect health, although he had not complained; and we have more frequently known the hemorrhage to succeed bodily exertion, such as running, ascending heights, or long speaking, than when no such evident cause had occurred; and in these cases we have remarked that the hæmoptysis did not appear during the exertion, but some hours after it. One young man, for example, had made considerable exertion in ascending a hill; he returned to dinner, and while dressing was attacked with hæmoptysis. Another, after great exertion in endeavouring to catch a horse, was affected in a similar manner a few hours after; and a third, after delivering a lecture in the evening, which required considerable effort, had an attack of hæmoptysis during the night.

There would appear to be a constitutional disposition to hæmoptysis in some persons, and even families. We have known several members of the same family die from the pulmonary hemorrhage during the progress of phthisis.

The quantity of blood discharged at one time differs greatly; in some instances not exceeding a single mouthful, and in others amounting to a pint or more. When it is slight, it is often confined to the mornings; and when it proves fatal, which is generally towards the termination of the disease when the structure of the lungs is extensively destroyed, several pints may be suddenly discharged. In this latter case, the hemorrhage arises, for the most part, from an opening occurring suddenly in a large artery implicated in the tuberculous disease.

As a diagnostic symptom, hæmoptysis is very important. We have already stated the very large proportion of cases in which it has been found to indicate tuberculous disease. Its occurrence, therefore, before or soon after the commencement of the cough, renders the presence of tubercles highly probable.

Pain of Chest.—Acute pain rarely attends the early stage of phthisis; but some pain is frequently experienced in the upper parts of the chest and shoulders, although it is scarcely noticed by the patient unless inquiry be made on the subject, as it is generally attributed to rheumatism. As the disease advances, the pain is more frequent, and we have usually found it more severe on that side on which tuberculous disease existed to the greatest extent.

We have noticed these slight pains in the clavicular regions, because in a doubtful case their presence would tend to increase our suspicions of the presence of tuberculous disease; especially when the other common symptoms are in accordance with this view, such as the tubercular character of the patient, the short cough, &c., and when as yet we have no positive sign to determine our diagnosis.

When severe pain has been experienced in the epigastric region and towards the back, adhesions have been found between the diaphragmatic and pulmonary pleuræ; but pains are often felt when an examination after death discovers no such adhesions to enable us to account for them. During the last months of phthisis, pains of one or both sides often add greatly to the patient's sufferings; indeed there are few cases in which they do not occur to a greater or less degree at this period of the disease.

The pain of the chest which attends catarrh is essentially different in its character; it is referred generally to the centre of the chest, between the sternum and the spine; it is chiefly felt during cough, and is described rather as a sense of soreness than of pain.

The Pulse.—Although the state of the pulse might be considered under the head of hectic fever, it perhaps deserves a distinct notice in this place, as much importance has been attached to it in phthisis. Like every other symptom, it varies very remarkably, being modified in each individual case by certain physiological and pathological conditions, which have no direct connection with the tuberculous disease. Generally speaking, the pulse of the phthisical patient is frequent, especially after the morbid condition of the lungs is fairly established; and in doubtful or obscure cases, a frequent pulse (by which we mean one of eighty or upwards in the adult) would add strongly to our suspicions of the existence of tubercles in the lungs.

But, before we form any judgment as to the frequency of the pulse, its natural state should, if possible, be ascertained in every case. Eighty pulsations in the minute may be the natural number in one patient, and yet constitute a frequent pulse in another, whose natural pulse is sixty or sixty-five. In our opinion, the average natural frequency of the pulse in adults is generally estimated too highly by authors; but be that as it may, its frequency should never be decided on until its natural state be first known. Many persons of the tuberculous constitution have habitually a slow, languid, and feeble circulation, which we have found continue with little variation, when there was clear evidence of extensive tuberculous disease in the lungs.

Without desiring, therefore, to fix the value of the state of the pulse as a sign of incipient phthisis, we regard it as always deserving the attention of the physician. A frequent pulse, in a tubercu-

lous subject, even taken as an isolated symptom, is one which should excite suspicion; and when accompanied with other symptoms indicative of pulmonary disease, it adds strongly to the presumption that mischief has already commenced. On the other hand, we consider a slow, or rather a natural state of the pulse, as a favourable and encouraging symptom, inasmuch as it is usually associated with a condition of the system which is favourable to the patient's recovery; while it is some proof that the lungs are not extensively tuberculous, and that there is neither much pulmonary nor gastric irritation.

Hectic Fever.—The fever which attends phthisis is usually slow and insidious on its first onset, and is, for some time, so slight as often to escape observation. Like some of the other symptoms which we have described, it varies greatly in degree in different cases throughout the whole course of the disease, and is more modified by collateral and accidental affections than perhaps any other symptom. The accidental occurrences to which we allude, are inflammation of the respiratory organs, and gastric and intestinal irritation. These appear to have more influence in exciting and modifying the fever than the primary tubercular disease, which frequently exists for a long period without being attended by an appreciable degree of fever. In stating this opinion, however, we do it with some hesitation, seeing that it is opposed in some degree to the views of that accurate pathologist Louis, who attributes the earlier febrile symptoms of phthisis to the presence of tubercles.

The first febrile sign remarked by the patient is a sensation of chilliness towards the evening. This sensation increases as it continues to recur, amounting often to a slight shivering; it is then usually succeeded by heat of skin during the night, the heat being particularly felt in the feet and hands, which are for the most part habitually cold in tubercular patients. After a time morning perspirations are found to succeed the hot stage. As the disease advances, these paroxysms of fever become stronger, especially the hot stage, and the heat is more generally diffused over the whole surface.

Perspirations.—Although this very prominent symptom forms a part of the febrile paroxysm, it is generally so disproportionate to the cold and hot stage by which it is preceded, and exercises so great an influence on the feelings of the patient and the course of the disease, that it merits a distinct consideration.

The fever has generally continued a considerable time, and the disease is far advanced, before the perspirations become copious. In many cases they are out of all proportion to the preceding fever,—in others, they are absent during the whole course of the disease. Louis found them wanting in one-tenth of his cases; and we have met with a few instances of the same kind. According to this observation of the physician, the stage of the disease at which the very copious perspirations occurred, corresponded generally with that at which the diarrhœa made its appearance. These two affections have commonly been considered supplementary of each other; the one diminishing as the other increased. This may occasionally be the case; but it is not the common rule, both in general proceeding apparently uninfluenced by each other. In this observation we are supported by the accurate Louis, who paid particular attention to the reputed reciprocal influence of these two symptoms, not only in phthisis, but in other diseases in which they frequently occur; and he could never find that any such reciprocal influence existed.

The perspirations occur chiefly in the mornings, more especially if the patient happens to fall asleep after having once awoke. As the disease advances, they come on whenever the patient falls into a sleep. During the early stages, they are confined to the head and upper part of the chest; but by degrees they extend over the whole surface. We have observed them exclusively confined to the anterior surface of the body, and in many cases to the head, neck, and chest. The copious perspirations of the phthisical patient present, as Louis observes, a remarkable instance of extensive and long-continued derangement of the function of the skin, without any appreciable alteration of structure; and it is very probable that if we could submit the fluid to examination, it would present characters very different from those of healthy perspiration. Although generally occurring in an advanced stage of phthisis, perspiration occasionally attends its very early periods. It seldom is copious at the commencement, and the patient, unless questioned on the subject, takes little notice of it. It not unfrequently happens that after having continued for some time, it ceases and again recurs, without our being able to account for this irregularity. In some feeble young persons, the copious morning perspiration is one of the most remarkable symptoms, and most disproportionate to all the others. We always look upon this as an unfavourable omen, and as indicating that the disease will run its course rapidly.

The importance of the perspiration as a diagnostic sign is not considerable, because other symptoms of a more marked character usually precede and accompany it; but at the same time it is never to be neglected or passed over with indifference in doubtful cases. We have seen perspiration, a frequent pulse, and emaciation the only symptoms of tubercular disease; and whenever we meet with it in a tubercular constitution, it ought always to rouse our fears and lead us to examine the state of the chest with attention.

Thirst.—This is not a remarkable symptom in phthisis. It rarely exists to a very great degree, although we have seldom seen it absent. Louis found it wanting in one-fourth of his cases; and where it occurred, it appeared to be more dependent on the fever than on the condition of the digestive organs.

Diarrhœa.—This is so common an accompaniment of phthisis, that it has been with justice considered one of the most important of its symptoms, exerting apparently a greater influence over its progress than any other; the wasting, the debility, and therefore the rapidity of the disease being in almost all cases proportionate to the severity of the diarrhœa. In all Louis's cases, the loss of strength and wasting corresponded with the number and frequency of the evacuations. This fact suggests a wholesome and not unnecessary caution on the employment of active purgatives even in the early

stages of consumption, and also of mild aperients in large doses as the disease advances; since they reduce the patient's strength, and may bring on diarrhœa before it would otherwise have occurred. We have seen a table-spoonful of castor-oil throw a phthisical patient into a frightful state of debility.

In persons who have been long constipated, and whose bowels it has been extremely difficult to regulate so as to procure healthy biliary secretions, it is often remarkable how regular the action of the bowels becomes, and how natural the evacuations are, after phthisis has made some progress.

Diarrhœa seldom occurs until the disease is far advanced; in a small proportion of cases not until a few days before death; and we have found it in a few instances entirely wanting. In one-eighth of his cases, Louis found diarrhœa commence with the disease and continue till death; in the majority it occurred in the latter stages; in others during the last days of life only; and in four among one hundred and twelve cases, it never appeared. Diarrhœa often proves one of the most distressing symptoms of the disease, being attended, after it has lasted some time, with severe pains before each evacuation, and by a deadly sensation of sinking immediately after it. The evacuations are generally of a yellow bilious colour.

Although the diarrhœa has not much influence in abating the perspirations, it occasionally has an evident effect on the cough and expectoration, diminishing the quantity of the latter and the frequency of the former. At the same time, we may observe that in one of the cases in which phthisis proved fatal without being accompanied by any expectoration, diarrhœa was also wanting. It is not, however, of much importance as a diagnostic symptom, because long before it becomes conspicuous, the nature of the disease is sufficiently evident.

Emaciation. — Few persons die of phthisis without being reduced to a great degree of emaciation, when the progress of the disease is not interrupted by some accidental occurrence which cuts off the patient. In some cases the wasting is one of the first circumstances which attract the attention of the patient's friends; in others the disease makes considerable progress before the patient becomes visibly thinner; examples of which we have found most frequently in young females. The cases in which the emaciation takes place to a great extent before any marked symptom of pulmonary disease occurs, are met with most frequently in persons pretty far advanced in life, and in whom the disease has been induced by irregular or unhealthy modes of living, which have impaired the various functions employed in nutrition and assimilation before the occurrence of the tuberculous disease. In general, the emaciation begins early, and is probably in part owing to the disease of the lungs impeding the process of assimilation. The diarrhœa being once established, the process of wasting advances more rapidly; it goes on through the whole of the soft parts, and frequently before death little more remains than the integuments and the bony skeleton.

As a symptom of tubercular disease, emaciation merits special attention in obscure cases. In persons about the middle period of life, from forty to fifty, we have found it one of the earliest symptoms of phthisis, even when there was no frequency of pulse, no cough, no marked dyspnœa, nor any other symptom to draw attention to the lungs. The derangement of the digestive organs which is generally present, is regarded as the principal cause of this wasting; yet, in spite of all that is done to maintain a healthy state of them and to supply abundant nourishment, the emaciation continues to make progress; and it is not till this state of things has continued for some time that the patient has evening chills, that the pulse becomes frequent, and occasional night perspirations occur.

Emaciation should never be disregarded when there is no evident cause of its presence. If it is accompanied by quick pulse and loss of strength, and especially if there is any oppression or frequency of breathing, we agree with Louis in believing that the tuberculous disease of the lungs rarely fails to prove its cause. Wherever there exist grounds of suspicion in such cases, the chest should be carefully examined.

Œdema.—This symptom occurs in general towards the termination of phthisis only, although it occasionally appears in a slight degree at an early period. This is frequently the case in young delicate females, who are often subject to a degree of œdema in their best health, especially in warm weather.

There is nothing in the œdema of phthisis different from what is often remarked in other chronic diseases, except that it is an invariable attendant; at least we have never found it wanting in the last period of phthisis. Although usually confined to the lower extremities, and seldom extending higher than the legs, it is sometimes observed in the upper extremities; and the face is frequently œdematous in the mornings during the last weeks of the disease. Œdema of the lungs, also, occasionally supervenes in the last stages, and in other cases an œdematous state of the glottis. Œdema is of little importance as a diagnostic symptom, because for the most part the nature of the disease is well marked long before its occurrence. It is, however, in general, a sure prognostic that the disease is approaching its termination.

Aphthæ.—An aphthous state of the mouth is commonly the last in the long catalogue of maladies which affect the consumptive patient. It occurs generally a week or two before death, and, like the other symptoms, varies greatly in degree, being sometimes productive of little inconvenience, and at others attended with so much irritation and tenderness of the mouth, as to prove a source of considerable suffering to the patient. The approach of aphthæ is generally marked by a red shining appearance of the tongue, mouth, and fauces, though occasionally they appear with very little redness of the mucous membrane. Aphthæ are very little noticed by French authors on phthisis; Portal does not even allude to them.

Other symptoms. — There are some other symptoms which frequently attend the progress of phthisis, and which may be noticed in this place. An incurvated state of the nails, with a rounder appearance of the last joint of the fingers,

is very often observed, and is generally regarded as a diagnostic sign of some importance. The falling-off of the hair is also a common occurrence in phthisis. The appearance of the urine deserves some notice; it is very frequently turbid, and during the fever throws down a copious sediment; while during the early stages it is often covered with an irridescent pellicle. The condition of the nervous system undergoes, with all other parts of the body, a considerable change:—the patient becomes nervous, both mentally and physically. One of the circumstances which is often remarked even in the early period of the disease is this unusual degree of nervous sensibility. The patient is timid, and apprehensive of the slightest circumstance which can increase his complaint: his hand shakes, and he often becomes peevish and irritable. These nervous affections generally keep pace with the increasing debility. The intellect, however, for the most part remains clear till within a few days of death, when slight delirium, as already mentioned, occasionally supervenes.

II. **Physical Signs.**—In the very early stage of tuberculous disease, we can scarcely expect to derive much positive information from physical signs, because the deposition of tuberculous matter is not sufficient to produce any perceptible difference in the respiratory movements, or the sounds which accompany them. It is quite clear that, before such evidence can be presented to our senses, the tuberculous deposit must be sufficient to impede the free transmission of the air throughout the vesicular structure of the lungs, in a degree capable of modifying the sounds which accompany respiration in a healthy state of these organs. By persons possessed of a delicate sense of hearing, and whose ear has been well educated in the varying characters of the respiratory sounds, a difference may be detected, we believe, much earlier than is generally supposed; but this degree of nicety cannot be expected from the ordinary auscultator. Those persons, however, who have endeavoured to ridicule the stethoscope because it could not detect tuberculous disease at such an early period as we are now contemplating, could neither have possessed a right conception of the principles upon which the physical signs of pulmonary disease depend, nor a correct knowledge of the anatomy of incipient tubercles. They might as justly deny the powers and utility of the telescope because it does not enable us to ascertain all the minute phenomena of the starry heavens. Those, also, who venture to affirm that auscultation is useless until the disease is rendered evident by the common symptoms, are equally in error. It is true that auscultation *alone* is not sufficient to ascertain the existence of the disease at a very early period; yet, even at this time, the information which it affords is often very valuable both in a negative and positive point of view. If it does not give us positive assurance of disease when it is limited, it will generally enable us to say when disease does not exist to a great extent. In doubtful cases, therefore, we should never fail to examine the sounds of respiration and the degree of resonance of the upper parts of the chest. If both are natural and alike on both sides, we may feel tolerably certain that tuberculous disease does not exist, or is very limited; if, on the contrary, they differ, we shall ascertain the presence of disease which the ordinary symptoms scarcely led us to expect: in a few cases we have even found pectoriloquy, when neither the appearance of the patient nor the symptoms induced us to anticipate it. We therefore hold it wise to avail ourselves of auscultation in all cases. It will often assist us powerfully in our diagnosis, and can never lead into error when its results are taken in conjunction with our other means of diagnosis.

The following method of proceeding, while it will be the least formidable to the patient, will enable us most readily to discover the presence and site of disease.

Respiratory Movements.—In examining the chest, it is of importance to do so with as little parade as may be; otherwise, if the patient is nervous, the respiratory movements may be so imperfectly performed that we shall be unable to obtain any satisfactory information from them. It will also be advantageous to adopt a certain order in our examinations. We should first observe carefully the state of ordinary respiration, and afterwards, by placing the patient fairly before us, mark accurately if both sides of the chest are equally raised during a full inspiration. A difference in this respect between the two sides will frequently lead us to the seat of the most extensive disease, which exists for the most part on that side which is least raised.

Percussion.—This may next be resorted to, below the clavicles and over the inner extremities of these bones, in order to compare the sound of the chest with that of a healthy one (with which we suppose the auscultator to be acquainted), and also the sound of one side with the other. Mediate percussion is preferable in most cases; it is far more agreeable to the patient, and if carefully performed affords equal information. Various substances have been used as pleximeters; that which we think most suited for the purpose is a piece of flat caoutchouc; but perhaps the best, and almost the only one we employ, is the finger; it conveys the sound with perfect clearness, while at the same time it removes any fear of uneasiness on the part of the patient. To perform percussion well, either the back or fore-part of the finger may be pressed firmly on the chest; it should then be struck smartly but lightly with the points of two or three fingers of the other hand; to effect this, very little force is required; in children or young spare persons, the point of a single finger is sufficient. This simple operation will, with few exceptions, afford us all the information to be derived from percussion. It is not, however, by any means so easy as is commonly believed, and consequently it is often imperfectly performed. The points particularly requiring attention, are, to keep the finger in close contact with the chest, to strike it at the same angle wherever applied, and to do this so as to elicit the resonance of the contents, not merely of the parietes, of the chest.

Auscultation.—Having ascertained the resonance of the chest, we next proceed to examine the respiratory murmur, either with the unaided ear, or through the medium of the stethoscope. Although the ear alone is sufficient to examine

most parts of the chest, there are some situations in which the stethoscope is preferable; such as immediately below and above the clavicles in some persons, and in the axillæ of all. There are other objections to the application of the ear—some referable to the patient, others to the auscultator, which are sufficiently obvious. On the back and sides, however, when the form of the chest admits of it, the ear is generally preferable; but, assuredly, he who can use the ear and the stethoscope with equal facility and effect, possesses advantages which are not enjoyed by the auscultator who can use one of them only; and when we hear it stated that the ear answers all the purposes of a stethoscope, we are disposed to conclude that the advocates of that opinion are not very minute in their investigations.

Value of the physical signs.—1. Tuberculous disease must occupy a considerable portion of the lungs before we can conceive it capable of influencing the motions of the chest to a perceptible degree; simple inspection is not, therefore, of great value in the very early stage of the disease, but it is often useful, and not unfrequently points out the chief seat of the disease when it is more extensive. Neither is percussion of much value in detecting the very early stages of tuberculous disease, as this may exist even to a considerable extent, if the surrounding pulmonary tissue is healthy, without being detected by percussion; the sound elicited may even be clearer than over a more healthy portion of the lung. This will be the case when the pulmonary vesicles are dilated, which they often are, amid groups of small tubercles. Hence, by trusting to percussion alone, we might be led to consider the diseased as the sounder side of the lung; and we are the more likely to fall into this error, the greater the extent of the emphysematous portion of the lung. In such cases, by percussing carefully, we shall sometimes find a small spot, the dull sound of which contrasts remarkably with that of the surrounding emphysematous parts. In judging of the sonoriety of the chest, the thinness of the parietes must be taken into account; otherwise it may lead to error in the case of children and very thin persons.

When the disease is farther advanced, and the tubercles have coalesced so as to form a solid mass, or when the pulmonary tissue immediately surrounding them is rendered impermeable to the air by the effects of inflammation, a dull sound is perceptible over such portions of the lung; and if this dull sound exist in the upper part of the chest only, it may be considered as very generally indicating the presence of tubercles.

2. The information which auscultation affords us is more valuable and precise than that derived from the movements or resonance of the thorax; but in order to obtain the full advantage of it, we must employ it with circumspection, as various circumstances may render it deceptive. A morbid condition of the mucous membrane from frequent attacks of catarrh, or what has been termed by Laennec "the dry catarrh," or an emphysematous state of the lung, may render the respiratory murmur obscure, and lead to the belief that the lung is consolidated. Percussion, however, will enable us to correct both errors: in the first case it elicits the natural sound, in the latter a particularly clear, or even tympanitic sound. Emphysema is a more frequent source of error than is usually imagined. Portions of the lung are very frequently emphysematous, both in phthisical and other patients, particularly in persons subject to chronic coughs, or whose breathing is habitually laborious; and without keeping this in view, we may err in our diagnosis. In these cases, along with the obscure or absent respiratory murmur, we have the clear sound on percussion, and often a more elevated state of the chest over the emphysematous portion of lung; and if the emphysema exists more on one side than on the other, this rounder form of the chest is more remarkable, particularly in phthisical subjects, in whom the chest usually falls in under the clavicles. A little attention to these circumstances will soon enable the young auscultator to discriminate them.

When the presence of tubercles is suspected, we examine with the greatest care the clavicular and supra-scapular regions. If the respiration be soft, and free from any rhonchus in this region, if it be the same on both sides, and if the resonance of the voice be also equal, we have strong evidence that there is no tuberculous disease in that part of the lungs where it is most frequently found, or, if it does exist, that it is to a very small extent only.

If the tubercles are scattered generally through the summit of one lung, the resonance of the voice becomes rather stronger, and the respiratory murmur is simply rendered somewhat bronchial and less soft. If, on the other hand, they are in considerable numbers and confined to a portion of the upper lobe, the natural respiratory murmur is in a great degree lost, the respiration being almost entirely bronchial. In such cases the resonance of the voice also is much louder over the diseased than over the sound portion of lung, and amounts often to what is termed bronchophony. As tubercles are almost constantly present to a greater extent on one side of the chest, this difference of the signs on the two sides will greatly assist us in our diagnosis in obscure cases.

Although we have pointed out the upper part of the chest as that which requires to be most minutely examined in all cases where we suspect the presence of tuberculous disease, the examination should be extended over the whole chest; as the symptoms may be produced by chronic pleurisy or chronic pneumonia, the signs of which must be looked for in the condition of the lower part of the lungs. The upper lobes also are not always the seat of tubercles, although they are most frequently so; hence we should not draw our conclusions until we have ascertained the state of the respiration over the whole chest. In doing this we should not expose the chest; it may be covered with a flannel dress, which it will only be necessary in some cases to remove from the clavicular regions, where the examination should always be made with the greatest care.

By adopting this plan of careful investigation on being first consulted, we do not hesitate to express our conviction that the greater number of cases of tuberculous phthisis would be discovered at a much earlier period of their course,—often, we are satisfied, many months, nay even occasion-

ally years before they now are, from the careless manner in which this class of patients are too commonly examined. Until we adopt a more minute and methodical system of inquiry into the history of the case, and, in addition to the usual symptoms of pulmonary disease, avail ourselves of the light afforded by auscultation in the most extended sense of that term, tubercular disease of the lungs can rarely be detected at such an early period of its progress as will give reason to hope that its further advancement may be prevented. In the present superficial mode of conducting our inquiry into the nature of such cases, the disease of the lungs has too often made considerable progress when the patient is said to be merely threatened with it; and tracheal or bronchial irritation are the terms employed to account for symptoms which a close investigation would trace to a deeper source. We must not be satisfied with a few rough and slovenly thumps on the upper part of the chest, or even with the use of the ear or stethoscope for a few seconds, applied as if we were afraid rather than desirous of ascertaining the real condition of the lungs. Such superficial examinations, if they deserve the name, are worse than useless: with the semblance of doing something, they really effect nothing, unless it be to deceive the patient and his friends, and bring this method of diagnosis into unmerited disrepute. Nature will not be interrogated in this rude manner; her operations must be observed with care and studied with attention, before we can hope to interpret them with fidelity and precision.*

Sect. V. — Of the Morbid Anatomy of Phthisis.

The morbid anatomy of phthisis was for ages misunderstood; the real nature of tubercle being unknown, and the ulceration which follows the evacuation of the tuberculous matter being considered the cause of the disease. Tubercles are, however, mentioned by Hippocrates, who noticed them in the lungs and on the pleura, and thought that they consisted of a putrefied phlegm. His opinions, with some obscure notions of Galen respecting ulceration of the lungs being caused by the descent of humours from the head and the putrefying of blood effused in the lungs, were adopted by most medical writers who mention tubercles, until after the revival of letters. Sylvius de la Boe, whose works were published in 1679, was the first who gave a good account of tubercles, pointing them out as a cause of phthisis, and showing their connection with scrofula. He thought they arose from the scrofulous degeneration of certain invisible glands in the lungs, similar to those in the neck and mesentery. (Opera Medica, p. 692.) His opinions were adopted and illustrated by several of his successors, particularly by Morton and Wepfer, and have been revived in our own day by Broussais. Nothing more was known concerning them till the comprehensive and satisfactory essay of Desault of Bordeaux was published in 1733. (Dissertations de Médecine, tom. i.) This author having applied himself during a period of thirty-six years to the investigation of phthisis, acquired an extensive knowledge of the morbid anatomy of the disease. He maintained that the formation of tubercles in the lungs was the sole cause of phthisis, and pointed out many of the facts regarding their development which have since been attributed to more recent authors. In the middle of the last century, Russel, Tralles, Gilchrist, and Mudge, adopted, more or less, the views of Desault, while their contemporaries neglected or forgot his discoveries. With these exceptions, the knowledge of tubercles seems to have rather retrograded than advanced, till it was revived by the indefatigable researches of our countryman Stark; in whose early death the literature of medicine sustained a serious loss. Had his life been spared, he would, in all likelihood, have anticipated our continental neighbours even in their minute pathology; while his care and skill in the application of his facts to practice would have prevented the science from becoming, as it has in the hands of some, a hindrance rather than a help to the therapeutic art. By his own careful and minute observations, he acquired a surprising knowledge of the morbid anatomy of tuberculous phthisis.

The following enumeration of the facts which he ascertained by the examination of ten bodies only, will show at once the attention with which he had marked every circumstance, and the extent of our loss by the premature termination of his labours. He found that tubercles are not vascular, and exhibit no trace of organization when examined by the microscope; that they are of every size, from that of a granule to the diameter of half an inch; that they soften at various points of their substance; and that the cavities left by them vary in size from half an inch to three or four inches. He also found that these cavities communicate with the bronchi by smooth round openings, and with each other by ragged ones; that they are always lined, entirely or partially, with a smooth, thin, tender slough or membrane; that the larger cavities are often found nearly empty; that they are generally situated towards the back part of the upper lobe; that their communication with the cavity of the chest is prevented by broad firm adhesions between the pleura costalis and that portion of the lungs which they occupy; and that even crude tubercles are seldom found unaccompanied by such adhesions. He also described most accurately the hepatization of the lung, and the obliteration of the blood-vessels in the neighbourhood of tubercles and caverns. Nor did the thickening and reddening of the bronchi and trachea, nor the ulcerations of the intestines escape his observation. (*Stark*, Clinical and Anatomical Observations and Experiments.)

Since Stark's time the works of Baillie, and still more those of Bayle, Laennec, Louis, Andral, and Carswell have rendered our knowledge of the morbid anatomy of tubercles more complete than that of any other morbid product. Various opinions, however, are still entertained respecting their nature and mode of development; but as these have been fully discussed in the preceding article, Tubercle, we will at present confine our observations to the formation and progress of tuberculous matter in the lungs, and to the changes which its presence induces in this organ.

Tuberculous matter is deposited in three distinct forms,—namely, grey semitransparent gran-

* For a more detailed exposition of Auscultation, see the able article on that subject.

ulations; caseous, or crude tubercle; and tuberculous infiltration.

Granulations.—Grey semitransparent granulations are scarcely ever absent in any stage of phthisis, and accompany every form of the disease. They have a consistence somewhat less than cartilage, being sometimes almost colourless, though generally grey; they vary in size from that of a mustard-seed to a pea, being sometimes distinct, sometimes united in small clusters like grapes, and more rarely agglomerated in masses of one, two, or three cubic inches. They are most commonly found in considerable numbers, often occupying a great part of the tissue around large excavations and of the bands which traverse them. The period required for their development is very variable. In acute phthisis, Louis says they may reach the size of a pea in three or four weeks; in other cases they may remain small for a considerable period; thus, in several individuals who had cough and frequent attacks of hæmoptysis for many years, granulations, about the size of peas, were the only lesion found by this physician after death. When subjects already labouring under phthisis or who have a highly tuberculous disposition are exposed to violent irritations of the lungs, these granulations are deposited so rapidly and in such numbers over the whole extent of the lungs, as to give rise to the most alarming dyspnœa, and even cause death by suffocation. A case of this kind is related by Bayle, which terminated finally in twenty-two days. (Recherches sur la Phthisie Pulmonaire, p. 127.)

The granulations, after a time, begin to lose their transparency and consistency, and become white, opaque, and friable. When these changes are completed, the granulations receive the name of crude tubercles. The period at which such changes take place varies indefinitely; in adults, death rarely happens before some of them are effected; yet Louis has met with five adults in whom the granulations were unaltered. From the observations of Papavoine, (Journ. des Progrès,) Tornelle, (Journ. Hebdomadaire,) &c. it would appear that the change takes place much more rapidly in children than in adults. Laennec and Louis suppose that it begins invariably at the centre of the granulations; but Andral and Carswell (Illustrations of the Elementary Forms of Disease; art. *Tubercle*,) maintain that it may begin at the centre or at any point of the circumference indifferently.

Grey granulations were first observed and described by Bayle, who thought they were a morbid product, *sui generis*. He described them as constituting a species of phthisis, sometimes entirely simple, but most commonly complicated with the tuberculous. He supposed that in time they produce ulceration, and that the caverns to which they give rise are distinguished from those which follow tubercles by being lined with false membrane. Laennec, on the other hand, maintained that they are necessarily the first form under which tubercle presents itself; and Louis and some other pathologists have adopted Laennec's views. Another opinion regarding the nature of these granulations has been advanced by Andral, (Clinique Médicale, tome ii. p. 9, seconde edit.) who has endeavoured to prove that they are the result of chronic inflammation of the parietes of the air-cells. The opinion that grey granulations always constitute the first stage of tubercles is supported by the following facts—that granulations are found only in tuberculous subjects; that, in them, they occur, not only in the lungs but also in the lymphatic glands, in the liver, in the spleen, and on serous membranes; lastly, that in these organs, as in the lungs, they ultimately assume the character of crude tubercles. But Dr. Carswell shows that the grey semitransparent substance does not necessarily precede the formation of opaque tuberculous matter; that the latter is found in several organs in which granulations are never observed: and that its form chiefly depends on the structure of the organ on which it is deposited.

Crude tubercle.—This term is applied to certain tumours of a rounded form, varying in size from that of a pin's head to a small walnut. They have a yellowish white colour and a soft cheesy consistence: in some cases only a few are detected at the summit of the lungs; in others they occupy the greater part of their substance. They are, as we have before seen, generally the result of changes which have taken place in the matter deposited under the form of grey granulations; although, on the other hand, it is the opinion of all modern pathologists, with the exception of Laennec and Louis, that tuberculous matter is often primitively deposited in the crude form, in the lungs as well as in other organs. This opinion is supported by the facts that the granulations in some instances are wholly wanting,—and that large masses of crude tubercle are found in some cases of acute phthisis which are too rapid in their march to allow time for the change from granulation to tubercle. These two forms, however, almost always co-exist; Louis having met with only two cases of crude tubercle without granulations, and five of granulations without tubercles.

3. *Tubercular infiltration.*—The third form in which tuberculous matter presents itself in the lungs is that of infiltration into the cellular tissue of the organ. Baillie, who first noticed this state, gives the following accurate account of it:—"In cutting into the lungs, a considerable portion of their structure sometimes appears to be changed into a whitish soft matter, somewhat intermediate between a solid and a fluid, like a scrofulous gland just beginning to suppurate. This appearance is, I believe, produced by scrofulous matter being deposited in the cellular substance of a certain portion of the lungs, and advancing towards suppuration. It seems to be the same matter with that of tubercle, but only diffused uniformly over a considerable portion of the lungs, while the tubercle is circumscribed." (Morbid Anatomy.) This has since been described by the French under the name of "infiltration."

Another deposit of a peculiar kind never found in other diseases, is the yellow jelly-like matter, the "infiltration tuberculeuse gelatiniforme" of Laennec, who believes that it is only a more liquid state of the tuberculous matter poured into the parenchyma of the lungs. From our knowledge of the various forms which tuberculous matter assumes in other parts, and from having seen large quantities of a similar matter contain-

ing small isolated flakes of crude tubercles deposited around a scrofulous joint, we are inclined to adopt Laennec's opinion.

In general, tuberculous matter first makes its appearance in the lungs in the form of the grey semitransparent granulations which we have just described, and which gradually take on the characters of crude tubercles. While these undergo the usual process of softening, and while ulceration is going on around them, tuberculous matter continues to be deposited in the neighbouring tissue, so that we often find excavations at the summit, crude or softened tubercles below these excavations, and granulations offering no trace of opaque matter in the lowest part of the lungs. At a late period of the disease the pulmonary parenchyma is occasionally so filled with tuberculous matter as to leave but few traces of its original structure, the whole constituting one dull, opaque, grey, or white mass of tubercular infiltration, excavated to a greater or less extent.

The nature, extent, and relation of the different forms of tuberculous matter, and the changes which they undergo in the lungs, vary greatly in different cases. The upper and back part of the lungs is the most common seat of tubercle, and the left side is more frequently affected than the right; an observation which was first made by Stark, and corroborated by Carmichael Smyth from an examination of the cases recorded by Bonet and Morgagni, and more recently by Louis from his own experience. The last author found tubercles exclusively confined to the right in two cases only, whereas he noticed the same occurrence in five instances on the left side: of thirty-eight cases in which the upper lobe was totally occupied by large excavations and tubercles, so as to be impermeable to the air, he met with twenty-eight in the left and ten only in the right lung: and in eight cases of perforation of the pleura, he found seven on the left and one only on the right side. When to these observations we add the result of Reynaud's experience, who found twenty-seven of forty cases of pneumo-thorax on the left side, and thirteen only on the right, we consider that we have sufficient evidence to confirm the conclusion that the left lung is most frequently affected. (Journ. Hebdomadaire, vol. vii. p. 61.) This, however, is the reverse of the relative frequency of pneumonia, at all ages, on the two sides. M. Lombard found that of eight hundred and sixty-eight cases of pneumonia, four hundred and thirteen were affected on the right side only, two hundred and sixty on the left, and one hundred and ninety-five on both sides. By the above comparison it appears that pneumonia on the right side is to that on the left, in point of frequency, as three to two. (Archives Gén. de Méd. t. xxv. p. 60.)

State of the lung around tubercles.—So long as the tuberculous matter remains as primarily deposited, whether in the form of grey granulations or crude tubercle, we find the surrounding parenchyma healthy; but as soon as the change of grey granulations to crude tubercles or softening in the latter begins, we find the pulmonary tissue around the tubercles in a state of congestion, firmer than natural, and of a red or grey colour. In some cases the tubercles do not excite irritation in the surrounding tissues, and consequently remain, even for years, in their original state; in others the more fluid parts of the tubercle are simply absorbed, while the more solid ones are left in the form of a calcareous concretion. This last termination is more common than is usually imagined, and is met with very frequently in persons who fall victims to a subsequent attack of phthisis at a more advanced period of life. In such cases the new deposit occurs most readily in those parts of the lungs previously affected, and whose tissue has been more or less changed by the presence of the tubercles originally formed; for it is by no means uncommon to find bony or calcareous concretions in the midst of tuberculous masses, in caverns, or even expectorated with matter derived from the softening of tubercles of a more recent date. In the process of this change from crude tubercle to calcareous concretion, such a degree of irritation occasionally takes place in the immediately surrounding parenchyma, as to produce the deposition of coagulable lymph, which then forms a sort of cyst surrounding the tubercle or concretion, and thus completely destroys its power of again irritating the lung.

The process of softening has been regarded as a consequence of the death of the tubercle, by those who, like Laennec, regarded this substance as an organizable morbid product; and it has been stated by others who did not take this view of the subject, to begin always at the centre and to proceed towards the circumference. This opinion, however, supposes some change in the substance of the tubercle; but as we have ample proof that tubercle is a mere morbid product or secretion incapable of organization, we cannot admit that it is subject to any change after its deposition, excepting that which arises from the action of the surrounding tissues upon it. Dr. Carswell has shown that the softer appearance of the centre of the tubercle has no connection with the process of softening, but depends on the tuberculous matter being deposited from the internal surface of the air-vesicles or bronchi, leaving a hollow in the centre filled frequently with the soft fluid usually contained in them. This central softening has been attributed by Andral to the escape of a portion of the tubercle along the bronchi. Stark, Andral, and many others have made the observation that the softening does not always begin in the centre, but may appear either there or at some part of the circumference indifferently. The process of softening is, in our opinion, to be regarded merely as a consequence of the changes produced in the tissues where this matter is deposited. Before these changes take place, tubercle appears to excite little disturbance of the general economy, and may exist for a length of time in several organs, attended by symptoms so slight as scarcely to indicate its presence.

The changes in the lungs induced by the existence of tubercles, are, sanguineous congestion, inflammation, induration and softening, ulceration, mortification, and atrophy. When the tubercles exist in great numbers, or accumulate in considerable masses before the process of softening commences, they press upon and generally obliterate some of the blood-vessels; thus preventing the

free circulation of the blood, and giving rise to various degrees of congestion. When this occurs towards the root of the lungs, the obstruction to the return of the blood which it occasions, is so great that the small capillaries often give way, and the blood is poured into the bronchi. Hæmoptysis arising from this cause was first noticed by Desault, and has been much insisted on by late authors.

When, instead of producing merely impeded circulation and consequent congestion of the lungs, tubercles give rise to irritation and inflammation in the surrounding tissues, or when other causes excite inflammatory action in parts containing tubercles, we have the usual appearances of inflammation in its various grades. The parts in immediate contact with the tubercle pour out serosity and take on the ulcerative action, by which the tuberculous matter is broken up and sooner or later expectorated, leaving a cavity in its place. By this successive breaking down of the contiguous tuberculous masses, the cavity becomes increased in size, when it is usually termed a "cavern."

The views of Dr. Carswell regarding the seat of tubercle enable us to explain, in a very satisfactory manner, the mode in which the different tissues are successively affected. The tuberculous matter being, as he describes, deposited in the air-vessels and minute bronchial tubes, these parts are necessarily first irritated by it; and being constantly distended and pressed upon in every direction by the matter accumulating within them, are gradually enlarged in size, and sooner or later destroyed by the ulcerative action. The bronchi are thus found invariably enlarged, stopping abruptly, and appearing as it were cut across at their entrance into a cavern; and unlike the other tissues of the lungs, they are never found enveloped and compressed by deposition of tuberculous matter around them, except in those instances of rapid infiltration in which the whole substance of the lung appears injected simultaneously.

The surrounding cellular tissue, healthy air-vesicles, and blood-vessels, are at first only pushed aside by the deposit of the tubercle, and are therefore only affected in a secondary manner, which is nevertheless sufficient to cause their atrophy, or produce from the infiltration of fluids a condensed state, partaking more or less of the characters of tuberculous matter, or of the common products of inflammation. Hence, the tissue which surrounds crude tubercles and excavations is almost always impervious to air, from the effects of inflammation or the infiltration of tuberculous matter.

The mode in which the blood-vessels are affected by the development of tubercles and the formation of caverns in the lungs, has been so well described by Stark, that we cannot refrain from introducing the whole of his remarks upon it. "The pulmonary arteries and veins," he says, "as they approach the larger vomicæ, are suddenly contracted; a blood-vessel which, at its beginning, measured half an inch in circumference, sometimes (although it had sent off no considerable branch) could not be cut up further than half an inch. And when outwardly they are of a large size, yet internally they have a very small canal, being almost filled up by a fibrous substance; and frequently as they pass along the sides of vomicæ they are found quite detached, for about an inch of their course, from the neighbouring parts. That the blood-vessels are thus obstructed, and that they have little or no communication with the vomicæ, is rendered still more evident by blowing into them; by blowing they are not sensibly distended, nor does the air pass into the vomicæ, excepting very rarely, and then only by some imperceptible holes: and after injecting the lungs by the pulmonary artery and vein, the parts less affected by disease, which before injection were the softest, become the hardest; and vice versâ, the most diseased parts, before injection the hardest, are now the softest.

"Upon cutting into the sounder parts, numberless ramuli may be seen filled with wax, but in the diseased parts there is no such appearance; and upon tracing, by dissection, the injected vessels, those which terminate in the sounder parts may be traced a long way to the smaller ramuli; but those which lead to tubercles and vomicæ, a very short way, and only to their principal branches. The wax was very rarely found to have entered the middling-sized vomicæ, and never the smaller or larger ones." (Op. cit.)

Perforation of the coats of the blood-vessels, though never observed by Stark, occasionally takes place; and, according to the size of the opening and the capacity of the affected vessel, the patient may have trifling hæmoptysis, or perish in a few seconds from the profuse discharge of blood. The rarity, however, of this accident may be estimated by the fact, that the bands which traverse the caverns were found by Louis to contain pervious blood-vessels in only five out of one hundred and twenty-three subjects whom he examined.

As the neighbouring caverns increase in size, the intervening parenchyma is gradually destroyed, till they coalesce, and change an entire lobe into one large, jagged, irregular cavity, in which portions of the pulmonary tissue are often found, either hanging loosely or traversing it in various directions in the shape of bands, and occasionally perfectly detached. These loosened portions, the bands, and the walls of the caverns, present little or no trace of the healthy pulmonary structure. They are of a red or grey colour, and exceedingly hard, being for the most part composed of semi-transparent granulations, or crude tubercle and black pulmonary matter. Portions of the walls also occasionally mortify, which gives rise to the fetid smell which is sometimes observed in the breath and expectoration of the patient towards the termination of the disease.

After the matter first formed is expectorated, a fluid more or less resembling pus continues to be secreted from the parietes of the caverns. These are composed of the pulmonary tissue, generally covered with a crust of very soft, grey, inorganic matter, from one to two lines in thickness. This is believed by most pathologists to consist merely of the thicker parts of the matter secreted by the surrounding pulmonary tissue. It is intimately united with the mucous membrane of the bronchi at the point where the latter enter, and, according to Louis, frequently consists of two layers,—the first or internal being dense, grey, almost semi-transparent and semi-cartilaginous, about the third

or fourth of a line in thickness; the second being very soft, yellow or white, of about the same thickness, but often not continued over the whole surface, as the first is. Both these layers were wanting in a fourth of the cases examined by Louis, leaving the pulmonary tissue quite bare. Their destiny and even their existence often seem to bear a relation to the age of the cavity.

The cavities generally contain more or less of a fluid of various consistence and colour; sometimes having a resemblance to thick curds; at others to pus, mucus, or simple serum. A cavity may contain more or less of all these various products, mixed with effused blood or destroyed parenchyma, or it may be filled with one only. In a few rare cases, it is found quite empty, and is then generally lined throughout with a dense false membrane. Cavities were never found empty by Louis, before the end of the third or beginning of the fourth month from the commencement of the disease. When old, and especially when not lined with membrane, they contained a green, dirty-looking fluid, sometimes tinged with blood.

Although, as we have seen, caverns generally tend to increase in size, yet not infrequently when they occur singly, and when no fresh depositions of tubercles take place, they remain a long while stationary. In cases still more uncommon, they gradually contract and are obliterated. The process by which this obliteration is effected is well described in Dr. Carswell's Illustrations, already referred to. The parietes of the cavity consisting of simple mucous tissue, become gradually and successively converted, according to this author, into serous and fibrous, and sometimes into fibro-cartilaginous and cartilaginous tissue. More frequently it retains the fibrous character, possessing the property of contracting, so as to diminish the bulk of the excavation. As the contraction proceeds, a puckering of the surrounding lung takes place, which is most conspicuous where the pleura is forced inwards by the retrocession of the pulmonary substance. The contraction in some cases proceeds so far that a small portion of fibro-cartilaginous tissue only remains where an excavation of considerable extent had existed. (Op. cit.) That caverns are really obliterated in this manner, is proved by the previous existence of pectoriloquy and other signs of caverns in those parts where the cartilaginous masses are found; by their situation and form, by the condition of the bronchi, and the puckering of the surrounding pulmonary tissue. This alone constitutes what can be considered a perfect cure of tuberculous disease of the lungs.

Caverns vary extremely in size, being sometimes so large as to occupy the whole of the superior lobe; being bounded superiorly by a semi-cartilaginous false membrane, and inferiorly by the pleura separating the superior from the inferior lobe: in other cases the cavern of the superior lobe communicates with one in the posterior part of the inferior. Caverns are usually nearer to the posterior than to the anterior surface of the lung. Louis never found them large in the middle of the inferior lobe; but in the greater number of subjects, he met with them in both lungs; and in the sixth part of the cases they were found in one lung only.

The extent to which the lungs are affected by the progress of tubercular disease, varies indefinitely. In some cases a few caverns only are found at the summit of the lungs; in others the quantity of healthy parenchyma which remains is so exceedingly small as to excite surprise that the function of respiration could have been carried on so as to support life. Stark calculated that the portion which remains fit for the admission of air may be estimated, at a medium, to be about one-fourth of the whole substance.

Sect. VI.—Of the principal Complications of Phthisis.

Since tubercular phthisis has its origin in a morbid state of the constitution, we should naturally expect to find the disease affecting various organs. This is actually the case; for although the lungs are generally the organs first and most extensively affected, many other parts become tuberculous in the course of the disease: indeed there is scarcely an organ or structure of the body in which tubercles do not occasionally occur in the progress of consumption.

There are also other morbid states, particularly of the mucous membranes, which complicate phthisis, and are so intimately connected with it as apparently to form a constituent part of the disease. We shall confine our remarks in the present chapter to the most frequent and important of these complications. It is, however, worthy of notice that some of these secondary affections are occasionally so prominent as to be taken for the principal disease; and it is not till after death that the primary and most important affection is made manifest. In some cases, for example, the diarrhœa is so severe, and assumes so much the character of chronic dysentery, as to throw in the background, for a time, the less evident symptoms of pulmonary phthisis. But, on examination after death, although the intestines are found ulcerated in such cases, the lungs are in general so much more extensively diseased, as to leave no doubt that they were the primary seat of the morbid affection. Again, disease of the larynx occasionally produces such marked symptoms that it is taken for the chief disease, even when the lungs are extensively tuberculous. We shall briefly advert to the chief of these complicating affections.

I. Diseases of the Organs of Respiration.—The mucous membrane of the air-passages is generally diseased to a greater or less extent, in the course of pulmonary consumption.

Ulceration of the Epiglottis.—This generally occurs late in the disease. The ulceration, when slight, gives rise to no symptom by which its existence can be known; but in general the larynx is affected at the same time and in the same manner. The lingual surface of the epiglottis is rarely ulcerated; Louis found it in one case only. The symptoms of this affection are, a painful sensation in the region of the os hyoides and difficult deglutition, fluids being frequently ejected through the nostrils in the attempt to swallow them. This last symptom is characteristic of diseased epiglottis, although it does not always attend it: we have seen the epiglottis swollen and intensely red, although deglutition was not attended with

much pain. In some cases the epiglottis becomes œdematous.

Ulceration of the larynx.—This also is a frequent concomitant of tuberculous disease of the lungs. It occurs for the most part only in the advanced stages, but occasionally symptoms indicative of its existence make their appearance before the signs of the pulmonary affection are very evident. The symptoms by which it is accompanied depend upon the site of the ulceration, and of course keep pace with its extension. In some cases they are so prominent and attract so forcibly the attention of both the practitioner and patient, as to lead to the belief that the larynx is the chief seat of the disease, and that the patient labours under laryngeal phthisis. But, as M. Andral justly remarks, the disease which has been designated by that term is in most cases nothing more than pulmonary consumption accompanied by a morbid condition of the larynx, the symptoms of which predominate and mask those of the pulmonary disease upon which the emaciation, hectic fever, night-sweats, and other symptoms of phthisis chiefly depend. One of the most constant symptoms of ulcerated larynx is hoarseness, which goes on often to complete aphonia. More or less pain commonly exists in the region of the os hyoides, being often severe when the ulcerations are deep. The cough has a peculiar character in this affection; it is accompanied with a harsh, grating sound, and sometimes resembles a kind of whistling.

Ulcerations of the trachea.—These do not give rise to any particular symptoms, and their existence is in general ascertained only by examination after death. One patient only of the many examined by Louis complained of the sensation of heat and obstruction behind and above the sternum; in this case a great part of the mucous membrane of the fleshy part of the trachea was destroyed by ulceration. In the other cases examined by this accurate pathologist, no symptom could be attributed to the ulcerations however numerous; neither the cough nor the character of the expectoration had any thing peculiar. Louis attributes the absence of symptoms in these cases to the slowness with which the disease proceeds. When simple inflammation of the mucous membrane of the trachea exists, there is often a sensation of heat and pain. Ulcerations of the trachea are almost exclusively found in phthisical subjects: they are frequently confined to one side of the trachea, which, according to Andral's observation, invariably corresponds with the diseased lung, or, if both lungs are diseased, with that which is most affected. (Op. cit. vol. ii. p. 475.)

The bronchial membrane is found reddened, much thickened, and sometimes ulcerated. These changes are, however, chiefly confined to the tubes in communication with caverns, and in M. Louis' opinion, depend upon the passage of the purulent matter along them, inasmuch as they are seldom met with in the neighbourhood of unsoftened tubercles or grey granulations, and occur more frequently and to a greater extent near old caverns than near those of recent formation. The like changes which occur in the larynx, trachea, and epiglottis, appear to M. Louis to be connected with the passage of the sputa; since they affect chiefly the posterior parts of the trachea and larynx, and the laryngeal surface of the epiglottis, and are, as we have before remarked, scarcely ever found on the lingual surface of the latter, or in the ventricles of the larynx. At the same time, the circumstance that disease of the larynx occasionally precedes the stage of expectoration may be adduced as an objection to this opinion; and although Louis never found grey granulations or tubercles in the tissue or at the surface of the larynx or trachea, Dr. Carswell has occasionally met with tuberculous matter in the mucous follicles of the larynx.

Ulcerations are much more frequent in the larynx and trachea than in the larger bronchi. In the minute ramifications of the bronchi Dr. Carswell informs us ulcerations are very common. The ulcers are generally accompanied with reddening and thickening of the surrounding membrane, although Louis has met with instances in which this was perfectly colourless. The margins of the ulcers are even and well-defined, and are generally so small and superficial as to be detected only by close examination. At other times they extend along the whole length of the fleshy portion of the trachea, or along the back of the larynx or under-surface of the epiglottis. They seldom penetrate deeper than the mucous membrane, although cases occur in which the muscular and cartilaginous rings of the trachea, the vocal chords, the arytenoid cartilages, and epiglottis are partially involved in the disease; and in one case observed by Louis, the latter was completely destroyed.

The close connection of these lesions with phthisis is established by the fact that Louis found ulceration of the epiglottis and larynx in *one-fifth*, and ulceration of the trachea in *one-third* of the cases of phthisis which he examined; whereas he found it once only in one hundred and twenty-two patients who died of other chronic disorders. The same accurate pathologist discovered that these ulcerations occur more frequently in men than in women, in the proportion of two to one.

[From the statistical information contained in the last edition of Louis on Phthisis (Paris, 1843, or Sydenham Society edit. by Dr. Walshe, Lond. 1844), it appears, that of 190 cases, there were ulcerations of the trachea in 76; in 193 cases, ulcerations of the larynx in 63; in 134 cases, ulcerations of the epiglottis in 35; and in 49 cases, ulcerations of the bronchia in 22. These lesions were found much more frequently in males than in females,—why, it is impossible to say.]

Affections of the pleura.—The morbid changes which the pleura undergoes during the progress of tuberculous disease of the lungs consist in the effusion on its surface of coagulable lymph, and consequent adhesion to the pleura costalis. Such adhesions almost constantly accompany the formation of tubercles, and in extent correspond to that of the tubercular disease. In one hundred and thirteen cases which were examined by Louis, both lungs were free from adhesions in one instance only; the right was exempt from them in eight cases, and the left in seven. In twenty-eight examples, the adhesions were small and easily broken down, and the caverns in these cases were either small or wanting. In the other two-thirds, the adhesions were dense and firm, and accompanied with excavations of large size.

In two cases, where the lungs contained only two excavations, the adhesions existed only in the parts corresponding to them.

These facts show, in the clearest and most satisfactory manner, the intimate relation of tubercles and adhesions as cause and effect. From the adhesions being often confined to the spot corresponding to the tuberculous excavations, and from the absence of all appreciable signs of inflammation during their formation, it is probable that the lymph of which they are composed is frequently poured out from the vessels with little or no irritative action. If the ulcerative process goes on in the walls of the caverns till the intervening pulmonary tissue and pleura are destroyed, these adhesions form the proper walls of the caverns; and if the process advances, they also may be destroyed, and the matter point externally. These adhesions sometimes present the appearance of semi-cartilaginous crusts, covering the summit of the lungs, and are in other instances changed into true tuberculous matter; instances of which are recorded by Louis.

Perforation of the pleura.—One of the most distressing accidents which occur during the progress of phthisis, is the perforation of the pleura, and the consequent escape of air and purulent matter into its cavity. It is characterized by the suddenness of its occurrence and by the marked symptoms to which it gives rise; such as sudden pain in the side affected, accompanied with great oppression of breathing and extreme anxiety, which are speedily followed by symptoms of acute pleurisy. This accident coincides in character with the perforation of the intestine, the escape of feculent matter into the cavity of the peritoneum, and the violent inflammation of that membrane.

Perforation of the pleura for the most part occurs in the advanced stage of the disease when the patient's strength is greatly reduced, and in general proves speedily fatal. It has caused death in twenty-four hours; but when the symptoms are less acute, the patient has lived for thirty days, and Dr. Stokes states a case where the patient survived five months. A sudden attack of pain, on one side of a phthisical patient, with much oppression and anxiety, may be considered as indicating the accident. Louis, however, gives a case (xliv.) where oppression and anxiety indicated its occurrence without the presence of pain.

The perforation of the pleura may take place under two circumstances:—a tuberculous cavity, which communicates with the pleura by means of the perforation, may or may not communicate with the trachea. In the former case we have generally an effusion of air and fluid into the cavity of the pleura, connected with which there is a peculiar symptom present, called *metallic tinkling*, or a clear fine sound resembling that produced by the falling of a pin on glass, and heard when the patient speaks. When there is no communication between the tuberculous cavity and the pleura and bronchi, or when there is an effusion of air only or a very small quantity of liquid, it was Laennec's opinion that there could be no metallic tinkling. Dr. Williams, however, has shown this opinion to be erroneous, and that neither communication with the bronchi nor liquid effusion is necessary to the production of the phenomenon:—he considers it to be nothing more than an echo or resonance which any sound or impulse propagated to a cavity of a certain form may produce. (Rational Exposition of the Physical Signs of the Diseases of the Lungs and Pleura, by C. J. B. Williams, M.D., p. 139–46.)

Of eight cases of perforation which occurred to Louis, seven were on the left side,—a circumstance which he attributes to tuberculous disease being more frequent on that side, and often more advanced than on the right.

Perforation of the pleura generally takes place over a tuberculous abscess or cavern of considerable extent; yet cases occasionally occur in which a small softened tubercle immediately under the pleura bursts and discharges its contents, and this may be one of a very few contained in the lungs. Andral mentions a case of this kind where the lungs contained only five or six tubercles. In such cases, from the small size of the cavity, little or no effusion of pus or other matter takes place, and, consequently, such perforation is not necessarily followed by pleuritis.

The accumulation of air in large quantities in the pleura gives rise to the most distressing dyspnœa, and death generally follows, after a short interval, from impeded respiration. We lately met with one remarkable example of this kind: tuberculous disease was far advanced in the right side, while the left was but little affected; the patient was suddenly attacked with severe dyspnœa after a fit of coughing: the left side was found tympanitic, the intercostal spaces were distended, and no respiratory murmur could be heard. An opening was made between the intercostal space of the fourth and fifth ribs, from which the air rushed out with great violence and with considerable relief to the patient. Death, however, took place in twelve hours from the commencement of the attack. On opening the body, the right lung was found every where adherent and full of caverns and tubercles; the left was, for the most part, free, but in one part a dense though not extensive adhesion had been partly torn from its attachment, thereby causing a rupture of the pleura over a very small tuberculous cavity, through which the air passed freely from the bronchi into the chest, and gave rise to all the distressing symptoms. The history of this case affords a good example of the mode in which the perforation is sometimes produced. This patient was seized, a few days before the accident, with acute pain in the left side of the chest, accelerated pulse, and other symptoms indicating an attack of pleuritis, which was combated by antiphlogistic treatment, and had entirely ceased two days before the accession of the dyspnœa. From the weak state of the patient the existence of effusion could not be ascertained during life, but after death it was found to have taken place to the extent of twelve or fifteen ounces; this, by separating the pulmonary from the costal pleura to a considerable extent, had produced a partial rupture of the cellular tissue which formed the adhesion, and which was elongated between the two pleuræ to nearly an inch, and kept in a state of tension. In this state of the parts, the succession of the cough had torn through the pleura at the edge of the adhesion, and thus

produced the perforation. We are indebted to Dr. Carswell for this ingenious explanation of the mode in which effusion may break up adhesions, and occasionally give rise to perforation.

In addition to the lesions we have described, which, in a greater or less degree, accompany the progress of the disease, there are others which frequently occur towards the termination of phthisis; but, as they also attend the latter stages of other chronic diseases, they cannot be considered as peculiar to it.

Inflammation of the lungs and of the pleura and pericardium, are among the most common intercurrent diseases which attend and complicate the last stage of phthisis, and not unfrequently cut off in a few days a patient who might otherwise have lived for weeks, or even months.

II. **Diseases of the Abdominal Viscera.**—The mucous membrane of the alimentary canal rarely escapes disease during the progress of tubercular consumption. A distinguished pathologist observes, "softening of the mucous membrane of the stomach, hyperæmia of the different portions of the intestines, ulceration of the small intestine, accompanied in many instances by a development of tubercles, are all of such frequent occurrence in phthisis, that they may be fairly considered as constituent parts of the disease." (*Andral*, op. cit., vol. ii. p. 558.) These morbid states of the alimentary canal generally occur subsequently to the pulmonary disease, although they occasionally appear to precede it; at least, it has occurred to us to observe the usual symptoms of diseased bowels some considerable time before those indicating disease of the lungs. This also accords with the experience of Andral, who observes that "these lesions may either precede or follow the formation of tubercles in the lungs; and in some cases the pulmonary and abdominal affections set in together." The stomach, the lower portion of the ileum, and the colon are the parts most frequently affected.

Morbid conditions of the Stomach.—Inflammation of the mucous membrane of this organ is not an infrequent occurrence during the progress of phthisis. It generally comes on at an advanced stage of the disease; but we have frequently found it present, in a slight degree, at its commencement. The symptoms are loss of appetite, thirst, epigastric pain, and heat, with nausea, and sometimes vomiting. When the inflammation is situated in the anterior part of the stomach, the pain is generally much increased by pressure. Of one hundred and twenty-three phthisical patients observed by Louis, eight suffered from the present affection, and one only of this number was exempt from pain;—in the others, a sensation of heat and pain, much increased by pressure, was experienced in the epigastrium, and also a degree of resistance which was found to arise from enlargement of the liver. Ulceration of the stomach is accompanied by nearly the same symptoms.

It becomes a matter of some moment, in a practical point of view, to distinguish the vomiting which occurs in the course of phthisis, (and which is commonly attributed to the cough,) from that which depends on a diseased state of the stomach. A little attention to the concomitant symptoms will generally enable us to make this distinction. When the vomiting is simply the consequence of the cough, we find no epigastric tenderness or pain; the appetite remains, and the digestion, in the intervals of coughing, goes on well; in this case it frequently occurs at the commencement of the disease. When, on the other hand, it is the result of a morbid condition of the stomach, it is generally preceded for some length of time by loss of appetite and pain in the region of that organ—symptoms which continue and usually increase during the course of phthisis: the period, also, at which vomiting first occurs in this case is generally late in the disease.

We occasionally meet with another morbid condition of the stomach in tuberculous subjects, the nature of which is not fully understood; its chief symptoms are vomiting and pain. Louis considers it dependent upon softening and wasting of the mucous membrane; but the experiments of Dr. Carswell have clearly demonstrated that such softening of the coats of the stomach is a *post-mortem* change produced by the action of the gastric fluid: the red softening is essentially different in its nature, and is the result of inflammation. But, whatever be the pathology of the gastric affection at present under consideration, it is very distressing and difficult to remedy. According to the observations of Louis, it occurs from two to six months before death; but we have known it to exist for a much longer period, and even long before any symptom of pulmonary disease presented itself. In one young lady we saw it exist for several years; and it was only within a few months of death that the pulmonary disease became evident. The extent to which the latter was found after death, showed how long it had remained latent, masked by the deranged condition of the stomach. We have another case at present under our care: this patient has retained very little on the stomach for the last eighteen months;—a few table-spoonfuls of some fluid being generally the extent of her nourishment for a whole day, and this is more frequently rejected than retained:—the emaciation, as may be imagined, is extreme. This patient is also a young female, twenty-five years of age, whose brother died lately of tuberculous consumption; she presents all the external characters of tuberculous cachexia, with a short dry cough, and will most probably die of phthisis at no very distant period, if the affection of the stomach do not prove fatal previously. The pain in the epigastric region is not great in this case, even on pressure; but in some it is so severe, and so entirely absorbs the patient's feelings and attention, that without minute observation on the part of the medical attendant, the pulmonary disease will escape notice. In general the stomach can digest very little during this state, and then only the lightest nourishment. Occasionally the appetite returns for a time, but in other cases the mildest fluids are injected. This occurred in the patient last alluded to; during a residence in the country for several months in the summer, the stomach retained and digested light food well; and she is, at this moment, able to retain more than she has for many months, although this only amounts to about a spoonful of fluid food two or three times a day.

Enlargement of the Stomach.—An increase in

the size of the stomach has evidently an intimate connection with phthisis, as Louis found it in more than two-thirds of the cases which he examined; while in two hundred and thirty subjects who died of other diseases, only two examples of this enlargement presented themselves. It sometimes goes on till the organ acquires double or treble its usual volume, and descends so far into the abdomen as to be on a level with the spine of the pubis.

The other lesions observed in this organ do not appear to be necessarily connected with phthisis, though their occurrence in the course of other chronic disorders is far less frequent. They consist of a thickened, reddened, mammellated, or ulcerated state of its mucous membrane.

The same lesions occur in the mucous membranes of the small and large intestines; but in these they appear to have a more intimate relation to phthisis, inasmuch as they depend on the development of tuberculous matter in the mucous follicles; where it is deposited in its usual forms, and after a time excites inflammation and ulceration of the surrounding tissues.

Ulceration of the Intestines.—Ulcers of the intestines, when first formed, are always small, and, from the locality of the mucous follicles, occur most frequently in the lower portion of the ileum, and chiefly in that part opposite its attachment to the mesentery, where the glandulæ agminatæ are most numerous. In the large intestines the ulcerations occur irregularly. When the ulcerative process is once established, it often extends to the surrounding tissues; the neighbouring ulcers coalesce, and the mucous membrane is frequently undermined or destroyed to a great extent. Louis found them spreading to the length of nine inches, and running quite round the colon. Perforation of the intestine occasionally takes place, although it is a very rare occurrence.

The period at which tubercles are developed in the intestinal glands during the progress of phthisis, varies in different cases: in some they occur early in the disease, giving indications of their presence at the commencement of the pulmonary affection, and in a few rare cases, even at an earlier period; but more generally they appear when the disease of the lungs is considerably advanced. In a small proportion of cases the intestines are not affected.

The more early that ulceration of the intestines occurs, the more rapid in general is the progress of the disease, because it is usually accompanied with intractable diarrhœa, which speedily wastes both the flesh and strength of the patient. Louis found tuberculous ulceration in the small intestines in *five-sixths* of the cases which he examined, and noticed it almost as frequently in the large intestines, the mucous membrane of which often presented other diseased appearances, being red, thickened, or softened in one-half of the cases; so that, of the whole number of phthisical cases examined by this physician, the large intestines were found in a healthy state through their whole extent in three instances only.

The mesenteric glands are very often found in a tuberculous condition in phthisical subjects, and more especially in children. Papavoine found them so in one-half of the cases of tuberculous diseases of children; while in the cases of adults examined by Louis, they were tuberculous in something less than one-fourth only.

Disease of the Liver.—The liver, in phthisis, presents one remarkable alteration of structure, which consists in an equable transformation of its substance into a fatty matter. This change appears to take place simultaneously over the whole organ, and to be intimately connected with the development of tubercles in other organs; for of forty-nine cases of this degeneration observed by Louis, forty-seven were phthisical; and of two hundred and thirty subjects who died from other diseases, it occurred in nine only, seven of whom had a few tubercles in the lungs. When far advanced, it soiled the scalpel and hands like common fat:—when the change existed in a less degree, its presence was detected by the impregnation of paper with fat, on a portion of the organ being enclosed in it and exposed to heat. This degeneration of the liver is marked by a pale fawn colour, diminished consistence, and increased bulk of the organ, which sometimes enlarges to double its usual size. The rapidity with which it takes place seems to depend almost entirely on that of the development of phthisis; for it has been found when this has run through all its stages in fifty days. Its occurrence is modified neither by the patient's age nor strength of constitution; sex, however, has a decided influence, since of the forty-nine cases observed by Louis, only ten were males. The causes which conduce to this morbid change are very obscure: affections of the duodenum, which Broussais supposed to affect it, have been found by Louis to have no influence in its production. It is yet more remarkable that it is accompanied by no appreciable symptom except increase of bulk, and that the functions of the organ seem to go on undisturbed. The liver seldom presents other morbid alterations in phthisis: however, like all the other organs, it occasionally contains tubercles, particularly in children. A diseased state of the liver appears more frequent in some localities than in others. According to Desault, it is a very common occurrence at Bordeaux; so much so, indeed, that he scarcely met with a case of phthisis in which he did not find this organ enlarged during life. This is certainly not the case in this country; for, although a congested state of the liver is a frequent attendant on phthisis, and often long precedes it, still we believe that it does not often proceed to such an extent as to form, during life, a perceptible tumour in the abdomen.

Fistula in Ano.—This affection has been frequently found in consumptive patients, and has been supposed to be connected with the disease. Although we have often met with it, we have been unable to trace any connection between it and phthisis, further than its probable dependence on abdominal venous plethora, which so often precedes pulmonary consumption. Andral states that the result of his observations does not confirm the opinion of a connection between the two diseases; [and M. Louis accords with him; yet Dr. Morton, (*Illustrations of Pulmonary Consumption*, p. 72, Philad. 1834,) states, that he has met with four cases, in three of which fistula supervened so directly on the pulmonary symptoms

and so kept pace with them, that he could scarcely consider its presence as an accidental coincidence.]

It occasionally happens that death occurs suddenly in the course of phthisis. When this termination takes place, it is almost always in the advanced state of the disease, and in persons greatly reduced. The cause is often unknown. The patient does not appear worse than he has been for some days, when, suddenly, while sitting up, he falls back and expires. Examination after death does not always enable us to explain this sudden cessation of life. Louis gives two cases, in one of which œdema of the glottis appeared to be the cause; and in the other, a rapid hepatization of a large portion of the lungs; but neither of these pathological lesions could account for the cases to which we allude.

Among the causes of sudden death during the progress of phthisis, *pulmonary hemorrhage* may also be mentioned, as it is occasionally so profuse as to prove fatal in a few minutes. In such cases the blood flows from a considerable artery, the coats of which have been destroyed by ulceration in the progress of the tuberculous disease.

We cannot conclude this section without expressing our obligations to M. Louis, the able author of the *Traité de la Phthisie*. We are so much indebted to this zealous and indefatigable physician for all our more precise knowledge of the pathological anatomy of phthisis, that we think it due to him to acknowledge the great assistance we have derived from his researches in the composition of this article; and we beg to refer our readers for more full information to his treatise, as they will not only find therein the best account of the morbid anatomy and symptoms of the disease, but will moreover learn to admire, and perhaps to imitate, the industry, the zeal, and the scrupulous veracity of this most accurate and philosophical observer.

Sect. VIII. — The Statistical History of Phthisis.

The influence of age, sex, race, climate, &c., in disposing to tuberculous disease, and the more decided effects of various occupations and modes of living in the production of phthisis, form a very important part of our subject.

It is, however, to be regretted that the materials which have hitherto been collected are still too scanty to enable us to enter so fully into this question as its merits demand. But we trust that a subject of so much interest and utility will be soon elucidated by the more extended co-operation of numerous medical observers.

I.—Of the prevalence of Tuberculous Diseases at the different periods of life.

Tubercles have been found in various organs at every age, and examples are not wanting of their presence in the fœtus, in which they usually occur in the form of transparent granulations, although they have been also found in the state of suppuration. Chaussier discovered miliary tubercles in the lungs of a fœtus which died at birth, and an encysted abscess, or rather vomica, in the lungs of another. (Procès Verbale de la distribution des pris aux élèves sages-femmes de l'Hospice de la Maternité, an. 1812, p. 62.) Oehler found the mesenteric glands swollen, hard, and of a fatty consistence, not only in the fœtuses of scrofulous mothers, but of others who did not present any appearance of scrofula. (*Desormeaux*, Dict. de Médecine, vol. xv. art. *Œuf*, p. 402.) Husson reported to the Paris Academy of Medicine the dissection of two infants, one eight days old, and the other still-born at the seventh month of pregnancy, both of whom had tubercles in a state of suppuration; the former in the liver, the latter in the lungs. (Ibid. p. 402.) Billiard, who examined a great many infants at the Foundling Hospital of Paris, found tuberculous granulations of the peritoneum in an infant who died four days after birth; and in two still-born children he met with evident tuberculous disease of the mesenteric glands. (Traité des Maladies des Enfans nouveaux-nés et à la mamelle, p. 648.) Although many other cases of the presence of tubercles in the fœtal state might be cited, still the fact that Velpeau and Breschet never observed them in the course of their researches, (Thesis, p. 10,) and that M. Guizot did not find a single example of tuberculous disease in four hundred new-born children whom he examined, is sufficient to show that its occurrence in the fœtus is comparatively rare. (Journal des Progrès, loc. cit.)

During the progress of infancy, tuberculous disease is frequently developed. Billiard found tuberculous granulations of the spleen and liver in five infants whom he examined at the Foundling Hospital; in two of the cases there were also tubercles in the lungs: he also found tubercles in the lungs of four children in one year, all of whom appeared healthy at birth, but gradually fell into a state of marasmus, and died at the respective ages of one, two, three, and five months, without presenting any of the symptoms proper to the phthisis of adults. (Op. cit.) We have not sufficient data to estimate the comparative frequency of tuberculous disease during the first two years of life, yet we are well assured, from observation, that the disease is not uncommon at this early age. We have met with several cases of infants dying of phthisis within the first year, in whom the lungs were not only extensively tuberculous, but contained large caverns with all the characters of those found in the lungs of adults. We have reason to believe that the disease in infants is frequently overlooked from the symptoms being less evident than in more advanced life, and from the want of the oral information afforded by the adult. The expectoration also is rarely seen in them, and the cough often assumes the character of pertussis; so that the disease is not unfrequently mistaken for that or chronic catarrh.

After the second year of life, the great prevalence of tuberculous diseases has been remarked by many pathologists. M. Guersent, a physician of extensive experience attached to the Hôpital des Enfans Malades in Paris, where none are admitted below the first nor above the sixteenth year, is of opinion that tubercles existed in two-thirds or even five-sixths of the bodies which he examined. (Clinical Reports, Journ. Hebdom. t. vii. p. 588.) The researches of M. Lombard, (*Andral*, Anat. Path., Townsend and West's Translation, vol. i.) and more lately those of M. Papavoine, (Journal des Progrès,) carried on in the same institution, have determined with great

precision the frequency of tubercular affections, and the differences in their prevalence at various periods. From the records of deaths under fifteen years of age in the practice of the New Town Dispensary during two years, Dr. Alison is of opinion that the mortality from scrofulous diseases in the children of the lower orders in Edinburgh might be estimated much higher than one-third of the whole deaths. (Trans. Med. Chir. Soc. Edinb.)

The following table is calculated from six hundred and ninety-five examinations recorded by Papavoine and his colleagues. The bodies were examined with great care, and the tuberculous distinguished from the non-tuberculous for each year of age from the third to the fifteenth inclusive. It is, however, to be observed that in two-fifths of the cases the tuberculous disease was not the cause of death. It is probable that the numbers here given express with considerable accuracy the relative proportion of the tuberculous to the non-tuberculous that die in the hospital, and perhaps among the poor of Paris generally; but since the children admitted are from the most indigent classes, and generally remain some time in the hospital, it may be supposed that the proportion of the tuberculous is exaggerated; as, however, Papavoine's observations do not include the deaths in the scrofulous wards, any error which may arise from these circumstances is thereby obviated. To exhibit the influence of age on the production of tubercles, our table was constructed by ascertaining the annual mortality in ten thousand individuals at each age, and setting down in opposite columns the proportions of the tuberculous and the non-tuberculous determined by Papavoine. Ten thousand children are supposed to be alive at the beginning of each year. The first column gives the age; the second is calculated on the law of mortality in France, (Annuaire 1832, p. 83,) and shows the total number of deaths in the course of the year; the third shows the proportion of tuberculous, and the fourth the proportion of children not tuberculous, that die in the ten thousand. The fifth column gives the number of tuberculous in a hundred deaths.

Table V.

Age.	Total deaths.	Tuberculous.	Non-tuberculous.	Tuberculous in one hundred deaths.
1	2630	100?	2530?	0
2	1290	161?	1129?	12?
3	729	292	437	40
4	408	204	204	50
5	263	173	90	66
6	178	130	48	72
7	125	87	38	70
8	99	74	25	75
9	82	52	30	63
10	78	52	26	67
11	77	44	33	57
12	78	47	31	60
13	80	60	20	75
14	4	56	28	66
15	89	47	42	52

From an examination of this table, we are led to conclude that age has more influence in determining tuberculous disease than all other appreciable causes taken together. The tendency to this process is five times more intense at one period of life than at another; it may, perhaps, be said that it is some hundreds of times more intense in the fourth year than at birth. The frequency of the disease is in no constant relation either to the mortality or the growth. Tubercles prevail most through the third, fourth, fifth, and sixth years, when the annual growth does not exceed one-tenth of the child's weight, and the mortality declines to nearly one in a hundred. Papavoine has committed an error in stating that tubercles are generally most frequent in those periods of life when the mortality is least. If we refer to the table, the mortality is least (seventy-seven in the ten thousand) in the eleventh year, and forty-four in the ten thousand die tuberculous; the mortality is much greater in the fourth year (four hundred and eight in the ten thousand), and so is the number of tuberculous (two hundred and four). The error originates in supposing that the number of the tuberculous is as the relation of the tuberculous to the non-tuberculous among the deaths. M. Andral says, after M. Lombard, that "tubercles are most prevalent from four to five: they appear in much greater quantities, and in a greater number of organs at once." (Op. cit. vol. i. p. 528.) Now there is little doubt that the proportion of those who die tuberculous is at its maximum relatively to those who die without tubercles, about this period; but it is erroneous to suppose that a child aged five years is more liable to tubercles than a child aged three:—indeed the contrary is the fact; for only one hundred and seventy-three aged five, and two hundred and ninety-two aged three years, are tuberculous in ten thousand. M. Andral, depending on the accuracy of the calculations, has been led into the error of concluding that at this age every irritation or congestion is far more to be dreaded than in the preceding years, inasmuch as it may be followed by the production of tubercles.

More than one-fourth (27) of those that die from birth to puberty are affected with tuberculous disease; yet this causes death in about one-sixth only of the cases. From the third year upwards, these proportions become two-thirds and one-third.

The great prevalence of tuberculous diseases in early life, which the researches of these pathologists have demonstrated, is a subject highly deserving the attentive consideration of the physician. The mortality from these affections in infancy and childhood is much greater than is generally believed; at least we can say for ourselves, that although we had long had occasion to remark the frequency of phthisis in childhood, we were not aware of the extensive prevalence of the disease at so early an age, until we examined the results obtained by the French pathologists; and we believe that many of our readers will find themselves in the same position. The practical inferences to be deduced from the facts which have here been stated are sufficiently evident, and require little comment. They show the paramount importance of attending to the health of infants and children, particularly in scrofulous families. But we shall have occasion to return to the consideration of this subject in a future part of the article.

With the view of ascertaining the comparative prevalence of tuberculous disease at different periods of life, we have examined all the statistical reports which appeared worthy of attention. The results of our researches concerning the relative prevalence of phthisis at different ages above puberty, as shown in the following tables, are so conclusive as to preclude the necessity of any comment. Table VI. gives the numbers as we found them in the various works which we have consulted. Table VII., constructed from the first, gives the absolute mortality from phthisis, the number of persons in the thousand who die at each age in the different places, and the average of the whole. The comparison of this general average with any of the separate observations will show the correctness of the results by the similarity which it bears to many of them. It will be seen that, with one exception, all these instances, although collected under different circumstances of time, place, &c., agree in showing the greatest number of deaths to occur between the age of twenty and thirty; the next in proportion between thirty and forty; the next between forty and fifty; the succeeding grade of mortality being sometimes placed between fifteen and twenty, at other times between fifty and sixty, or even above sixty. This remarkable agreement of all the places warrants the conclusion that, after the fifteenth year of age, fully one-half the deaths from phthisis occur between the twentieth and fortieth years of age, and that the mortality from consumption is about its maximum at thirty, and from that time gradually diminishes.

TABLE VI.

Mortality from Phthisis at different ages.

	Place of Observation.	15 to 20	20 to 25	25 to 30	30 to 35	35 to 40	40 to 45	45 to 50	50 to 55	55 to 60	Above 60
1	Edinburgh,	6	9	13	8	11	8	6	3	9	4
2	Berlin,	18	28	27	27	39	29	20	32	39	53
3	Nottingham,	42	73	76	46	51	28	20	11	5	6
4	Philadelphia,	182	974		875		565		338		258
5	Chester,	15	27		24		22		16		6
6	Carlisle,	15	45		34		31		15		15
7	Paris—*Louis*,	11	39		33		23		12		5
8	Ditto—*Bayle*,	10	23		23		21		15		8
9	Charleston,		26		24		13		21		4
10	Ditto, Whites,		14		17		10		3		3
11	Ditto, Blacks,		15		13		9		3		3

TABLE VII.

Showing the proportion, at different ages above fifteen, of one thousand deaths from Phthisis.

	Place of Observation.	15 to 20	20 to 30	30 to 40	40 to 50	50 to 60	Above 60
1	Edinburgh,	78	285	245	182	157	52
2	Berlin,	69	212	256	190	274	204
3	Nottingham,	117	416	271	134	45	17
4	Philadelphia,	59	305	275	178	106	81
5	Chester,	136	245	218	200	145	54
6	Carlisle,	97	290	219	200	97	97
7	Paris,	92	325	275	192	100	42
8	Ditto,	99	225	225	206	147	78
	Average of the above,*	99	285	248	185	108	78

1. Reports of New Town Dispensary, three years, Edin. Journ. 1821-25.
2. Sussmilch Göttliche Ordnung.
3. Dr. Clark's Report, 1806-10, Edin. Med. Journ.
4. American Journal of Med. Science, 1826-32.
5. Dr. Haygarth, Phil. Trans. vols. 64, 65.
6. Dr. Heysham on Mortality, &c., of Carlisle.
7. *Louis*, Traité de la Phthisie.
8. *Bayle*, Traité de la Phthisie Pulmonaire.

* In comparing this average, it must be borne in mind that the first column embraces a period of five years only, while the others comprise ten years.

The researches of MM. Andral and Lombard have led them nearly to the same conclusions as those deduced from the preceding tables. The former considers that males after puberty are particularly subject to tubercles between the ages of twenty-one and twenty-eight; while females seem to be more exposed to them before twenty. (Op. cit. vol. i. p. 529.) The latter believes that after the age of puberty females are most liable to tubercles between their eighteenth and twentieth year, and males between twenty and twenty-five. (Op. cit. p. 29.)

The opinion of Hippocrates on this subject corresponds still more closely with the results obtained from our tables. That accurate observer fixed the age at which phthisis most frequently occurs, between the eighteenth and thirty-fifth year. (Coac. Progn. 539.)

II.—Of the influence of Sex in determining the prevalence of Phthisis.

It has generally been believed that phthisis is more prevalent among females than among males; but the Paris Reports have been the chief sources from which statistical information on this subject has been obtained. It will, however, be seen by the following table that Paris forms a remarkable exception in this respect to the other places for which we have been able to collect materials for our calculations.

TABLE VIII.

	Place.	Males	Females.	Males	Females.
1	Hamburgh,	555	445	10 to	8·7
2	Rouen Hospital,	55	44	10 to	8·6
3	Naples Hospital,	382	315	10 to	8·2
4	New York,	1584	1370	10 to	8·6
5	Geneva,	71	62	10 to	8·7
6	Berlin,	328	292	10 to	8·8
7	Sweden,	20·8	1800	10 to	8·9
8	Ditto,	3054	3103	10 to	10·4
9	Berlin,	560	655	10 to	11·6
10	Blacks, New York,	47	58	10 to	12·3
11	Paris,	2219	2970	10 to	13·3
12	Ditto,	3965	5579	10 to	14·3
13	Berlin, boys and girls,	363	567	10 to	15·6

1. *Julius Nachrichten* über die Hamburgischen Krankenhäuser, 1829.
2. *Hellis*, Clin. Méd. de l'Hôtel Dieu de Rouen, 1825.
3. *Renzi*, Topog. Med. di Napoli.
4. New York Med. and Phys. Register.
5. Chisholm on the Climate and Diseases of Tropical Countries.
6. Sussmilch Göttliche Ordnung.
7. Kön Swenska Vetanskaps Hand. 1801. Nicandar.
8. Ditto, quoted from Marshall's Statistics of the British Empire.
9. Neue Berliner Monat Schrift, 1809, p. 225.
10. New York Med. and Phys. Register.
11. Conseil de Salubrité.
12. *Chabrol*. Statistique de la Ville de Paris.
13. Neue Berliner Monat Schrift, 1809, p. 225.

The two first columns in the preceding table give the facts as we found them; the two last columns show the relative deaths, ten being taken for the number of males.

The conclusions which might be drawn from this table are liable to error, from our neither knowing the relative number of the sexes alive in each place, their relative deaths from other diseases, nor their relative admissions into the hos-

pitals referred to. The smallness of the numbers also allows any accidental circumstances to modify the result; so that any conclusion deduced from our materials can only be considered an approximation to the truth. In noticing the observations more particularly, we shall refer to the numbers given to each place in the preceding article.

Nos. 1 *to* 7.—The constant equal relation of the first seven numbers is certainly most remarkable, and appears to warrant the conclusion that ten males die phthisical for every eight or nine females, which is very nearly in the relation of the number of males born to that of females. It therefore goes far to prove that the sexes are equally subject to phthisis. *Nos.* 8 *and* 9, do not materially affect the preceding conclusion, as the preponderance of deaths among the females might probably be soon counterbalanced by more extended observations. *No.* 10, referring to the blacks, is rendered of little value by the small number of cases to which it refers, and by our ignorance of the relation of the sexes in a black population. *No.* 13, is a very curious observation; it does not, however, apply to the general calculation, for it refers to children only. If it be correct, it would show that, in childhood, phthisis is much more frequent among females than among males. *Nos.* 11 *and* 12, referring to Paris, are in direct contradiction to the first seven observations, and differ widely from *Nos.* 8 *and* 9, but approach 13 rather closely. They would show that the disease is more prevalent among females than among males in Paris by about one-fifth; and it is worthy of remark that other observations made in that city have led to the same conclusion. M. Lepelletier found that the number of phthisical females admitted into the hospitals of Paris were in relation to the males as five to three. From the data, however, which we already possess, it is evident that the law of comparative mortality from phthisis which results from the observations hitherto made at Paris, is not applicable to the comparative mortality from that disease in other places. We have no statistical reports in this country on a sufficiently extended scale, to enable us to institute a comparison on this subject between England and other countries.

[The great frequency of tuberculous disease in childhood is shown by the fact recorded by MM. Rilliet and Barthez, (*Traité Clinique et Pratique des Maladies des Enfants*, vol. iii. Paris, 1843), that it existed, in a more or less advanced state, in some part or other in 314 out of 525 children examined after death. In regard to the influence of sex and age, they found that it was more frequent from 6 to 10½ years than from 11 to 15: next from 2 to 5: and lastly from 1 to 2½. The female sex was on the whole more liable to it than the male; but this did not apply to all ages: from 1 to 2½ more cases were met with in the male; from 3 to 5 there was a slight excess amongst females; and from 6 to 10 the two sexes seemed to be equally liable; but from 11 to 15, or at the age of approaching puberty, females suffered much more than males.]

III.—Of the influence of certain occupations in inducing Phthisis.

Although from an early period medical writers have noticed the influence of certain occupations in producing pulmonary disease, it is only in late years that their attention has been more particularly directed to this very important subject. Those trades which expose the workmen to an atmosphere loaded with pulverulent bodies or charged with gaseous substances of an irritating quality, and sedentary occupations of all kinds are believed to exert a very deleterious action on the respiratory organs, and to cause pulmonary consumption; while, on the contrary, those which require constant exercise in the open air are as generally considered to afford protection against this disease.

Up to a very recent period, writers on this subject contented themselves with giving the results of their observation in a general manner; but attempts have of late been made to determine the relative effect of different occupations by numerical tables. Of this kind are the observations of M. Benoiston de Chateauneuf, published in the Annales d'Hygiène, and the more recent researches of M. Lombard, recorded in the same journal. In order, by this method, to ascertain with precision to what extent phthisis is produced by the circumstances in which an individual is placed by particular pursuits, it would be necessary to ascertain the numerical relation which persons engaged in such pursuits bear to the whole population of the place, the relation of the deaths of such persons to the whole deaths, and, thirdly, the number of deaths from phthisis among the total deaths of each trade Possessed of such data upon a sufficiently extensive scale, we might arrive at accurate conclusions respecting the influence of occupation in the production of this disease; and having established the aggregate effect of the circumstances connected with the exercise of any particular trade, we might be able, by a careful study of all such circumstances taken separately, to refer each of them to its proper place in the scale of causes, and determine the positive effect of each.

Researches of this kind, if carefully conducted, could not fail to lead to valuable practical results, by showing what alteration of circumstances might render any particular trade more salubrious. The materials, however, for such calculations do not exist, although they are essentially necessary to enable us to speak with precision on a question of so much importance. The most complete information which we at present possess on the subject is contained in the paper of M. Lombard already referred to; but unfortunately the calculations adduced by him to show the prevalence of phthisis in the different trades at Geneva, although very valuable in enabling us to approximate to the truth, are defective, inasmuch as the number of persons engaged in each trade is not stated. In consequence of this defect it is impossible to ascertain the absolute frequency of phthisis, and we can only determine its prevalence in relation to the total mortality in each trade, which may of course vary from many causes; and the most unhealthy trades in other respects may appear the most healthy in regard to phthisis. Our other sources of information are still more deficient in the essential elements of such calculations, so that

in the present state of the subject we are unable to determine by numbers the relative influence of trades, and must therefore endeavour to arrive at the most probable conclusions by reasoning upon such general observations as we possess.

All the agencies enumerated by authors may be reduced to two classes, the first embracing those which act as local irritants to the lungs; the second, those which exert an injurious effect on the whole economy. These two classes are so distinct in their nature that the evidence of their influence, and the consideration of the manner in which they lead to pulmonary disease, might be separately investigated with great propriety, if they were not so frequently combined in the same case.

The occupations which have been noticed by various authors as exerting a direct influence in irritating the respiratory organs and inducing pulmonary consumption, comprise a large proportion of our industrious mechanics; such as stone-masons, miners, coal-heavers, flax-dressers, brass and steel polishers, metal-grinders, needle-pointers, and many others who are exposed during their labours to inhale an atmosphere charged with irritating particles.

We have Dr. Alison's authority that there is hardly an instance of a mason, regularly employed in hewing stones in Edinburgh, living free from phthisical symptoms to the age of fifty.* Mr. Thackrah remarks that masons are generally intemperate; they are exposed to the vicissitudes of the weather, to great bodily exertion, and to the inhalation of fine particles of sand, dust, and powdered stone: they are subject to chronic inflammation of the bronchial membrane and to pains of the limbs, and generally die before the age of forty.† Miners, as we learn from the same author, particularly while cutting through sandstone, are much exposed to inhale dust; but they also take large quantities of ardent spirits, and seldom attain the age of forty. Dr. Forbes also states that an immense proportion of the miners in Cornwall are destroyed by chronic bronchitis; one of the principal, though by no means the sole cause of which he considers to be the inhalation of dust.‡ Wepfer remarked the destruction of the miners in his time employed in cutting millstones from the mines of Waldschut on the Rhine, where all the men are said to have become consumptive. (Observ. de capitis affect.)

The inhalation of silex in a minute state of division is shown to be equally pernicious by Benoiston de Chateauneuf and by M. Clozier. The latter, speaking of the workmen in the quarries of St. Roch, says, "Quelque forts et robustes que soient ces ouvriers, les uns plutôt, les autres plus tard, mais ordinairement avant quarante ans, sont attaqués d'abord d'une toux sèche," &c. and few reach the age of forty. (*Le Blanc*, Œuvres Chirurgicales, vol. i. p. 585.) The effects of this trade are so constant that the disease is commonly known by the name of "La Maladie de St. Roch." The evidence of Chateauneuf is more conclusive on this point:—the entire population of the small commune of Meusnes has been for the last hundred years exclusively employed in the manufacture of gun-flints. During this period the mortality has increased to a frightful extent, and the mean duration of life diminished in proportion.

The inhalation of metallic particles appears to be equally injurious to the respiratory organs, and perhaps as destructive of life. The pernicious effects of needle-pointing were long since described by Dr. Johnstone of Worcester (Memoirs of Med. Soc. Lond. vol. v.); and Thackrah notices the operation of dry-filing cast-iron as most injurious to the workmen. The mouth and nose are blackened; the lining membrane of the nostrils, where the annoyance is first felt, discharges copiously; the fauces become preternaturally dry, respiration difficult; habitual cough succeeds, accompanied with derangement of the digestive organs and morning vomitings; and the common termination is bronchial disease, and no doubt often tubercular consumption: while on the other hand, dealers in old iron, whose clothes are covered with a thick brown layer of metallic dust, suffer no inconvenience. Thackrah attributes the mortality of the filers to the greater irritation of the mucous membranes of the respiratory organs produced by the angular particles of steel. The filers are remarkably short-lived; in the two principal machine manufactories at Leeds there were only two filers of the age of forty-eight. The men of these establishments are not intemperate; nor can their shortness of life be attributed to anything but their employment. But the history of the grinders of Sheffield, recorded by Dr. Knight, affords one of the most striking examples of the pernicious influence of the inhalation of mechanical irritants with which we are acquainted; and the deleterious effect of such inhalation is further illustrated by the difference between the health of the dry and wet grinders. The number of grinders "altogether amounts to about two thousand five hundred; of this number about one hundred and fifty, namely eighty men and seventy boys, are fork-grinders: these grind dry, and die from twenty-eight to thirty-two years of age. The razor-grinders grind both wet and dry, and they die from forty to forty-five years of age. The table-knife grinders work on wet stones, and they live to betwixt forty and fifty years of age." (North of England Med. and Surg. Journal, vol. i. p. 86.) Dr. Knight is of opinion that the grit-dust is not only the most copious, but also the most injurious part of what is inhaled by the grinders. On comparing the diseases of these men with that of the other mechanics in Sheffield, he found that of two hundred and fifty grinders, one hundred and fifty-four laboured under disease of the chest; while only fifty-six were similarly affected in the same number of workmen engaged in other trades. On examining the respective ages of grinders and other workmen, he obtained the following results:—

* See his excellent paper in the first volume of the Trans. of the Med. Chir. Soc. Edinburgh.

† On the Effects of Arts, Trades, and Professions, &c. on Health and Longevity. By C. Turner Thackrah, Esq.

‡ Translations of Laennec, second edition, p. 137. For extensive statistical researches respecting the health of this class of men, see an admirable essay on the Medical Topography of the Land's End, by Dr. Forbes, in the second volume of the Trans. of the Provincial Med. and Surg. Association.

Age.	Grinders.	Other workmen.
Above 30	124	140
35	83	118
40	40	92
45	24	70
50	10	56
55	4	34
60	1	19
	286	529*

Many more instances might be adduced to show the pernicious effects of mechanical irritants applied to the mucous membrane of the respiratory organs in producing fatal disease of the lungs; but the account of the grinders and flint-cutters which has just been given, is so conclusive that it is unnecessary to enter more fully into this part of our subject. There are, however, other circumstances in the history of these cases of chronic bronchial disease which deserve particular consideration, in addition to the question of pulmonary irritation which we have just discussed. In almost every instance the sufferers are exposed to causes fully adequate to the production of the tuberculous cachexia; they pass much of their time in a confined deteriorated atmosphere, often in a sedentary posture unfavourable to the free action of the respiratory organs; many of them are exposed to the vicissitudes of the weather, and the majority are addicted to the use of ardent spirits.

The influence of a confined and deteriorated atmosphere is shown in a remarkable manner in the fork-grinders confined to the town of Sheffield and those employed in the same occupation in the country. The former die, as we have stated, between the ages of twenty-eight and thirty-two; the latter generally attain the age of forty. In both cases the exposure to mechanical irritation is the same, and the habits of the grinders in and out of Sheffield do not differ; but the rooms in which the country workmen carry on their occupation are much better ventilated.

Persons employed in many other manufactories suffer in the same manner, but in a less degree. Feather-dressers and brush-makers, according to Chateauneuf, are confined to close apartments, and generally work in a sitting posture. In the former trade the deaths from pulmonary disease amounted to 11·47 in the hundred, and in the latter to 7·76. Thackrah observes that in such trades the digestive functions are even sooner disordered than those of respiration. The process of flock-dressing appears to be most pernicious in this respect. "The subsequent sieving and examining of flocks produces great dust, and decidedly injures both respiration and digestion. In proportion to the degree and continuance of this deleterious agent is the head affected, the appetite reduced, respiration impeded, cough, and finally bronchial or tubercular consumption produced:" (p. 66.) "Dressers of flax and persons in the dusty rooms of the mills," he continues, "are generally unhealthy. They are subject to indigestion, morning vomiting, chronic inflammation of the bronchial membrane, inflammation of the lungs, and pulmonary consumption." (Op. cit. p. 71.) In all these cases the effect of the causes acting on the general system is made evident by the prominent place which disordered digestion, &c. hold among the symptoms enumerated. When disease is produced by bronchial irritation alone, these symptoms are not present, or occur only at a late period of the disease.

With respect to the nature of the pulmonary disease induced by the inhalation of mechanical irritants, of which the hard impalpable kind, according to the researches of Lombard, have the greatest influence, our information is still very defective. It is surprising, indeed, how few accurate examinations have been made and recorded of individuals dying under the circumstances described. The symptoms are so similar to those of tubercular phthisis, and are no doubt so often connected with this, that we shall only be able to state how far the mechanical irritation of the bronchial membrane contributes to the development of tuberculous disease, when we have a considerable series of well-conducted post-mortem examinations of mechanics employed in the operations referred to, and of others who are engaged in similar occupations without being at the same time exposed to the action of mechanical irritants on the organs of respiration. That there is sufficient disease to destroy life, and this with fearful rapidity and to an immense extent, is fully established; but we have no doubt that in many cases tuberculous disease has no share in it. Our opinion on this point will, we apprehend, be confirmed by the following summary of all the morbid inspections of the disease which we have been able to collect.

In the cases of the stone-masons of Edinburgh, reported by Dr. Alison, he enumerates the following as the appearances generally observed: "portions of the lungs hardened and condensed, others in a soft pulpy state, nearly resembling the ordinary texture of the spleen, and others loaded with effused serum, with much adhesion of the pleura and much effusion into the bronchi." (Op. cit. p. 372.) These are certainly not the appearances presented by tubercular disease of the lungs; and we quite agree with Dr. Alison that they were the consequence of inflammation.

Dr. Hastings, in his excellent work on Bronchitis, has recorded the examination of three leather-dressers, (his eighth, tenth, and eleventh cases,) who died from pulmonary disease excited by the inhalation of dust. In the first of these cases, the lungs were more solid than natural; the mucous membrane of the bronchi much inflamed, thickened, and containing several extensive superficial ulcers; the bronchi filled with purulent fluid mixed with blood; no tubercles were found. In the next case, the mucous membrane of the trachea and bronchi was highly inflamed and ulcerated; the air-cells were filled with mucus mixed with pus; the lungs strongly adherent over the whole surface, their substance was much gorged with blood; no tubercles. In these two cases, the heart was enlarged. In the third case, the bronchial membrane was thickened and ulcerated; there were many tubercles in both lungs, some of them in a state of suppuration.

* The disease which thus embitters the life of the grinder, and ultimately destroys him when he has scarcely attained one-half the ordinary age of man, is generally denominated *grinders' asthma*, and often, from its great fatality, *grinders' rot*.

Dr. Knight has recently favoured us with an account of two cases which have occurred to him since the publication of his valuable paper in the North of England Medical Journal.* Dr. Knight's first case was that of a fork-grinder, who died July 31st, 1831, at the age of thirty-eight, and had lost two brothers, also grinders, at the respective ages of twenty-four and twenty-eight years. The examination disclosed the following appearances: extensive adhesion of the pleuræ, especially on the right side; tubercles mostly in a crude state in both lungs; in the superior posterior part of the left lungs was a mass of the appearance and consistence of cartilage, and the size of a pigeon's egg; upper part of the right lung indurated; numerous ulcers in the bronchial membrane, particularly of this lung, over which the adhesion of the pleura was most extensive and firm. Several bronchial glands were enlarged and indurated; the larynx and trachea were free from disease; heart of natural size. The immediate cause of this man's death was acute inflammation of the peritoneum and pericardium, presenting the usual appearances. The second case was a scissor-grinder, aged forty-seven, of a scrofulous habit, very temperate and industrious. He had for many years laboured under cough, at times dry, and at others accompanied with copious muco-purulent expectoration. The following appearances were observed on examination forty-eight hours after death: adhesions to a considerable extent between the pleuræ; upper part of both lungs emphysematous, particularly the right, which was gorged with blood to the extent of a large orange, but not indurated, immediately below the emphysematous portion. In the same lung were a large cretaceous mass inclosed in a cartilaginous cyst, and many tubercles in an indurated state. The left lung likewise contained many small hard tubercles, and at its posterior part a small collection of pus in a cartilaginous cyst. The bronchial glands were enlarged; the bronchial membrane was red, softened, and covered with pus and blood. Heart adherent to pericardium; many of the mesenteric glands enlarged and of cretaceous consistence; mucous membrane of the stomach extremely vascular and softened, and thickly covered with red blood. The patient had vomited a pint of fluid blood a few hours before death.

Such, we apprehend, are the appearances which will be generally found in these cases, viz. vascular congestion and ulceration of the bronchial membrane, congestion or induration of the pulmonary substance, and adhesion of the pleura. They will probably be found in all cases, and, in many, complicated with emphysema, tubercles, and enlarged heart. The mechanical irritation of the respiratory organs, the sedentary habits and constrained position of the workman, the impure air in which he works, and his usual habits of life, are abundantly adequate to account for all these morbid changes; but we cannot admit that the mechanical irritation alone is sufficient to produce them. In two of Dr. Hastings's cases, wherein mechanical irritation of the bronchial membrane had been maintained for years together, extensive disorganization was thereby produced, and death caused without the formation of a single tubercle. In regard to Dr. Knight's second case, it may be remarked that the grinder was originally of the tuberculous constitution, and that he had passed the ordinary term of a grinder's life; and notwithstanding the constant irritation kept up in the lungs by his occupation, nature had made considerable advances to effect a cure of the tuberculous disease. We have already observed, with respect to Dr. Alison's cases of the stone-masons at Edinburgh whose occupation is constantly carried on in the open air, that no tubercles were found in the lungs. But there can be no doubt that a very considerable proportion of the persons will be found to have real tuberculous disease; as when a disposition to it exists, nothing is more likely to prove an exciting cause than the perpetual irritation produced by the inhalation of mechanical particles. [(See, on this subject, Dr. G. Calvert Holland, *Lond. and Edinb. Journ. of Med. Science*, Oct. 1843, p. 886.)]

We shall now notice some circumstances which affect the general health of labourers, and thereby induce tuberculous cachexia. Among these none operate more injuriously in disposing to this morbid state than the deficient bodily exercise and the want of pure air which are generally united with sedentary occupations. Shoemakers, tailors, weavers, and dress-makers, may be cited among those who suffer most from these causes. Their sedentary position, the crowded and ill-ventilated apartments in which their labour is generally carried on, and the peculiar posture which they habitually assume, are eminently calculated to prevent the free exercise of the pulmonary organs, to diminish the powers of the system, to impair the nutritive function, and produce a corresponding depression of nervous energy. Their habits also are frequently careless and irregular; they adopt little precaution against the vicissitudes of temperature, expose themselves to the influence of cold and damp, and too often to the evils arising from dram-drinking, and to those other causes which are most likely to produce congestions, fevers, and inflammations. If the female dress-makers and other females employed in similar occupations are exempted from some of these causes, the total privation of exercise, the late hours and long duration of their work are more than sufficient to injure, if not destroy, their health in a few years.

Now in all these circumstances we find not only the conditions most favourable to the development of the general tuberculous diathesis, but those also which have a peculiar influence in promoting its manifestation in the lungs. The effect of sedentary habits in all classes and conditions of society is in our opinion most pernicious; and there is perhaps no cause, not even excepting hereditary predisposition, which exerts such a decided influence in the production of phthisis, as the privation of fresh air and free exercise. Indeed, the result of our inquiries leads to the conviction that sedentary habits are among the most powerful causes of tuberculous disease, and that they operate in the higher classes as the principal cause of its greater frequency among females. In this rank of society we find the mortality from

* We are gratified to learn that the objections to *post-mortem* examinations, which have hitherto been almost insurmountable, are beginning to abate; and we therefore trust that we shall soon have this subject fully investigated.

phthisis below the average, almost all the active causes of the disease being removed. M. Egret (Annales d'Hygiène, vol. vi. p. 46,) found that only two males and five females died of phthisis, in seven hundred and thirty persons of this class, treated by him during a period of ten years; and Lombard calculated that the disease is only half as prevalent among persons in easy circumstances as it is among the great bulk of the population.

There are certain trades which are generally considered unfavourable to the occurrence of phthisis; among these, seamen, butchers, and tanners hold the first rank.* It has been imagined that there is something in these occupations which has a special effect in preventing the development of tubercles, arising, in the one case, from the impregnation of the atmosphere with saline particles,—in the other, from peculiar properties in the atmosphere when impregnated with effluvia from dead animal matter or living vegetables. We have no belief in the special effect of such agents, but refer the exemption of these classes chiefly to the free and regular exercise in the open air which they enjoy.

The facts which we have adduced in this section, although they are, we admit, imperfect, may nevertheless lead to useful practical results. They not only open an interesting field of observation and inquiry, but suggest measures for improving the health and condition of society, which are simple and in many cases available. We can only expect to see a decided diminution of disease among the industrious artisans of this country, when their workshops and apartments are more spacious and better ventilated,—when their physical powers are less exposed to the depressing influence of variable temperature, when they take more exercise in the open air, pay more regard to cleanliness, and cease to seek excitement in the pernicious habit of spirit-drinking.

IV. Of the influence of Climate in the production of Phthisis.

Our information respecting the influence of climate in the production of tuberculous disease is still very imperfect, and its operation as a predisposing and exciting cause has not been sufficiently discriminated.

A cold, damp, and variable climate, such as that of this country, not only gives the predisposition to the disease, but becomes its exciting cause, and determines in an especial manner its local manifestation in the lungs. Sir William Crichton states that "consumption is infinitely more frequent in Great Britain and Ireland, in comparison of their population, than in the northern parts of Russia; yet the climate of Russia is in general infinitely colder and ruder than ours. The scrofulous or strumous constitution is more common in the northern and middle governments of Russia than in England, and commits greater ravages and disfiguration than are ever witnessed in this country. Great Britain no where exhibits such dreadful effects of scrofula as Russia does; but in that empire its attacks are mostly confined to the external set of glands, to the face, the eyes, and throat, and to the bones, especially those of the extremities; the lungs suffer rarely, except in public schools, and among those who adopt the European dress and fashions." (Pract. Obs. on Pulmonary Consumption, p. 50, &c.) There are, however, circumstances which must be taken into account in estimating the influence of the respective climates of Russia and England: the Russians clothe themselves more warmly, and take greater precautions against the severity of the climate than the English; on the other hand their poorer classes are worse fed, black sourish rye-bread and vegetables being their chief nourishment. The occupations also of the Russians are for the most part in the open air; whereas a large proportion of the labouring classes in England are employed in manufactories, in which they are shut up for the greater part of the day in a confined and deteriorated atmosphere. [See on this subject Sir George Lefevre, *Thermal Comfort*, Amer. edit. New York, 1844.]

Great heat appears also to have a powerful effect in predisposing to tuberculous disease. The general constitution of the inhabitants of very hot countries, as the Malays and negroes, may be cited in confirmation of this opinion, as both these races are well known to be much more subject to tuberculous disease than Europeans when exposed to the same causes.

We shall adduce further proof of this in the subjoined tables, containing a statistical account of the prevalence of phthisis in different countries.†

Table IX.

Showing the general result of our researches on the effect of Climate in determining the relative prevalence of Phthisis among the troops.

Place.	Proportion of phthisis to the total deaths.
N. S. Wales and East Indies‡	one-thirty-fifth
East Indies	one-thirty-third
Cape of Good Hope	one-seventh
Mediterranean	one-sixth
West Indies (Europeans)	one-fifth
Canada	one-fourth
France	one-third
Great Britain	one-third
Blacks in West Indies	one-third

The isolated facts relating to the prevalence of phthisis in different nations, which we have collected from their statistical documents, are so discrepant and contradictory, that no positive conclusions can be drawn from them respecting the effect of climate in producing the tuberculous diathesis. On this point, therefore, our information remains very incomplete, although by reference to the preceding table it is quite evident that the actual

* We beg to refer the reader who is desirous of more minute information, to the writings of Dr. Beddoes, who has collected a considerable body of evidence on the subject of this section; to Mr. Thackrah's valuable work on the Effects of Trades; to Dr. Forbes's able Memoir in the Transactions of the Provincial Medical and Surgical Association; to the excellent articles of Benoiston de Chateauneuf and our friend Dr. Lombard of Geneva in the Annales d'Hygiène, and of Dr. Knight and Dr. Kay in the North of England Medical Journal.

† We avail ourselves of this opportunity to express our acknowledgments to Sir James M'Gregor and Sir William Burnett, to whose kindness we are indebted for the facilities afforded us of examining the valuable collection of journals and reports from the medical officers of the army and navy.

‡ The troops were employed in different parts of the East Indies, in 1828, 1829, and 1830.

ravages of the disease decrease in a direct ratio with the increased warmth and equability of climate, and increase in the same ratio under opposite conditions; and it is a well-known fact, that the inhabitants of warm climates, whether men or brutes, frequently fall a sacrifice to phthisis, when removed into colder countries.

To determine the influence of climate satisfactorily, we require an accurate table of the prevalence not only of pulmonary phthisis, but also of all the forms in which the tuberculous diathesis manifests itself among the inhabitants of different countries; for the influence of any climate in producing this diathesis cannot be estimated from tables illustrating the prevalence of one form of the disease among strangers to that climate, who of course brought with them that disposition to disease which their native country induced, and which we have no means of estimating.

We may, therefore, seem to have arrived too hastily at the conclusion that this disease is favoured by excessive heat, and is more prevalent among the negroes and Malay race. We have, however, been led to it by the study of their physical peculiarities, by the general character and course of their diseases, and by the fact that when these people are removed to Europe, the diathesis manifests itself rapidly in its most characteristic form of crude tubercles, not in their lungs merely, but simultaneously in almost every organ of their body.

The two following tables have been compiled from the Army Medical Records, for the purpose of determining the greater prevalence of phthisis and other diseases of the lungs among the blacks than among Europeans in the West Indies. The first gives the relative mortality from phthisis, &c. among the blacks and whites of the West Indian army, for eight years, 1822 to '29.

Table X.

	Deaths from all diseases.	Phthisis.		Other pulmonary diseases.	
		Cases.	Deaths.	Cases.	Deaths.
Whites,	2275	318	177	3550	100
Blacks,	555	221	158	1488	105

By our calculations from the above table, we find that in every thousand deaths among the whites, one hundred and twenty, or little more than one-eighth, are from pulmonic diseases; while in every thousand deaths among the blacks, four hundred and seventy-two, or nearly one-half, are caused by pulmonic diseases.

The following table has been constructed to show that phthisis is not only relatively but absolutely more prevalent among the natives than among Europeans in the East Indies. The table has been compiled from Mr. Marshall's Medical Topography of Ceylon. By adding together the items of his tables from 1815 to 1820 inclusive, reducing them to unity, and then dividing the total deaths per annum, × 1000, by the average strength, we obtained the first column, showing the absolute mortality in 1000 of each race during the equal period of one year. By dividing the deaths from phthisis per annum, × 1000, by the average annual mortality, we obtain the second column; and by dividing the deaths from phthisis, × 1000, by the total deaths, we obtain the third.

Table XI.

	Europeans.	Malays.	Caffres.	Indians.
Total deaths in 1000 persons during one year.....	142	56	49	45
Deaths from phthisis, in 1000 persons, during one year.....	6	2.0	7.0	2.6
Deaths from phthisis, in 1000 deaths from all diseases.....	4.3	58	146	59

In concluding this section, we beg to express our thanks to our ingenious friend, Mr. Fergus, for assisting us in collecting materials for various parts of this paper. We are indebted to him for the six last tables which this section contains:—founded as they are on researches which have required great industry and labour, the task of collecting the materials and of making the necessary calculations has occupied more time than we could have devoted to it, and much more than persons unacquainted with such inquiries imagine. We also avail ourselves of this opportunity to express our thanks to Mr. Farr, for the compilation and arrangement of the first, second, and fifth tables in this article.

[It would appear from the statistical report on the sickness, mortality, and invaliding among the British troops in the West Indies, by Major Tullock, that in Jamaica, with a high temperature, consumption is as frequent as in Great Britain; and M. Rufz states, that in Martinique this disease is the most frequent of all chronic maladies.

It has been shown, moreover, that consumption is much less frequent amongst sailors than amongst soldiers. The benefits of a sea voyage to the phthisical valetudinarian have been long known, and there can be no doubt, that in those who are predisposed to pulmonary disease, the revulsion thereby effected in the system may prove most salutary. According to the statistical reports laid before the House of Commons, it appears, that in the West Indies and North America, the mortality from consumption in the navy was at the rate of 1.9 per thousand, whilst among soldiers in the same region, the returns were as follows:—In the Windward and Leeward Island command, 12 per 1000 were annually attacked with consumption. In Barbadoes, 15.8 per 1000 die of it; in Jamaica, 7.5 per 1000; and in the more northern portions of the same command, the deaths from diseases of the lungs amongst the troops were, in Nova Scotia and New Brunswick 7.1 per 1000; and in Canada, 6.7 per 1000. In Bermuda, there were attacked annually by consumption, 8.8 per 1000.

When a tuberculous individual passes from a warm and dry country to one that is cold and damp, the tubercles undergo development. It was observed, that the French regiments suffered more from phthisis in Holland than in Spain and Italy; and it would appear, that almost all the animals

which are brought from the torrid regions to our menageries, die of tuberculosis of the lungs. See, on all this subject, the writer's *Practice of Medicine*, 2d edit. 362, Philad. 1844.]

Sect. IX. — Of Tuberculous Diseases in Animals.

The history of tuberculous disease in animals is a subject of much interest to the physician, inasmuch as it affords a collateral illustration of the disease in man.

We believe that tuberculous disease may be induced in any class of animals by those circumstances which produce it in the human subject, being equally influenced by climate, impure air, imperfect nutrition, deficient exercise, and other causes. Tubercles have been noticed in many orders of the mammalia, carnivorous and herbivorous, in birds, and perhaps in insects. Among the mammalia, they have been found in the lion, dromedary, horse, antelope, deer, cow, sheep, goat, domestic pig, monkey, guinea-pig, hare, rabbit, squirrel, and porpoise: among birds, in the psittacus erythæus and some other macaws and parrots, in the flamingo, house-sparrow, turkey, and domestic fowl. Mr. Owen, Assistant Curator of the Museum of the Royal College of Surgeons, informs us that he has discovered tuberculous disease in the following animals which died in the Gardens of the Zoological Society,—felis caracal, *Persian lynx;* paradoxurus typus, *paradoxure gennet;* viverra Rasse, *civet cat;* herpestes mungos, *Indian ichneumon;* nasua fusca, *brown coati mondi;* usus Thibetanus, *Nepál bear of the Himalaya Mountains;* tapirus Americanus, *American tapir;* alces Americanus, *American elk;* simia satyrus, *ourang outang;* Macacus cynomolgus, *Macaque monkey;* M. radiatus, *bonneted monkey;* M. Rhesus, *pig-tailed monkey;* cercopithecus sabæus, *green monkey;* papio maimon jun., *Mandrill baboon;* lemur nigrifons, *black-fronted lemur;* lemur macauco, *ruffed macauco.*

Our friend, Mr. Newport, a comparative anatomist of great promise, whose name is already favourably known by his researches into the minute anatomy of insects,* has favoured us with an account of what he believes to be tuberculous deposits in that tribe. In the larva of the spinx ligustri, or common privet moth, he met with a peculiar matter disseminated in small, irregular, aggravated masses, white, opaque, and of a cheesy consistence, over the whole internal surface of the insect, between layers of very delicate cellular tissue. These masses were most numerous among the muscles; on the exterior of the alimentary canal, particularly the stomach; on the secretory silk glands, in the biliary ducts, and on the nerves. In the carabus catenulatus, or ground-beetle, and in the staphylinus olens, both carnivorous feeders, he noticed similar deposits of more uniform and much smaller size in the cellular and pulmonary tissues: he has also detected appearances similar to those observed in the sphinx ligustri, in the common cray-fish, the astacus fluviatilis of Leach. It is worthy of remark that the sphinx was fed upon stale leaves of the privet for some days previous to examination, the unusual wetness of the season having prevented a fresh supply; the deposition of the same matter has also been produced by purposely feeding the insect upon deteriorated or stale food.

Although the existence of tuberculous disease in insects requires to be established by more numerous observations than have as yet been made, still the view which we take of the pathology of tuberculous disease inclines us to believe that no class of animals is exempt from it; we therefore have little doubt that the application of the causes which lead to it in the human species will also induce it in any animal which is exposed to their influence.†

The morbid appearances presented on examination of the animals we have enumerated also bear a close analogy to those observed in man: the lungs, spleen, mucous membrane of the intestines, the liver, mesenteric, bronchial, and lymphatic glands, are the organs most frequently affected. We are, however, better acquainted with the morbid anatomy of monkeys, because, of all animals, that family is most subject to tuberculous disease; indeed, nearly all the monkeys in our menageries die tuberculous. Dr. Reynaud, of Paris, has devoted much research to this department of comparative pathology, and has published an excellent memoir on phthisis in the monkeys at the Jardin des Plantes. (Archives de Médecine, t. xxv.) In fourteen of these animals he found the lungs containing tubercles, and in many cases entirely converted into tuberculous matter. In three monkeys the disease was confined to the lungs exclusively; in the others various organs were at the same time affected. The larynx was ulcerated in two cases; the bronchial glands were always more or less tuberculous, and in one instance were so much enlarged as to obliterate the left bronchus and prevent respiration in the corresponding lung, which was much contracted. The spleen in six cases was much diseased, being enlarged and adherent to the peritoneum. The blood in the cells formed reddish clots, in the midst of which were tuberculous points. The tuberculous deposit was found in various stages of softening, and sometimes in caverns lined with a false membrane. In one case the tubercles were isolated and crude in the lungs, while in the spleen they were large and softened in the centre; showing that the spleen was the organ in which the tuberculous matter was first deposited.

The disease occurs in animals, as in the human species, at all ages. MM. Andral and Dupuy have even observed it in the fœtus of the sheep and rabbit.

Sect. X. — Of the Causes of Tuberculous Disease, and in particular of Phthisis.

The causes of tuberculous disease, like those of most diseases, are referable to two distinct heads, the remote and the exciting, — or those which induce the constitutional predisposition, and those

* See his papers on the *Sphinx Ligustri*, in the Phil. Trans. 1833 and 1834.

† All the milch cows in Paris become tuberculous after a certain period of confinement to the house. We have been informed that for some time after the disease has commenced, the quantity of milk obtained from them is greater than before, and their flesh is more esteemed by the unsuspecting epicure than that of the healthy animal. A circumstance of the same kind is mentioned by Aristotle, who observed tubercles in the pig, the ox, and ass; he says, in regard to strumous pigs, that when the disease (*grandines*) exists in a slight degree, the flesh is sweeter (*caro dulcior est*). Historia Animalium, lib. viii. cap. 21.

which determine the local deposition of tuberculous matter after such predisposition is established. The one class of causes operates by modifying the whole system, the other by determining in a system so modified, the particular morbid action of which tuberculous matter is the product. Until this distinction between the causes of the constitutional and local disease is fully understood and acted on in practice, we shall make little progress in the prevention or treatment of tuberculous disease.

The share which these two classes of causes have in the production of tubercle varies in different cases. When the person is little exposed to the exciting causes, the constitutional predisposition may be long present without any local affection, while continued exposure to exciting causes may determine the local disease when the morbid state of the constitution exists in a slight degree. We have examples of the former among the wealthy classes of society, where we see the tuberculous cachexia prevail for a considerable time without the actual development of tubercles, because the person is little exposed to the usual exciting causes, and even seduously avoids them; and we meet with instances of the latter amongst the poor, when engaged in occupations in the exercise of which the lungs are peculiarly exposed to irritation, by which a diseased state of the bronchial membrane and ultimately tuberculous disease are produced. Of this number are the numerous classes of mechanics, who breathe, for many hours every day, an atmosphere charged with fine particles of sand, metal, &c. But the most striking examples of consumption which have been adduced as the consequence of pulmonary irritation, occur in persons who are at the same time exposed to some of the most powerful causes of tubercular cachexia, such as sedentary occupations carried on in a confined and deteriorated atmosphere, and very often also to excessive indulgence in the use of ardent spirits; so that they are exposed to that cause of the constitutional and local disease at the same time.

I.—Of Hereditary Transmission considered as a Cause of Phthisis.

That pulmonary consumption is an hereditary disease, — in other words, that the tuberculous constitution is transmitted from parent to child, is a fact not to be controverted; indeed we regard it as one of the best established points in the etiology of disease. But it may not be so generally admitted that various other morbid states of the parent produce the predisposition to tuberculous disease in the offspring; a position, however, which we hold to be equally true, and still more important in its consequences. A parent labouring under tuberculous cachexia entails on his offspring a disposition to the same affection, proportioned to the degree of disease under which he labours. Examples of this fact are constantly present in the families of scrofulous parents, where we find the scrofulous constitution much more strongly marked in general in the younger than in the elder children. We even occasionally meet with families the first children of which are healthy, while the last are the subjects of tuberculous disease; the health of the parents having undergone a change during the increase of their family. There may be exceptions to this rule, depending on circumstances beyond our cognizance, but we have little doubt that it is generally true.

It has been made a subject of inquiry whether the child is more disposed to the diseases of the father or mother; and we believe the majority of authors give it in favour of the father: Professor Nassi, however, of Bonn, in his excellent essay on tuberculous diseases, expresses his opinion that the hereditary disposition is more frequently derived from the mother. The point is one which it is very difficult to decide. There can, we think, be no doubt that the child may inherit the constitution of either or both parents: on some occasions we see the constitution of the father, in others that of the mother, predominating in different children of the same family. It has also been remarked, and we think the observation is founded in truth, that the more a child resembles in its external lineaments one or other parent, the more certainty will it inherit the diseases of that parent.

But a state of tuberculous cachexia, as we have just remarked, is not the only morbid condition of the parent which entails the tuberculous predisposition on the children; there are several diseases which have that effect, the most frequent and important of which are a disordered state of the digestive organs and its consequences. Gout, cutaneous diseases, the injurious influence of syphilis or long courses of mercury on the constitution, debility from disease, age, &c.; in short, a deteriorated state of health in the parent from any cause, to such a degree as to produce a state of cachexia, may give rise to the scrofulous constitution in the offspring. However various the causes of the cachectic state of the parent, its effect is constantly manifested in the disposition of the children to tuberculous disease. This is a most important fact in the history of consumption, and is highly deserving the attentive consideration of the profession.

It may appear that we are disposed to generalize too much in ascribing tuberculous disease in the offspring to morbid conditions of the parent; nevertheless we have not formed our opinion upon superficial observation, nor without mature consideration; and we feel persuaded that the more carefully the subject is investigated, the more correct will our views be found. We have frequent opportunities of remarking a strong disposition to this disease in the children of parents who enjoy what is usually termed good health, and in whose family no scrofulous taint can be traced; whereas, according to our own observation, we never see the parents in an unhealthy state, whatever the nature of their disease may be, without finding, at the same time, that the children are strongly predisposed to tubercles. An opinion is entertained that one generation sometimes escapes tuberculous disease, although their parents and children suffer from it. This is to be explained by the improved state of health enjoyed by the generation exempted, and by the other circumstances which counteract or prevent the development of tubercles.

Of all diseases, we consider dyspepsia the most fertile source of cachexia of every form, for this plain reason, that a healthy condition of the digestive organs and a proper performance of their functions are essential to the due preparation of the food, and consequently to the supply of healthy

nourishment to the body. The adjusting powers of the system may do much to correct a disordered condition of the different functions concerned in the process of assimilation, by means of the increased activity of the healthy organs; but the system cannot continue long in a healthy state when any one important function connected with nutrition is materially deranged. Without, however, entering into this most interesting subject, we consider it an established fact,—it is so at least to us,—that dyspepsia and any other disease which induces a cachectic state of the parent, shows itself either in the tuberculous constitution of the children, or in their strong tendency to become the subjects of those disorders which generate such a constitution, such as that form of dyspepsia which has been denominated *strumous* by Dr. Todd, (see article INDIGESTION.)

A cachectic state of the system may also originate in a defective state of the various secretory and excretory functions, the effete matter not being fully carried off; and this cause very generally accompanies dyspepsia, and accelerates its deteriorating influence on the health. There are doubtless other circumstances in the state of the parents which may give rise to the strumous diathesis in their offspring, which are not so evident as those which we have noticed: and yet there can be little question of their influence when we see children so often present the characters of the scrofulous diathesis at the earliest age, while their parents are in the enjoyment of good health, and free from all appearances of tuberculous disease, local or constitutional. Some remarkable examples of this kind have come under our observation, where whole families have fallen victims to tuberculous consumption, while both parents have not only enjoyed good health themselves to an advanced age, but have been unable to trace any hereditary disposition to the disease in their families for generations back. An imperfect development or a feeble state of the organs of generation has been considered a cause of scrofula in the offspring; anything which interferes with the act of conception or with the nourishment of the fœtus in utero, such as a disordered state of the mother's health, depressing passions, a sedentary or unhealthy mode of life, and whatever induces imperfect nutrition in the mother during pregnancy, may lead to such a result; and this may even explain why in some instances one child is predisposed to disease, while the others of the same family are exempt. It is quite impossible to define the various circumstances in the health of the parent which may give rise to the scrofulous disposition in the child, much less to explain their operation: we rather allude to them as subjects deserving the investigation of the general pathologist and practical physician. That tuberculous disease can generally be traced to an hereditary origin, will not be disputed by any medical observer who has given his attention to the subject; but there may be a difference of opinion as to the particular condition of the parent which induces the tuberculous constitution in the offspring, and also as to the degree in which this constitution may exist in the child at birth. We have already stated our opinion respecting the former, and we shall now give our views respecting the latter of these conditions.

1. We have seen that in a very small proportion of cases the child is tuberculous at birth. This, we believe, will rarely occur unless one or both parents are labouring under tuberculous disease in a very advanced stage.

2. The next degree of hereditary disease is that in which the infant is afflicted with tuberculous cachexia from birth,—a state which requires very slight exciting causes to determine the deposition of tuberculous matter in some of its organs; which in such cases occurs early in life, the child often dying tuberculous within the period of infancy. This is a frequent occurrence in the children of consumptive parents.

3. Again, the child presents all the characters of the tuberculous or scrofulous constitution which have been already noticed, and without care will probably soon acquire tuberculous cachexia and die of tuberculous disease in early life. The greater number of scrofulous and consumptive cases which we meet with in childhood and youth are referable to this degree of hereditary disease.

4. In another class of cases, the child is merely predisposed to those functional derangements which generate the tuberculous constitution. The cases of predisposition to consumption which come under this class are, according to our observation, the offspring of parents who have laboured under dyspepsia, gout, cutaneous diseases, and other deranged states of health not of a tuberculous nature. They constitute the most numerous and the most remediable of all the classes; and yet, we take leave to add, they are the least generally understood.

This view of the hereditary causes of tuberculous disease we consider of great practical importance, as it is only by our acquaintance with the mode and degree in which the hereditary predisposition affects the constitution, and the circumstances on which its increase depends, that we shall be enabled to direct the management of the child so as to correct the constitutional predisposition, and obviate those derangements which increase it.

II.—Of the Causes which give rise to Tuberculous Cachexia in individuals not hereditarily predisposed to Phthisis.

The earlier in childhood the causes of tuberculous cachexia are applied, the more speedily will this be induced. If, for example, an infant born in perfect health, and of the healthiest parents, be insufficiently or improperly fed, that is, be nursed by a woman whose milk is inadequate in quantity or quality to afford due nourishment; or if the child be fed on other food ill-suited to the state of the digestive organs, or be kept in close rooms in which free ventilation and cleanliness are neglected, a few months will often suffice to induce tuberculous cachexia. The countenance will become pale, the flesh soft, the limbs emaciated, the abdomen tumid, the evacuations fetid and unnatural. The external lymphatic glands, especially those of the neck, will enlarge and become tuberculous, and the child will speedily fall a victim to tuberculous disease; and this may happen in a family in which the brothers and sisters of this infant who have been properly suckled and reared with care and in pure air, attain a healthy maturity. We may thus see the change from perfect health to complete tuber-

culous cachexia effected in the infant in the course of a few short months. Now, if this occurs in a strong infant, born of healthy parents, and perfectly healthy at its birth, how much more certainly and rapidly will the same effects be produced in a feeble infant born of unhealthy parents, or, still more, of parents absolutely scrofulous? Again, take a child of three or four years of age, in perfect health, having been born without any hereditary predisposition to disease, well-nursed, and properly nourished, — let it be fed upon coarse innutritious food, and confined in close apartments, where neither the heat nor light of the sun have free admission, and where the ventilation is imperfect, and we shall soon see the blooming healthy child changed into a pale, sickly, leucophlegmatic creature,—a fit subject for tuberculous disease. This will occur during the whole period of youth, a longer time being required to effect the constitutional deterioration; but in all cases it will vary according to the number and force of the causes, and the power possessed by the individual to resist their operation.

Up to the period of the full development of the system, till the body has ceased to increase in stature, till it has reached maturity and acquired the stability of the adult, tubercular cachexia may be readily induced. After maturity the powers of the system in resisting the causes of disease are greater than at an earlier period; still we see the same results produced by similar causes, — the constitutional affection being the same, although it manifests itself more slowly and in a different manner, according to the age and peculiar constitution of the individual. As we increase in years, a more powerful or longer application of the causes is required to induce tuberculous cachexia, but we are not satisfied that this rule holds good after a certain period of advanced life. In old age, it has appeared to us that tuberculous cachexia is acquired more easily than about the middle period of life; but we admit that our facts are not sufficiently numerous, and have not been observed with enough of care to enable us to speak with confidence on this point.

The principal causes which induce tuberculous disease may be arranged under the heads of improper diet; deficiency of pure air, exercise, clothing, and cleanliness; excessive labour and affections of the mind.

Improper Diet. — Of the remote causes, the leading are those circumstances which interfere with the nutrition of the body; among these the imperfect supply of food holds a conspicuous place. But we have rarely an opportunity of seeing the effects of this alone, because when the means of procuring proper nourishment are wanting, there are generally other causes of the disease in action at the same time; such as residence in ill-ventilated and dark apartments, exposure to cold from imperfect clothing, &c.; the whole of which are often combined, and hence more speedily effect the deterioration of the health. Food in excess, or of a kind too exciting for the digestive organs, may also induce tubercular cachexia, — a circumstance which is not sufficiently attended to, — we may say not generally understood, even by medical men: nevertheless we hold this to be a frequent cause of scrofula, and believe that it produces the same effects on the system as a deficient supply; the imperfect digestion and assimilation in the one case, and the inadequate nourishment in the other, being equally injurious: the form and general characters which the disease assumes may differ, but the ultimate result will be the same in both cases. The adaptation of the food, both in quality and quantity, to the age of the individual, as well as to the powers of the digestive organs, is too little considered; and the evil consequences of this neglect are often evident in the children of the wealthy classes of society, who are frequently allowed an unrestricted use of the most exciting kinds of animal food.

Impure Air.—Next to improper food, we rank an imperfect supply of pure air. It is in the lungs that the assimilation of the chyle is completed; and when either the respiration is imperfectly performed, or a sufficient supply of air is wanting, perfect assimilation is prevented.

In the confined abodes of the poorer inhabitants of large and populous cities, where neither pure air nor sufficient light can enter, in consequence of the obscure and overshaded sites of the buildings, the food cannot be assimilated even though the supply be unexceptionable. A sensible writer on scrofulous diseases considers impure air as the only real cause of scrofula; other causes may assist, but this he considers essential to the production of the disease. "Personal experience," says Baudelocque, "reading, reflection on a great number of facts, and the analysis of many observations, have impressed me with the deep conviction that there exists one principal cause of scrofulous disease, a cause which predominates over all others, and without which, perhaps, the disease would never, or at least very rarely develop itself. This cause consists in particular conditions of the atmosphere in which the individual resides. However ill-chosen or unsubstantial his food may be—however much cleanliness may be neglected—whatever be the nature of his clothing and its adaptation to the temperature—whatever the climate in which he lives, the exercise he takes, or the duration of his sleep and waking, — if the house in which he dwells be placed in a situation to which the fresh air and the sun's rays have free and direct access, and the house itself be sufficiently airy, light, and well-proportioned to the number of its inmates,—scrofulous disease will never make its appearance. On the contrary, however well-chosen and nutritious the food, however minute the attention paid to cleanliness, with whatever care the clothing be adapted to the temperature, or the duration of exercise, sleep, and waking be regulated, — if the houses are so placed that the sun's rays cannot reach them, or the fresh air cannot be renewed without difficulty,—if, in short, they are small, low, dark, and badly aired, scrofulous disease will inevitably supervene." (Mémoire sur les Scrofules, Revue Médicale, 1832, vol. i. p. 10.)

Though we are fully satisfied of the powerful influence of impure air in the production of scrofula, we cannot entirely coincide with M. Baudelocque. We believe that the other causes which we have mentioned are capable of inducing tuberculous cachexia, while the patient is breathing a

very pure air. We find the disease not infrequently affecting the inhabitants of elevated and dry countries, where the atmosphere is pure and the people are occupied in grazing sheep and cattle, and are hence so much in the open air during the day that the confined atmosphere of their ill-ventilated hovels can scarcely be considered the chief cause of the scrofulous diseases by which they are often afflicted, since we have other and more evident causes in the coarse and innutritious vegetable food which forms almost their only sustenance, and in their scanty clothing and exposure to the inclemency of the weather. But there can be no doubt that the habitual respiration of the air of ill-ventilated and gloomy alleys in large towns, as well as that of many manufactories, workhouses, and even schools, is a powerful means of augmenting the hereditary disposition to scrofula, and even of inducing such a disposition *de novo*. Children reared in the workhouses of this country and in similar establishments abroad almost all become scrofulous, and this more, we believe, from the confined impure atmosphere in which they live and the want of active exercise, than from defective nourishment.

Deficient Exercise.—Deficient exercise ranks next as a cause of tuberculous disease. If a due supply of proper nourishment and pure air is necessary to nutrition, bodily exercise is equally necessary to apply such nourishment to the growth and development of the body. The amount of exercise necessary to produce this effect and to maintain a healthy state of the system, will vary according to the age and nature of the constitution; but without such exercise there can be no sound health.

Excessive Labour.—While a certain quantity of exercise is necessary to the maintenance of health, excessive labour, by debilitating the body, may be ranked as a cause of disease. It operates on the whole system, though, according to the mode in which the fatigue is produced, one set of organs may be more affected than another; and when these are overworked and require an excess of nervous influence, others must suffer from a deficient supply. When the labour is carried on in confined apartments, its injurious effects are more decided.

Improper Clothing.—Proper clothing is essentially necessary to the preservation of health. An imperfectly covered state of the body in the cold season, especially in persons engaged in sedentary occupations where exercise does not assist the circulation of the fluids, is most injurious, especially to young persons, in whom it is necessary to maintain a vigorous circulation through the extreme parts of the body in order to ensure its growth and development, to secure the due performance of the cutaneous secretions, and to prevent sanguineous congestion of the internal viscera. These objects cannot be effected without exercise and warm clothing.

While on this subject, we must advert to the pernicious effects of the modern system of female dress. We consider the free expansion of the chest and unimpeded action of all the muscles connected with respiration, as highly conducive to health, and as one of the means of obviating pulmonary congestion. The employment of tight stays and other forms of dress which impede the full and free action of the respiratory organs, cannot be too strongly reprobated. This, however, has been so well explained in the excellent article on Physical Education, that it is unnecessary for us to say more than express our concurrence in the views therein promulgated on this important subject.

[Yet it has been affirmed on the high authority of M. Louis, (*On Phthisis*, Sydenham edit. p. 440, Lond. 1844,) that "the alleged influence of clothing of different kinds, and especially of stays, on phthisis, is perhaps nothing more than matter of assertion wholly unsupported by proof."]

Want of Cleanliness.—Cleanliness is also essential to health, and inattention to it is another common cause of disease; and although this may be less powerful than those causes which have just been mentioned, still it has its influence. Without attention to cleanliness, the functions of the skin cannot be properly performed, the effects of which in producing tuberculous cachexia we have elsewhere explained.

Abuse of Spirituous Liquors.—Among the causes of tuberculous cachexia, a free indulgence in ardent spirits holds an important place. While it is one of the most powerful means of debasing the morals and of extinguishing the best feelings of human nature, this pernicious habit is no less effective in destroying the physical constitution. We believe that the abuse of spirituous liquors among the lower classes in this country is productive of tuberculous disease to an extent far beyond what is usually imagined. Indeed, it is only necessary to observe the blanched cadaverous aspect of the spirit-drinker, to be assured of the condition of his internal organs. The tale of his moral and physical degradation is indelibly written on his countenance. Nor does the evil rest here—he not only destroys his own health, but entails on his unfortunate offspring the sure disposition to tuberculous disease.

[It has been doubted, however, whether intemperance develops tubercles. Of 35 persons dying of various diseases, all of whom were decidedly intemperate, and most of them grossly so, in 26, according to Dr. J. B. S. Jackson, of Boston, (*New England Quarterly Journal of Medicine and Surgery*, July, 1842, p. 30,) no tubercles were found; in 5 there were tubercles in the lungs; in 1 in the bronchial glands; and only 2 died of phthisis. In several of the most striking, the organs were as free from tubercular disease as those of a new-born infant. These results led Dr. Jackson to suggest, whether intemperance may not have some effect as a prophylactic?]

Mental causes.—Too close application to study is a powerful cause of tuberculous diseases. It operates in several ways:—it necessarily implies sedentary habits, and hence exposes to all the evils which have their origin in want of exercise, such as imperfect digestion, constipated bowels, &c. In addition to these, the sensorium is so much exhausted by excessive exertion, that the nervous system generally is weakened, and the various organs of which the functions are essential to health are deprived of their due proportions of nervous influence.

Mental depression holds a very conspicuous

place among those circumstances which diminish the powers of the system generally, and often proves one of the most effectual determining causes of phthisis. Disappointed hopes which have long been cherished, slighted affections, loss of friends, and reverse of fortune, exert a powerful influence in inducing phthisis in persons predisposed to the disease.

Various other causes of consumptive diseases have been noticed by authors. Hard water, that is, water holding an unusual quantity of calcareous matter in solution, has been recorded among these causes, and the evidences of this are sufficiently strong to show that such water has an influence in the production of scrofula. The effects of the water at Rheims, related in the Memoirs of the Royal Society of Medicine at Paris, has often been adduced as a striking example. (Mém. de Soc. Royale de Méd. vol. ii. p. 280.) Heberden (Commentaries, p. 362,) and Cullen (Materia Medica, vol. i. p. 406,) have both noticed the influence of this cause; and we may refer the reader to the various works of Dr. Lambe, who has gone into minute details on this subject. It may be difficult to explain how hard water produces such an effect; but the fact should be sufficient to guide us in our selection of a residence for children, more especially for those of a tuberculous constitution. Mercury, when used so as to affect the system, has been very generally considered capable of inducing tuberculous disease. We are inclined to believe this, and therefore consider that its use requires the greatest care in persons of a delicate or strumous constitution.

Contagion.—There remains another imputed cause to be mentioned, viz., contagion. The contagious nature of phthisis has been believed by some authors of high authority, at the head of whom may be placed Morgagni, and altogether disbelieved by others. In the south of Europe the general opinion is in favour of contagion, in the north of Europe against it. The subject is one that scarcely admits of being confirmed or refuted. It would, therefore, be profitless to occupy the pages of this work in adducing authorities or in detailing opinions on a subject, on which every medical man in this country has too frequent opportunities of making his own observations and forming his own judgment. The view which we take of tuberculous cachexia, without which tuberculous disease of the lungs in our opinion cannot occur, leads us entirely to disbelieve that phthisis can be communicated by contagion. But we consider that the practice of sleeping in the same bed, or even in the same room with patients in the advanced stage of phthisis, is highly objectionable, because the rooms of the consumptive are rendered peculiarly injurious to health by the nature of the disease, and the confined atmosphere and high temperature in which they are too often kept.

Reviewing what has been said respecting the causes of tubercular cachexia, they may be stated generally to comprehend all those circumstances which debilitate, and increase the irritability of the system, impede the due digestion and assimilation of the food, diminish the various secretions and excretions, and induce internal sanguineous congestion. Defective assimilation,—from whatever cause it proceeds,—whichever be the first link in the chain of morbid actions which derange this process or series of processes,—induces, according to our view, tuberculous cachexia; and whether the primary error exist in the inadequate supply of food, or in the incapacity of the organs to extract from this the elements of nutrition, to assimilate and apply them to the reparation, growth, and various purposes of the animal economy, the ultimate result is the same.

Seeing that the causes which produce tuberculous cachexia are so numerous, we should be extremely cautious in estimating their power, and in attributing to any of them specific properties. Whenever their combined effect is such as to depress the vital energy, and lower the power of assimilation beyond a certain degree, the tubercular diathesis will be produced: whenever, on the contrary, the nutritive functions are vigorously carried on, this disposition will not manifest itself, however strongly it may be favoured by the separate action of any one of the causes in the degree in which it is usually applied.

III. Causes determining Tuberculous Disease of the Lungs.

The chief causes that come under this head may be divided into two classes: those which act immediately on the lungs, and those which act partly on this organ and partly on the general system. 1. To the first class belong bronchitis, pneumonia, hæmoptysis, pertussis, and some other pulmonary affections.

Bronchitis.—Irritation and inflammation of the mucous membrane of the larynx, trachea, and bronchi, are considered a frequent cause of tubercles. Certain it is that no affection so commonly appears to precede tuberculous phthisis as bronchial irritation. This circumstance may be accounted for in two ways. The pulmonary mucous membrane of tuberculous subjects is more susceptible of the impressions of the causes which produce congestion and irritation, such as vicissitudes in the temperature and humidity of the atmosphere, or mechanical irritants conveyed into the air-passages during respiration,—and tubercles often prove a source of bronchial irritation some time before their presence is indicated by other symptoms. But we also readily admit that repeated attacks of bronchial inflammation, or the long-continued application of mechanical irritants to the membrane of the bronchi, may prove the exciting cause of tubercles, when the constitutional predisposition exists.

In some instances the irritation commences in the larynx, and from thence appears to extend to the trachea and bronchi; the patient in this case is subject to frequent attacks of laryngeal irritation, which are usually excited by exposure to a cold humid atmosphere: there is a sensation of uneasiness in the larynx, and after a short time an increased secretion of mucus, with frequent hawking to remove it: generally, also, more or less hoarseness is present, and some cough. In other cases the person suffers from repeated attacks of inflammation of the internal fauces, and from thence the disease seems to extend to the larynx. After a series of attacks of laryngeal irritation have occurred, one, more obstinate than the others, does not subside, but continues, and is

soon accompanied by a cough; or should this symptom have existed previously, it is increased in severity; and the uneasy sensations, which were at first confined to the larynx, are now felt under the upper part of the sternum, and soon extend over the whole chest. The cough likewise becomes deeper, calling into action all the muscles of respiration. A patient may continue in this state for a considerable time, without fever or any other symptom, except the uneasiness of the chest and the cough; the latter of which gradually becomes more troublesome, and medicine is found to do little more than palliate it.

Such a patient is commonly said to have an "affection of the trachea," although in truth the tracheal portion of the mucous membrane is that which is the least affected, and when affected produces the least irritation: for extensive ulceration is frequently found in this part without giving any signs of its presence during life.

In another class of cases (and these are the most numerous) the morbid state of the mucous membrane commences in, and is chiefly confined to the bronchi; the larynx and trachea appearing to be little affected. The patient is liable to pulmonary catarrh on the slightest exposure to cold; during the whole winter and spring one attack succeeds another, so as scarcely to leave an interval of a few weeks free from cough. This state of bronchial disease often continues for many years in persons even of a tuberculous constitution, without terminating in phthisis, and has been termed tubercular bronchitis. The subjects of these chronic bronchial affections, when they occur in early life, are generally persons of great delicacy of constitution. Their cases are extremely puzzling, and without the aid derived from the physical signs of pulmonary disease, the medical attendant will remain ignorant of the nature of the disease. With care such patients may be preserved for many years; but after a shorter or longer period the catarrhal affection generally becomes permanent, the respiration is more oppressed, the pulse habitually frequent; and the emaciation, which had varied according to the severity or duration of the catarrhal attacks and the length of the intervals between them, now remains or progressively increases. The aspect of the patient is also much changed, and the symptoms collectively leave little doubt that tuberculous disease is established in the lungs. These cases of long-protracted catarrh preceding the manifest existence of tuberculous disease, afford the strongest evidence of the influence of bronchial irritation in exciting phthisis; and we have no doubt that when the least predisposition to tubercular disease prevails, long-continued disease of the bronchial membrane leads to the deposition of tuberculous matter in the extreme branches of the bronchi and the air-cells.

But, as M. Andral observes, "what ought never to be lost sight of is this, that in order that inflammation of the mucous membranes of the air-passages shall be followed by the production of pulmonary tubercles, it is necessary to admit a predisposition. This being admitted, we can easily conceive how in one individual very slight bronchitis is sufficient to produce tubercles, whilst others do not become phthisical from the most severe and long-continued pulmonary catarrh." (Clinique Médicale, t. ii. p. 32.)

[Light has been thrown upon this subject by more recent researches of M. Andral, (*Hématologie Pathologique*, Paris, 1843, or American edit., Philad. 1844.) He found when tubercles were under the form of hard masses, without any sign of inflammation around them, that the blood constantly exhibited, on analysis, its normal quantity of fibrin; but in proportion as they experienced softening, a process of elimination, similar in character to the inflammatory, was established around them; the blood became charged with a larger and larger proportion of fibrin; so that, he properly infers, the formation, in excess, of this principle is not dependent upon the development of the accidental product, but rather on the inflammation, which becomes associated with it at a certain period of its existence; an additional fact, he adds, to many others, that the process which creates different accidental products is not of the same nature as that which constitutes inflammation. In all the cases of incipient tuberculosis, the individual was, to a certain extent, anæmic, or the blood possessed a modification of composition like that which belongs to feeble constitutions, or those in which, owing to some cause, the vital forces have lost their energy. The quantity of globules was diminished. In proportion, too, as the tubercles progressed, the diminution of the globules became greater and greater; and when the lungs were filled with caverns, it attained its minimum; yet this diminution was never so great as in chlorosis. M. Andral (*Op. cit.*) has only seen a single case in which the proportion of globules was below 80 in 1000. In every other, it oscillated between 80 and 100. (Louis, art. *Phthisie*, in *Dict. de Méd.* 2de édit., p. 366, Paris, 1841.)]

The bronchial affections which we have just noticed are those which are met with in all classes of life, and are for the most part the consequence of exposure to a cold and humid atmosphere, or the alternation of this with hot rooms. Another fruitful source of bronchial irritation, originating in those occupations which expose the labourer to breathe an atmosphere loaded with particles of matter which mechanically irritate and excite permanent disease of the bronchial membrane, has been noticed in a former part of this article.

Pneumonia.—Inflammation of the pulmonary tissue next claims our attention, as being considered a frequent, and, by some authors, the chief cause of phthisis. The question of inflammation as a cause of tuberculous disease has been already treated so fully in the preceding article, (Tubercle,) and we accord so perfectly with the opinions of the author, that it is quite unnecessary to enter on the subject here. Although we believe inflammation incapable of producing tubercles in a healthy subject, we are of opinion that it may prove a determining cause in a tuberculous constitution; and on this account the most sedulous care should be taken to prevent its occurrence in such subjects, and to remove it when it has taken place. Pneumonic inflammation is one of the worst evils that can befall a patient already labouring under tuberculous disease of the lungs, as it never fails to increase the mischief, and frequently converts that which was latent, and might have long remained

so, into active disease. It promotes the softening of the tubercles, and renders the pulmonary tissue at once incapable of the functions of respiration, and a fit nidus for the further deposition of tuberculous matter. Indeed, we shall not err far, we believe, in stating, that in proportion to the extent of pneumonic inflammation, will be in general the rapidity of phthisis. It is chiefly in those persons who, without suffering from extreme debility, are little liable to inflammation, that we observe phthisis protracted to a great length; the tuberculous disease passing slowly and gradually through its various stages, and often arriving at a considerable extent without producing much febrile disturbance.

Hæmoptysis.—Pathologists differ in their opinion respecting the influence of hæmoptysis, as we have already had occasion to remark while on the subject of diagnosis. One class of authors regard the effusion of blood as the consequence merely of the presence of tubercles; while some others consider it a cause of the disease. M. Andral believes the hæmoptysis to be at once a proof and consequence of pulmonary congestion, which he considers necessary to the formation of tubercles; and having also on several occasions found, both in man and in the horse, tubercles deposited in the coagulum of blood which is the result of pulmonary apoplexy, he concludes that in this way the effusion of blood may become an exciting cause of the disease.

There can be no doubt, we think, when we attend to the history of the cases in which hæmoptysis occurs, that it is very generally a consequence of tubercles in the lungs, or at least occurs subsequently to their formation; although it may originate in simple pulmonary congestion.

It is to be regretted that in the accounts of this and other diseases adduced as causes of phthisis, the patient's previous health and the diseases of his family are not stated. The cases of French authors, which in other respects are detailed with such praiseworthy care and minuteness, are often defective on this point. It is a kind of information which is not sufficiently appreciated, and we have had constantly to lament the want of it in our examination of works on the subject of this article.

Pertussis.—Hooping-cough occurring in a predisposed subject may lead to the deposit of tuberculous matter in the lungs, but we are not aware that it is a frequent cause.

2. We now proceed to consider the second class of causes, which embrace various diseases affecting the general system, and which have been considered capable of giving rise to phthisis.

Fevers.—Fevers, both continued and intermittent, are not infrequently followed by the disease so closely as to make them appear in the light of exciting causes. Portal gives a chapter on a form of phthisis induced by fevers, both continued and intermittent; yet the cases which he has adduced, chiefly from Lieutaud, are fever complicated with inflammation of the lungs and pleura, followed by tuberculous disease. But independently of such complications, it is often remarked that symptoms of phthisis occur towards the conclusion of fever, or during the succeeding convalescence.

When fever occurs in a person of a tuberculous constitution, it may prove the exciting cause of tuberculous deposits in the lungs, from the irritation to which these organs are exposed in all fevers; or if tubercles already exist in a latent state, (which we believe to be the most frequent case when fever is the exciting cause of phthisis,) it is very likely to call the tuberculous disease into activity. In this *last* case, the fever commonly goes through its usual course favourably: the febrile symptoms abate; the tongue becomes moist and clean; the skin soft, the various secretions natural; but there is still a slight return of fever towards evening, and the pulse is frequent at all times: yet the patient seems on the verge of convalescence, and the medical attendant expects to find the pulse slower at each visit, and generally predicts a speedy recovery. But he is disappointed: the frequency of the pulse continues; the evening accession of fever becomes more marked; there is a circumscribed flush on the cheek different from the general flush of fever; the cough which attended the latter in a slight degree increases; perspirations occur towards morning; and the breathing is observed to be more rapid than during the severity of the fever. The real state of things now becomes evident. The fever has ceased, but in place of terminating in convalescence, as in a healthy subject, it is immediately succeeded by, or rather lapses into, hectic fever. The patient, already greatly reduced, becomes an easy victim to tuberculous disease of the lungs, and generally sinks rapidly under it: a few months, and in some cases a few weeks, suffice to complete his destruction.

When the individual is merely predisposed to phthisis before the attack of fever, it is generally succeeded by a more perfect but lingering convalescence: the patient gains strength slowly: he is observed to cough occasionally; his pulse remains quick, and after some time a degree of hectic fever supervenes. These symptoms gradually increase, and at length evening fever and morning perspirations occur more regularly, and are soon followed by a train of symptoms which need not here be noticed. The disease in this case also proves speedily fatal.

There is a third class in which the fever appears connected with consumption, although this does not succeed so closely upon it. Months may elapse before the presence of phthisis is indicated by the usual symptoms, although the fever may still have been the determining cause; inasmuch as the patient never regained his wonted health after it. In this case the fever acts as a remote rather than an exciting cause of phthisis, and might more properly have come under remote causes.

The rapid progress of many cases of phthisis, apparently originating in fever, depends upon the existence of tuberculous disease in a latent state previously to the occurrence of the fever, during the convalescence from which symptoms of consumption were first observed. The irritation of the mucous membranes of the lungs and digestive organs which generally accompanies fevers, favours the increase of tuberculous disease already existing; and the state of convalescence is perhaps of all conditions the most favourable to the progress of pulmonary disease. In a subject exhausted and debilitated by an acute disorder, ex-

posure to cold, over-fatigue, &c., may easily determine the production of phthisis.

Another circumstance which often occurs to aggravate and complicate the cases now under consideration, is an attack of pleurisy, pneumonia, or bronchitis, which is a frequent occurrence from imprudent exposure after febrile diseases.

There remains to be noticed a febrile affection peculiar to childhood, at least in its more acute form, which is fraught with the utmost danger, as it proves a frequent exciting cause of tuberculous disease; we allude to what is commonly denominated *Infantile Remittent Fever*. If neglected or improperly treated, it often induces fatal cerebral disease; but more frequently assumes a chronic form; and being essentially seated in the digestive organs, speedily leads to a derangement of the digestive function and the various secretions connected with it, and moreover renders the child extremely liable to acute attacks of gastric and bronchial irritation, from slight errors in diet, exposure to cold, &c. This affection is considered by Hufeland as so intimately connected with tuberculous disease, that he regards it as a precursor of the scrofulous diathesis, or a sign of its presence, and proposes to name it scrofulous fever. According to his observation, it is most frequent within the two first years of life. (Traité de la Maladie Scrophuleuse, p. 92.)

Eruptive fevers, particularly rubeola, scarlatina, and variola, are attended with still greater danger to persons of a tuberculous constitution than continued fever.

Rubeola.—Bronchial disease, often of a very severe character, forms an essential part of measles; so that we have bronchial irritation superadded to the fever. In early life measles are known to prove a frequent exciting cause of tuberculous disease.

Scarlatina.—Although attended with less bronchial irritation, scarlatina is still a very dangerous disease to young persons disposed to or labouring under the tuberculous diathesis. During convalescence from scarlatina there is a peculiar disposition to inflammation; and pleurisy and pneumonia are easily induced by slight exposure to cold, fatigue, &c., for some time after the eruption has ceased; and the rapidity of phthisis after scarlatina, which was noticed by Morton, is, we believe, chiefly owing to the inflammation of the pleura or lungs being superadded to the tuberculous disease previously existing. It is during the convalescence from these diseases that the great danger is to be apprehended, and the most sedulous care should be taken during that period to guard against exposure to cold and other exciting causes of pulmonary inflammation.

Variola.—Small-pox is generally accompanied with much bronchial irritation, and proves a very fatal disease in the strumous habit; but fortunately we have few opportunities of witnessing the evil consequences of this disease at present. The following remark of Heberden will show that the influence of the diseases which have just been noticed, in inducing phthisis, did not escape the observation of that sagacious physician: "Fieri potest ut morbilli graviores, vel peripneumonia, vel tussis convulsiva, vel alia adversa valetudo latentia tabis semina excitent, vel etiam gignant, tam in ultimâ senectute, quam in pueritiâ; cujus rei exempla ubique obvia sunt." (Commentarii.)

Several other diseases have been considered causes of phthisis, such as *rheumatism*, *syphilis*, *psora*, &c.; but the observations upon which this opinion rests do not appear to us to have been made with sufficient accuracy to merit notice in this place.

Sect. XI. — Of the Pathology of Phthisis and of Tuberculous Diseases in general.

In a certain condition of the system which we have endeavoured to describe under the title of tuberculous cachexia, a peculiar matter is poured out by the blood-vessels and deposited in the various tissues and organs of the body. This matter, constituting one of the forms in which the morbid modification of the general system manifests itself, is subject to laws of formation and has physical characters proper to itself, by which it can generally be recognised, however modified in form and appearance by the structure or functions of the part in which it is deposited.

From remote antiquity to the present day, the disease of which this matter constitutes the distinctive anatomical character, has received different names according to its development in particular organs and tissues. In the external glands and in bones, it is commonly called scrofula; in the lungs, phthisis; and in the glands of the mesentery, tabes mesenterica, &c. The identity of these affections was only suspected by the ancients from the similarity of the general symptoms, but has been demonstrated by the moderns on the clear evidence of morbid anatomy; an increased attention to which science, and the study of the causes of the disease, have led pathologists to entertain more accurate opinions and more comprehensive views regarding it.

From the rounded form which this matter assumes in certain situations, it received the very inappropriate name of *tubercle*; a term which is still applied to it by modern pathologists, although it designates an appearance not constant to this, but occasionally assumed by other morbid products, and depending rather on the structure of the organs in which it is deposited than on the matter itself; as is clearly shown in Dr. Carswell's "Illustrations." It occurs perhaps more frequently than any other morbid product; and a proof that it is dependent on a certain morbid condition of the animal economy is to be found in the circumstance, that it is often deposited at the same time in various parts of the body,—on some occasions in almost every organ.

Tubercle or tuberculous matter is now, we believe, generally considered as a secretion or deposit depending upon a morbid state of the general system, from the liability to which no constitution, no temperament, age, sex, or race, as we have already seen, is entirely exempt, though the disposition to it is strongest in that condition of the body called lymphatic in the age of infancy, in the female sex, and in the negro race. These and other circumstances of climate, occupation, &c., not only influence its absolute frequency, but have also a powerful effect in determining its development in particular organs or structures, in modifying the course of the disease, and in giving a various character even to the general diathesis

by which the disposition to its formation is characterized.

But in whatever point of view we may regard tuberculous cachexia, we shall find its phenomena explicable only by admitting that it depends on a general modification of the whole and every part of the animal economy; and that all notions which regard it as the morbid degeneration of any organ or tissue, or of any particular system, or the morbid modification of any single fluid, are necessarily erroneous, and founded on limited views of its nature and laws, and totally inadequate to explain its phenomena.

The deposition of the peculiar matter of tubercle in any of the tissues or organs of the body is only the result of previous changes in the general system, cognizable, as we have endeavoured to show (Sect. II.), by the physical condition of the patient and by a disordered state of various functions,—a condition of body quite distinct from mere debility, and therefore inexplicable on the idea of a difference of force or tone of the system; and which, though very generally accompanied with a feeble organization, is not inconsistent with too great development and inordinate action of particular parts, and even with considerable physical power of the system.

As tuberculous cachexia appears to be the consequence of an imperfect assimilation of the nutritive matter received into the economy, it is evident that its influence cannot be confined to any part, tissue, or organ, but pervades the whole system, and modifies the entire organism,—the structure of every part and the nature of every secretion. Thus the osseous system is more spongy; the cellular tissue is singularly lax; the muscular flaccid and imperfectly developed; the vascular system is weak and irregular in its actions, and subject to local congestions from the slightest disturbing causes. The circulating fluids also partake of the general disorder; the blood is serous, and deficient in fibrine and colouring matter. (Andral, Anat. Path. Trans. vol. i. p. 535.) The glandular and lymphatic systems are more peculiarly affected, as being more intimately concerned in the function of nutrition; and hence this system has been by many considered as the seat of the disease. The skin is generally thin and soft, or thick, coarse, and dry, and subject to many diseases apparently arising from the morbid condition of its function of secretion, which is always in tuberculous subjects more or less deranged. The mucous system is peculiarly susceptible of disease; and great discharges of matter, differing more or less from the healthy secretion, are poured forth from the surfaces of the mucous membranes on the application of the slightest causes of irritation or congestion. These we consider as examples and proofs of a defective state of organization,—the consequence of defective power in the assimilative organs, or an imperfect supply of nutritious matter, &c. This view of the pathology of tuberculous cachexia is that, we believe, generally adopted by the best pathologists of the present day. But Dr. Todd has gone further, and explained his opinion by attributing the formation of tubercles to the deposition of coagulable lymph imperfectly organizable. From his experiments on the reproduction of the amputated members of the lower animals, he is induced to consider coagulable lymph as the matrix of the various tissues of the body. (See our work "On the Influence of Climate, &c." pp. 311–314, note.)

In the healthy state of the nutritive function each part separates the materials proper for its support, and converts them into its own particular tissue or structure; and the various secretory organs secrete their peculiar fluids in their due quantity and healthy qualities,—some to be applied to the purposes of the animal economy, others to serve as vehicles for eliminating effete and useless matter from the system. Hence, imperfect assimilation on the one hand, or defective secretion and elimination on the other, may ultimately give rise to a state of tuberculous cachexia. Such a condition being once established in the parent, it is easy to conceive what will be its influence on the offspring.

The extended view which we take of tuberculous cachexia, and of its influence on the secretions and on the products of diseased action, inclines us to believe that tuberculous deposits are always at first in a fluid or semifluid state, and that the concrete form in which they are commonly found arises simply from the absorption of the more fluid part, and is in many situations dependent even on their compression, as is shown by Dr. Carswell; and we have no difficulty in conceiving that the matter formed in certain cutaneous eruptions, and that thrown off from the free surfaces of mucous membranes, would have assumed all the characters of crude tubercle, had it been confined in the parenchyma of organs, or the extreme bronchial ramifications, &c. When the tuberculous diathesis prevails to a great degree, large depositions of tuberculous matter may take place in many organs of the body about the same time; or irritation of any one organ may determine the production of the disease in that alone, and death may be the result, before other parts of the system are affected.

The foregoing observations, with some slight exceptions, are to be regarded rather as a detail of the more constant phenomena which accompany the progress and development of phthisis, than as an exposition of the real pathology of the disease. In the few remarks which we are now about to make, if we deviate from the sure path of demonstrable fact, we believe that we are still borne out by observation and by the results of practical experience; and we are willing to incur the imputation of yielding a little to theory rather than hazard the chance of leaving unsaid that which, we are disposed to think, may be of practical value to some of our readers.

It is reasonable to believe that the remote causes of phthisis, however variously they may appear to operate, do so by inducing some peculiar or determinate derangement of the system—some positive pathological condition, which, being constantly present wherever tuberculous disease is found, may be regarded as necessary to its production. Although we hesitate not to say, that, in the actual state of our physiological and pathological knowledge, we are unable to define with certainty all the conditions in which tuberculous disease has its origin; we think that it would not be diffi-

cult to point out some of the more important links of the chain which connects special functional disorder with the formation of tuberculous cachexia. On some future occasion we may take an opportunity to enter more fully upon the subject; our limits at present merely permit us to call the attention of the reader to that morbid condition which, in our minds, constitutes the most obvious and important in a practical point of view.

A congestive state of the venous system of the abdomen is the condition to which we refer; it is one which was familiar to the pathologists and practitioners of the last century, and, although it has not been quite overlooked, it has been too much neglected by the moderns. Such of our readers as are familiar with the writings of the German physicians of the middle of the last century, particularly Stahl, (see his "Vena Portæ, Porta Malorum,") Hoffmann, (Med. Rat. t. i. s. 1. cap. viii.) and above all Kaempf, and his disciples, will be aware of the extensive influence and importance attached to this state of the abdominal circulation, at that time. Referring to those works where the facts upon which the doctrine rests are fully exposed, we shall restrict ourselves here to a few observations more particularly bearing upon the subject of this article, and which it is but justice to ourselves to say were established in our mind as the result of practical observation, before we were aware of the existence of the German doctrines of abdominal infarctus.*

In children originally of a strumous habit, we observe a constant disposition to this congestive state of the abdominal circulation; and unless we succeed in obviating it, they become tuberculous and die early in life. In youth we find the same state of congestion as a precursor of tuberculous cachexia; but it is during the middle period of life, from thirty-five to fifty, that it is accompanied with more marked symptoms, such as dyspepsia with its various concomitants, which exist often for a very considerable time, and not unfrequently obscure the pulmonary affection till tuberculous disease has made considerable progress. This is the form of the affection which has been denominated *dyspeptic phthisis*; and if the term referred merely to the cause of the pulmonary disease, there would be little harm in retaining it,—but if used to designate a species of phthisis differing from the tubercular, we consider it decidedly objectionable; because, however prominent the dyspeptic symptoms may be, tubercular disease of the lungs is the cause of death. While we admit to the fullest extent the necessity of attention to the state of the digestive organs, we must object to the pathological view which limits the attention of the practitioner to the dyspeptic affection, neglecting other and equally essential parts of the treatment. We do not know such a disease as dyspeptic phthisis as constituting a particular species; but we are well acquainted with that form of tuberculous phthisis which is long preceded and accompanied in its progress by dyspepsia. Indeed, tubercular phthisis rarely occurs in the middle period of life without this complication; but it cannot be doubted that the deranged condition of the digestive organs is, in these cases, very often a mere consequence of a long pre-existing state of congestion of the venous system of the abdomen; and which, if not corrected by more efficient measures than those generally applied to relieve the dyspeptic symptoms, may soon terminate in pulmonary consumption. The profession are highly indebted to Dr. Wilson Philip for calling their attention to the congestive state of the hepatic system, and pointing out some of the most effectual means of obviating it; but we cannot admit that this dyspeptic phthisis differs in its nature from common tubercular phthisis.

The effects of congestion and derangement of the abdominal viscera have long been remarked as causes of phthisis: they were regarded by Kaempf and his disciples as giving rise to most of the chronic diseases of the chest. Portal observes, that it is certain that engorgement of the liver and other affections which derange the secretion and even excretion of the bile, may become a cause of pulmonary phthisis; and several other authors have remarked the connection of phthisis with abdominal disease, but in a manner so vague and undefined as to attract little attention.

Abdominal plethora, when once established, gives rise to a series of deranged functions in the digestive organs, the lungs, skin, &c., which, by impeding digestion and assimilation, affect the whole animal economy. These are manifested in imperfect biliary secretion, constipated bowels, and irritated mucous surfaces, in congestion of the lungs, and a dry and harsh state of the skin. In consequence of the overloaded condition of the venous system, the heart, generally feeble in the tuberculous constitution, is oppressed, and the arterial circulation impeded and enfeebled. In this state of the system, very slight exciting causes induce disease, especially inflammation and hemorrhage; hence arises the constant liability of strumous subjects to inflammatory diseases of a sub-acute and chronic character, and hence also we derive an explanation of the hemorrhages to which they are peculiarly liable even at a very early age. The same pathological state of the abdominal circulation forms the remote cause of the various congestive and chronic diseases so common in the strumous subject; such as glandular swellings, cutaneous eruptions, &c. &c.

Sect. XII. — Prevention of Tuberculous Diseases.

We have stated our views so fully respecting the nature and causes of tuberculous diseases, that it is unnecessary to enter into minute details on the subject of prevention: we shall, therefore, confine ourselves to some general remarks regarding the principal circumstances which require

* John Kaempf, the original improver, if not author, of this doctrine of *abdominal infarctus*, and of its peculiar treatment by clysters, did not himself publish any work on the subject. The doctrine was first made known in the inaugural dissertation of his eldest son (also named John) *De infarctus vasorum ventriculi*, published at Basil in 1751. It was afterwards more fully developed in the dissertations of Koch, *De infarctibus vasorum in infimo ventre*, Argent. 1752; of Schmid, *De concrementis uteri*, Basil, 1753: of Elvert, *De infarctibus venarum abdominalium*, Tubing. 1754: of Faber and Brotbeck, *Ulterior expositio novæ methodi Kaempfianæ*, Tubing. 1755; of G. L. Kaempf (the second son), *De morbis ex atrophia*, Basil, 1756; and, finally, in the treatise published in his native language by John, the eldest son, entitled *Für Aerzte und Kranke bestimmte Abhandlung, &c.*, Dessau, 1784-8. The best of these dissertations, viz. those of J. Kaempf, Koc, Elvert, and Faber and Brotbeck, are reprinted in the third volume of *Baldinger's Sylloge*, Gott. 1778.

the attention of the physician who may be called upon to lay down rules respecting this most important subject.

The first question that suggests itself under the head of prevention regards Hereditary Transmission, and involves the consideration of two distinct objects;—the first being to check the transmission of the disease by the parent to the offspring; the second, to prevent the disease in children born with the constitutional predisposition to it.

I.—**Prevention as regards Parents.**

We have already endeavoured to show, in the section on the causes of phthisis, that it is not necessary that the parents should be the subjects of tuberculous disease in order to transmit the tuberculous constitution to their children:—the belief that scrofulous parents only have consumptive children is an error that cannot be too soon corrected. We have also shown that a deranged state of health in the parent from many different causes, may render the offspring predisposed to the disease before us.

Every member of the profession, by observing what is daily passing before him, may see numerous proofs of the truth of this statement: he will find that when the parents are unhealthy, the children are so likewise, and that the latter often show evident signs of the tuberculous constitution when the former have no symptoms of it. The children of parents who have suffered long from dyspeptic complaints, gout, cutaneous affections, or any other form of disease which has influenced the general system, are very frequently the subjects of tuberculous disease, or of such derangements as dispose to tuberculous cachexia. When both parents are affected, this result is brought about with more certainty.

Marriage.—In order to prevent effectually the extension of tuberculous disease, it is essential that we should in the first place direct our attention to the health of the parents:—were they convinced that the health of their children depended upon their own, a beneficial effect might be produced among the more reflecting part of mankind, and especially among families of a strumous habit. If more consideration were bestowed on matrimonial alliances, and a more healthy and natural mode of living were adopted by persons in that rank of life which gives them the power of regulating their mode of living according to their own choice, the predisposition which is so often entailed on their offspring might be checked, and even extinguished in their family, in the course of a few generations. In the present state of society, the reverse of this very commonly happens; and from the total disregard of the precautions alluded to, the third generation often terminates the race. The children of dyspeptic persons generally become the subjects of dyspepsia in a greater degree and at an earlier period than their parents; and if they marry into families of a delicate constitution, their offspring become highly tuberculous and die of phthisis in early youth or even in childhood. We could at this moment adduce many examples of this melancholy fact; but it is consolatory to know that it is an evil which may be in some measure obviated or removed. This extinction of families may, we believe, be prevented by judicious intermarriages with healthy persons. Families already predisposed to tuberculous disease should at least endeavour to avoid matrimonial alliance with others in the same condition; but above all they should avoid the too common practice of intermarrying among their own immediate relations,—a practice which is at once a fertile source of scrofula, a sure mode of deteriorating the intellectual and physical powers, and eventually the means of extinguishing the degenerated race. "There can be no question,"—says Dr. Mason Good, "that intermarriages, among the collateral branches of the same family, tend more than any thing else to fix and multiply, and aggravate hereditary predisposition. And hence nothing can be wiser, on physical as well as on moral grounds, than the restraints which divine and human laws have concurred in laying on marriages between relations." (Study of Medicine, vol. v. p. 35.) It would also be well if all persons who contemplate marriage were aware of the necessity of attending to their state of health previously to and after the adoption of this change of life. The dyspeptic should have recourse to those means which are calculated to restore the functions of his digestive organs; the gouty subject should renounce the well-known causes of his disorder; and those who are afflicted with organic disease, more especially with consumption, should pause before they enter into a contract which can only entail disease and unhappiness on all concerned.

The medical practitioner alone sees, or at least comprehends the extent of misery originating in marriages of this description; he will, therefore, appreciate the justness of these remarks, although he will acknowledge the difficulty of enforcing them on the practical consideration of the public. We are well aware that the mass of mankind are far too reckless to attend to any precautionary measures on the subject, even though perfectly satisfied of their truth and necessity; still there is a small proportion on whom we are inclined to think these cautions may not be wholly thrown away. It must not be forgotten that this is not merely a question which has reference to private feelings and social happiness, but one of great public importance, involving at once the well-being of society, and the moral as well as the physical character of nations.*

Pregnancy.—There are certain rules of management and conduct which it is necessary for every mother to pursue during pregnancy. Far too little regard is paid by females to their health during this most important period of their lives, and they are in general little aware of the influence of their own health upon that of their children. From the commencement of pregnancy, every female, especially if she is delicate or belongs to a strumous family, should regard her health with more than common solicitude. She should take daily exercise in the open air suited to her strength, and when circumstances permit, we would recommend that she should pass the period of pregnancy in the country.

It has often been imagined that females during

* We beg to refer to the valuable little work of Mr. Belinaye, on the "Sources of Health and Disease in Communities," for some very judicious remarks on this subject.

the state of pregnancy require a fuller diet than that to which they have been previously accustomed. This is a great error as a general rule: increase of diet is not necessary or beneficial; on the contrary, it is often useful to reduce the usual quantity of food, especially in the advanced months, a period during which stimulants of all kinds are generally hurtful. There is an increased activity in the system of the pregnant female, which, so far from requiring any additional increase from art, more frequently renders it necessary to diminish the stimulants in common use.

Crowded assemblies of all kinds, public spectacles and theatrical exhibitions, in short every thing calculated to excite strong feelings, to depress the mind, or excite the passions, ought to be sedulously avoided. There are numerous other circumstances regarding the conduct of females during pregnancy which do not come within the province of this article; these it will be the duty of the medical attendant to point out and enforce. He should particularly impress upon the attention of the young mother, that the health of her infant depends upon her own, and that from the commencement of pregnancy she is to consider herself responsible in a great degree for the health of her offspring.

II.—Prevention as regards Children.

Although we are not acquainted with any direct remedies for the constitutional predisposition to tuberculous disease, there can, we think, be no doubt that we are possessed of the means of correcting it in many instances in an indirect manner.

By placing the predisposed child in circumstances the most favourable to health, as regards nourishment, air, exercise, &c.; by removing functional derangements as they occur, and by maintaining especially a healthy condition of the digestive organs, we may improve the constitution so as to overcome the hereditary predisposition. By the measures now referred to, we are persuaded that a large proportion of such children might be saved, although it is perhaps not beyond the truth to say that five-sixths perish under the present system of management. In proceeding to develop more fully the measures which we deem essential in the accomplishment of this object, we are well aware that many of our recommendations will unfortunately be beyond the means and attainment of the public at large; but nevertheless we feel called upon to state them without regard to individual exceptions, as they are in our opinion the most effectual means of prevention when circumstances admit their application.

In order to render our observations more practical, we shall apply them to the different periods of life: this will, no doubt, give rise to some repetitions; but these are unavoidable in treating of a disease, the causes and remedies of which vary so much at different ages.

1. *Prevention of the disease in Infants.* — During the growth and development of the body, all those measures which are known to contribute to the general health must be adopted, in order to prevent tuberculous disease in an infant born with the predisposition to it. The rules for governing the health of strumous infants are nearly the same as for others; but they require to be more rigidly enforced and more strictly attended to. Unless the child of tuberculous parents be reared with the greatest attention to every circumstance which can contribute to health, he has but little chance of reaching maturity without becoming the subject of tuberculous disease.

Nursing. — If the infant derives the strumous constitution from both parents, or from the mother only, he should be suckled by a young healthy nurse; but should the disposition to disease be derived entirely from the father, and the mother's health be unexceptionable, she should suckle her own child. It is always satisfactory when this can be accomplished, as it is, with few exceptions, the plan most agreeable to the mother; and if her mode of living be consistent with her duties as a nurse, it will be far better for the infant: but all these contingencies acquire consideration before we decide on the plan which it is desirable to adopt. We do not enter upon the moral consideration of the question, — we merely speak of it in a medical point of view; and we are satisfied that when the mother's health renders her unfit to nurse her child, or her habits or mode of living are such as to prevent her from adhering to those regulations by which every nurse, whether mother or not, should abide, it is much better for the health of the infant that he should derive his first nourishment from the breast of a stranger.

The arguments advanced in favour of the opinion that every mother should nurse her own infant, appear very plausible, and would be perfectly just if every mother enjoyed that state of health which renders her fit for such a duty. In the present state of society, however, this is far from being the case, and we therefore consider it better for the delicate mother herself, and infinitely so for her child, that she should at once renounce a task for which her constitution renders her unfit, than struggle on for a few months in an attempt which may injure her own health and destroy her infant. Half measures, so often recommended in such cases, are always unwise; they generally end in the child being fed by hand in place of being suckled, — a plan which never fails to injure the health of a strumous infant. We would therefore lay it down as an invariable rule, that the child of a consumptive mother, or of one in whom the strumous constitution is strongly marked, more particularly if it be attended by decided scrofulous disease, should be suckled by another woman, and that the period of nursing should generally range from twelve to eighteen months, or even longer. We recommend the suckling to be continued for this length of time, partly with a view to enable the infant to pass over the dangerous process of teething with greater safety: indeed the strumous infant should not be weaned till the first set of teeth have appeared; he should have no food in general but the nurse's milk till he is six months old at least, and for some time after this it should be of the lightest quality, and constitute a small proportion of his nutriment.

It is almost unnecessary to add to these remarks, that the selection of a nurse for a tuberculous infant deserves especial attention. She should be young, healthy, and free from all suspicion of a

strumous constitution, and her child should not be older than that which she is required to nurse. She should take daily exercise in the open air; her regimen should not differ much from that to which she has been accustomed, and any change which is made in it should be gradual. It is erroneous to suppose that women when nursing require to be much more highly fed than at other times: a good nurse does not need this, and a bad one will not be much better for it. The quantity which many nurses eat and drink, and the indolent life which they too often lead, have the effect of deranging the digestive organs, and frequently induce a state of febrile excitement, or a premature return of the catamenia.

Dress, Bathing, &c. — The dress of all infants should be carefully suited to the season. The whole surface, particularly the extremities, should be well protected during cold weather: the notion that infants may be hardened by exposing them to the air in a half-covered state is false in the case of all children, and leads to pernicious consequences in those of a delicate constitution.

Much has been said and written in favour of cold bathing; and authors who have laid down rules on this subject have adduced in support of the practice the customs of savage nations, altogether overlooking the difference in the condition of infants in civilised life. The object of washing and bathing children is two-fold; the first and most important being that of cleanliness, especially in the tuberculous infant, in whom it is essential that the cutaneous functions should be maintained in a state of healthy activity. At first the infant should be washed with warm water; and a bath every night, with the view of thoroughly cleaning the body, will be beneficial; by degrees the water with which he is sponged in the morning may be made tepid, but the night bath should be continued of such a temperature as to prove grateful to his feelings. The second object in bathing being to brace and strengthen the infant, he may, as his age increases, be sponged with cold water, or even plunged into it, every morning during the summer with advantage. The judicious adoption of this plan, along with subsequent friction of the body with flannel, is, we believe, one of the most effectual means of strengthening children; but its effects must be carefully watched, as all children will not be equally benefited by cold bathing, and the health of some may even be injured by it.

Air.—As we regard the respiration of a deteriorated atmosphere one of the most powerful causes of tuberculous cachexia, so we consider the respiration of pure air an indispensable requisite for strumous children; indeed, without this all our efforts to improve their health will fail. Too much attention, therefore, cannot be paid to the construction and ventilation of the child's apartments: the room in which he sleeps should be large and well-proportioned, the air should be frequently renewed, and his bed should not have more curtains than are necessary to guard against currents of air. The custom which prevails in this country of surrounding beds with thick curtains is most injurious to health; and it is to this habit, and to the heated atmosphere of their bedrooms, that the languor and bloated appearance of many young persons, on first awaking in the morning, is in a great measure to be attributed. The bed-rooms should be large in all their dimensions, they should be in an elevated part of the house, and so situated as to admit a free supply both of air and light: those apartments to which the sun's rays and the refreshing breeze have free access, are always the most healthy and desirable.

The proper time for carrying an infant into the open air must be determined by the season of the year and the state of the weather. A delicate infant born late in the autumn will not generally derive advantage from being carried into the open air, in this climate, till the succeeding spring; and if the rooms in which he is kept are large, often changed and well ventilated, he will not suffer from the confinement, while he will most probably escape catarrhal affections which are so often the consequences of the injudicious exposure of infants to a cold or humid atmosphere.

Residence.—It is almost unnecessary to say, that when an infant can be suckled in a healthy situation in the country, it is, *cæteris paribus*, far preferable to the town; but the choice of situation requires so much judgment and is so little regarded, that we trust to be excused for offering a few remarks in this place on the rules by which it should be regulated.

There is no circumstance connected with health, concerning which the public are, in our opinion, so ill-informed, as the requisites of a healthy residence, both as regards the local position and the internal construction. In this island we have chiefly to guard against humidity, on which account our houses should not be built near water, especially when stagnant, and, still less, near marshes.

Large trees, which are both an ornament and an advantage at some distance from a house, become injurious when so near as to overshadow it, or prevent the air from circulating freely around it, and through its various apartments. The atmosphere of a building overhung by trees, or surrounded by a thick shrubbery, is in a state of constant humidity, except in the driest weather; and the health of the inmates rarely fails to suffer. The natural moisture of the country, arising from the humid state of the soil and vegetation, is greatly increased by such an injudicious mode of planting; an artificial atmosphere is thus created which renders a situation of this kind much less healthy than the more open parts of large towns. It is not generally known how limited may be the range of a damp unhealthy atmosphere; a low situation surrounded by trees may be capable of inducing tuberculous disease in an infant, whereas a rising ground a hundred yards distant may afford a healthy site for his residence. The dryness of the air in towns, which is the consequence of good drainage and an artificial soil, is at once the safeguard of the inhabitants, and a compensation, in some measure, for the want of that unimpeded circulation and renewal of pure air which the country alone affords.

2. *Prevention of the disease in Childhood.*—During the period of childhood the same unremitting attention is necessary to the circumstances just mentioned under the head of infancy. The important process of teething being fairly passed,

the food of the child ought to be regulated chiefly by the state of the digestive organs. In proportion to the delicacy of the child, the diet will in general require to be mild; when he thrives upon farinaceous food, milk, and light broths, no stronger or more substantial diet need be used during the first two years of life: when he looks healthy, and grows, and his bowels are regular (for this is one of the surest indications that the food is suited to the digestive organs), we have the best proofs that the diet agrees with him. When, on the other hand, the child appears heated or flushed towards evening, when he drinks greedily and more than is usual in children of the same age, and when his bowels do not act regularly, we may be assured that there is something wrong in the regimen employed.

There is no greater error in the management of children than that of giving them animal diet very early in life. To feed an infant with animal food before it has teeth proper for masticating it, shows a total disregard to the plain indications of nature in withholding such teeth till the system requires their assistance in masticating solid food. Before that period, milk, farinaceous food, and broth afford that find of sustenance which is best suited to the digestive organs, and to the nourishment of the system. The method of grating and pounding meat as a substitute for chewing, may be well suited to the toothless octogenarian, whose stomach is capable of digesting it; but the stomach of the young child is not adapted to the digestion of such food, and will be disordered by it. When the child has the means of masticating, a little animal food may be allowed; but at first it should be of the lightest quality and given on alternate days only, and even then its effects should be watched; for all changes in the regimen of children should be gradual.

The frequent origin of scrofulous disease in defective nourishment has led to the opposite extreme; and children who are disposed to tuberculous disease are too often subjected to a system of over-feeding, which induces the disease it is intended to prevent. By persevering in the use of an over-stimulating diet, the digestive organs become irritated, and the various secretions immediately connected with digestion are diminished, especially the biliary secretion; at least the sensible qualities of the bile enable us to observe it best. Constipation of the bowels soon follows, congestion of the hepatic and abdominal veins succeeds, and is followed by the train of consequences which have already been detailed. It would be well if the advocates of the system of high-feeding would bear in mind the salutary adage, *corpora impura quo plus nutries, eo magis lædis.*

Exercise.—When the child has acquired sufficient strength to take active exercise, he can scarcely be too much in the open air; the more he is habituated to this, the more capable will he be of bearing the vicissitudes of the climate. If children are allowed to amuse themselves at pleasure, they will generally take that kind and degree of exercise which is best calculated to promote the growth and development of the body. When they are too feeble to take sufficient exercise on foot, riding on a donkey or pony forms the best substitute; this kind of exercise is at all times of infinite service to delicate children; it amuses the mind and exercises the muscles of the whole body, and yet in so gentle a manner as to induce little fatigue. Young girls should be allowed, and even encouraged, to take the same kind of exercise: it is chiefly the unrestrained freedom of active play that renders boys so much less subject to curvatures of the spine and other deformities than girls,—a large proportion of whom are more or less misshapen, in consequence of the unnatural restraint which is imposed upon them in their exercise and dress.

The clothing of young persons requires particular attention, and must of course be regulated according to the season. The winter dress should be early resumed and laid aside late. It is in spring and autumn that the vicissitudes of our climate are greatest, and congestive and inflammatory affections most common; this is peculiarly the case in the spring, which is also the season when local strumous affections are most liable to occur in constitutions disposed to them. Flannel next the skin is, in our opinion, not only proper but generally necessary: it may be put off with advantage during the night, and cotton may be substituted during the summer, the flannel being resumed early in the autumn.

Education.—The education of strumous children requires much judgment and consideration; no such child should be condemned to pass the greater part of the day in the close apartments of a crowded school until he has attained his ninth year at least.

We consider that the hours of confinement in schools are much too long for the purposes of instruction, and might be abridged with great advantage to the health of the children; the young mind is easily wearied, and it is not sufficiently considered that the intellectual development ought for a time to give way to the physical improvement of delicate children. School-rooms should be large and lofty, so as to insure ventilation without the risk of exposure to currents of cold air, for the impure atmosphere which too commonly prevails in schools is an unfailing source of injury to health. During the first years of education, children should be allowed a little relaxation and play at intervals in the school hours.

At no period of youth should education be pushed beyond its proper limits, or the mind be worked above its powers; the welfare of the pupil demands the observance of this rule on the part of the master as well as the parents, more especially when the child belongs to that class of strumous children whose intellects are preternaturally acute. Unfortunately, however, these are generally the pupils selected by the master to do credit to his establishment; every means are taken to encourage the premature manifestation of mind, and to stimulate the child to renewed exertions; and thus health, and even life, are often sacrificed at a period of brilliant promise, when the hopes of friends are buoyed up by the fallacious expectation of a harvest, which a more rational system of education might have realized.

In some cases, however, the mischief resulting from this cause does not make its appearance at this early age; we have met with many distressing

examples of young men, who, after years of close application at school, had entered upon their studies at the university with the same unabated zeal, but were soon compelled by the sudden failure of their health to abandon their literary pursuits and the prospects which they had in view. The more we have seen of the prevailing system of management in schools, the more have we been persuaded that no subject more deserves the attention of parents than the education of strumous children; and, however laudable may be their desire to see the minds of their offspring highly cultivated, it should be checked by the knowledge that this object can only be attained by the sacrifice of health, and too often by the loss of life. "The time," says Dr. Beddoes, "is not perhaps far distant, when parents shall discover that the best method of cultivating the understanding, provides at the same time most effectually for robustness of constitution; and that the means of securing both parts of the comprehensive prayer of the satirist,—*ut sit mens sana in corpore sano*—are identical."

The consequences which we have just noticed as arising from the erroneous system of education in the schools for boys, prevail in a greater degree, and are productive of more injury in female boarding-schools. If the plans pursued at many of these establishments were intended to injure the health of the pupils, they could not be better contrived to effect that purpose. The prevailing system of female education is indeed fraught with most pernicious consequences;—at a period of life when the development of the physical constitution demands the most judicious management, young girls are sent to schools in which no other object appears to claim consideration than the amount of mental improvement, or rather the variety of accomplishments with which they can be stored. At an early hour in the morning the pupil is set down at the piano or the drawing-table, where she remains in a constrained position, often in a cold room, till the whole frame, and more especially the lower extremities, become chilled:—the brief relaxation during the short space allowed for meals and the formal walk, are insufficient to restore the natural warmth of the system; and it often happens that girls are allowed to retire to their room at bedtime with their feet so chilled as frequently to prevent sleep for hours. Those who are acquainted with the boarding-schools of this country will allow that this is no exaggerated picture of many of them. A delicate girl submitted to such a regimen cannot escape disease.

While school-boys have the advantage of a play-ground, or enjoy their recreation at pleasure in the open fields, the unfortunate inmates of a female boarding-school are only permitted to walk along the footpaths in pairs in stiff and monotonous formality, resembling, as Beddoes justly remarks, a funeral procession, and wanting nothing to funeral melancholy but sables and the hearse. The consequence is, that the muscles of the upper extremities and those which are chiefly concerned in the support of the trunk are rarely called into active play; they do not acquire strength as the body increases in stature; they remain weak and unequal to the task of supporting the trunk in the erect posture. A curved state of the spine is generally the consequence; and this, by altering the position and form of the thorax, renders the respiratory movements imperfect; the capacity of the chest is diminished, and the lungs are consequently more liable to congestion, and the diseases which are its consequences.

While the natural form of the body is thus destroyed, the derangement of the general health is manifested by the paleness of the countenance, the dry and coarse appearance of the skin, costive bowels, and cold extremities. In short, all the requisites for the production of struma may be found in a large proportion of female boarding-schools, where the system we have described is pursued.

There are many exceptions to this system of boarding-school education, and the number would no doubt be considerably increased if the conductors of such schools were aware of half the misery they inflict on the young committed to their charge. In the establishments to which we allude, as being conducted on different principles, the cultivation of the mind and the acquirement of the various female accomplishments are not the only objects of pursuit; the health of the girls forms, as it ought, the first and paramount consideration.

The time devoted to study by the present system should be greatly abridged, and that allowed for exercise augmented in proportion. The situation and construction of the school should be free from all the objections which we have already pointed out, and the exercise should be such as to call into action every muscle of the body in succession. The clothing during the winter must be warm, and every means should be adopted to guard against coldness of the extremities. The pupils should not be allowed to sit so long at one time as to induce this state, nor to go to bed with chilled feet. Were we to select any one circumstance more injurious than another to the health of young girls, it would be cold extremities, the consequence of want of active exercise and the prevailing and most pernicious habit of wearing thin shoes while in the house. A warm bath should form a necessary appendage to every boarding-school, and every girl should enjoy the benefit of it occasionally. A large, lofty, and well-ventilated room should be set apart for the express purpose of exercise, when the weather is such as to prevent it in the open air. We believe that a system of gymnastics is quite as necessary in the schools for girls as they are in those for boys; and, although they need not be carried so far as in the latter, they should be sufficiently varied to give free exercise to the trunk and arms, so as to expand the chest and strengthen the back. If the girl has any tendency to curvature of the spine, those exercises which are employed to cure this deformity should constitute a part of the daily gymnastics. To the room devoted to these exercises, the younger girls should be allowed to retire for a short time during the usual hours of school, and amuse themselves at pleasure. This latter recreation we consider of the utmost importance: it must nevertheless be understood that no exercise is to be considered a substitute for that which is enjoyed in the open air: and for this reason every female boarding-school ought to have a play-

ground, where the pupils may choose their own amusements, and play without restraint.

It is almost unnecessary for us to observe that all tight-dressing is utterly incompatible with the extent and variety of exercise which we recommend, and must therefore be discarded. The idea that young females require stays as a means of support is admitted by all medical men to be most erroneous, and only tends to perpetuate a practice which is productive of much evil and frequent deformity; especially at that unfortunate era, when, as Dr. Beddoes remarks, "the girl is taken up to be manufactured into a lady." If girls were properly exercised in the open air, and strengthened by the various means which are within the reach of all, and which nature points out to us as best, stays would not be necessary before the body is fully matured, and would even then be scarcely wanted.

The measures which we have suggested appear to us to be practicable, and could not fail to be productive of much good. We believe that if a judicious system of management were pursued in every boarding-school, the opprobrium which has so long attached to them would not only be removed, but they might be made the means of improving the general health of the pupils, and even of correcting the scrofulous constitution, and would thus become the source of much future happiness both to the children and their parents.

When we take a comprehensive retrospect of the nature and causes of consumption, the claim of this subject to our best attention will be fully apparent; and in urging it on the consideration of the profession, we would remind them that the most important object of physical education in this country, as Beddoes justly remarks, unquestionably is to guard against all tendency to consumption; and that it is only through their exertions that the desired improvements can be effected.*

Before we conclude these remarks on the education of youth, we would advert to the great and paramount importance of the choice of a profession. There may be some advantages, as our great moralist contends, in fixing a young person, from the first dawn of thought, in a determination to some state of life; but we consider that it is far more essential that the parent should pause in selecting a profession for his son before he has fully ascertained that his health and physical capacity are sufficient to sustain the duties inseparable from it. So little is this now considered, that the most unhappy results are very frequently produced by the ill-judged selection of professions without any regard to health.

III.—Prevention of the Disease in Youth.

The period of life which extends from youth to adult age, from about the eighteenth to the twenty-fifth year in males, and the sixteenth to the twenty-second in females, is one of great importance as regards persons predisposed to phthisis. If their health has suffered by mismanagement in education, or from other causes, during early youth, the system very often begins to show it about the period of puberty in a remarkable manner. The development of the body which should naturally take place at this epoch, and which in healthy persons is accompanied with an increase of strength and vigour in the system, is often delayed in such persons beyond the usual age, or imperfectly accomplished. If, therefore, they remain weak and thin, or look unhealthy after the period of puberty, they are in great danger of falling into tuberculous cachexia; this more especially happens in young persons who have been hard-worked at school, or kept much at sedentary occupations.

Under these circumstances, the utmost care will be necessary to prevent tuberculous disease. A strict inquiry should be made into the state of every function, and more especially of those connected with nutrition. The condition of the digestive organs and skin requires especial attention, because they are most commonly deranged: the tongue will very often be found furred; the alvine evacuations irregular; and the skin dry, harsh, and affected with eruptions, particularly with *acne* in its various forms:—in young females the catamenia will be found either to be imperfectly established, or not to have appeared. Such are the common symptoms presented to us in these cases, but they admit of considerable variety in different constitutions and temperaments.

The absolute necessity of attending to these early indications of tuberculous cachexia cannot be too strongly impressed by medical men upon the consideration of parents, in order to save the young persons to whom we allude. We have no doubt that a very large proportion of our youth who fall victims to phthisis from twenty to thirty years of age, might be saved by a timely adoption of the simple measures which we shall presently point out, and which are, in some degree, within the power and reach of all.

In the constitutions to which we allude, the pulse is generally feeble; the veins are largely developed; and the change in the balance between the arterial and venous circulation, which in others occurs only after the middle period of life, takes place in such persons before they have reached maturity, and hence we derive an explanation of many of their diseases. The chief object in our preventive treatment ought to be the maintenance of a healthy condition of the chylopoietic system, and an active state of the pulmonary and cutaneous functions; for which purpose very simple and available remedies are found beneficial: combined with these, warm bathing, frequent friction of the surface, exercise in the open air, and above all on horseback, along with a residence in a healthy part of the country, will often in a few months produce the most beneficial effects.

There is one kind of exercise which has not been sufficiently attended to in the prevention of pulmonary disease, but which deserves particular notice in this place; we mean the *exercise of the respiratory organs* themselves, and of all the muscles employed in the process of respiration:—the great object of this is to expand the chest and ensure the full action of the lungs.

* We would strongly recommend the careful perusal of Dr. Andrew Combe's excellent work on "The Principles of Physiology applied to the Preservation of Health, and to the improvement of Physical and Mental Education." It is far superior to any work of the kind that we have met with;—it ought to be familiar to every schoolmaster and schoolmistress, and cannot be too generally read.

Dr. Autenreith, of Tubingen, according to Sir Alexander Crichton, first recommended the practice of improving the narrow and contracted chest by deep and frequent inspirations. He advised his patients to place their hands upon some solid support, and to exercise themselves by taking repeated deep inspirations; but cautioned them against carrying this so far as to produce pain. (*Crichton*, op. cit. p. 137.) We are in the habit of recommending the full expansion of the chest in a manner somewhat different from that of Autenrieth; we desire the young person, while standing, to throw his arms and shoulders back, and, while in this position, to inhale slowly as much air as he can, and repeat this exercise at short intervals several times in succession: when this can be done in the open air, it is most desirable, a double advantage being thus obtained from the practice. Some exercise of this kind should be adopted daily by all young persons, more especially by those whose chests are narrow or deformed, and should be slowly and gradually increased. Fencing, the use of dumb-bells, and similar modes of exercising the arms, will also be eminently useful in attaining the important end we have in view; but they should never be carried so far as to induce fatigue or uneasiness. If regularly employed by boys under this necessary restriction, they would not merely expand the chest, but would tend to remove that disproportionate development of their upper and lower extremities which we so frequently observe in youth. By thus exercising the upper extremities and the muscles of the trunk, and inflating the lungs to their full extent, the chest and pulmonary organs will acquire their due proportions. We also consider exercises of this description particularly necessary to persons engaged in occupations which require a bent or stooping posture; and especially to those mechanics, as tailors and shoemakers, whose constrained position seldom allows the upper parts of the lungs to be fully expanded.

Reading aloud and public recitation will also, when prudently employed, be useful in strengthening the pulmonary and digestive organs, and in giving tone and power to the voice. The clear and distinct enunciation which is acquired only by long practice, is seldom found associated with pulmonary disease, and we are therefore inclined to commend the practice of recitation and elocution at schools. It would, we believe, be difficult to cite the example of any great orator who died of pulmonary disease, while many might be adduced whose health was improved and their life prolonged by the beneficial effects of this exercise. Cicero was disposed to phthisis in early life; and Cuvier attributed his exemption from pulmonary disease, to which he was expected to fall a sacrifice, to the increase of strength which his lungs acquired in the discharge of his duties as a public lecturer.

Many of the modes of exercising the pulmonary organs which we have just described will be equally useful to young females, although they will not require to be carried to so great an extent. We consider the ancient and well-known game of battledore and shuttlecock one of the very best exercises which can be adopted by them within doors.

Although we so highly approve of every judicious means of exercise, we would strongly condemn those which require excessive bodily exertion, such as climbing precipices, &c., and which have been sometimes recommended for the prevention of phthisis. These violent measures undoubtedly exercise the lungs, but they at the same time excite the action of the heart, and render it liable to be oppressed by the blood being suddenly forced upon it by the inordinate muscular exertion. We consider all such violent exertion fraught with danger: indeed we have met with several cases of diseased heart in young persons, apparently originating in forcible and long-continued exertion, as in boat-rowing, &c.

Of course, all these modes of exercise are quite incompatible with the existence of organic disease; it will therefore be incumbent on the medical attendant to ascertain the actual condition of the lungs before he recommends the adoption of any measures which would tend to aggravate the disease of which those now proposed are merely preventives.

There are also other rules relating to this important period of life, which the medical attendant will not fail to keep in mind in laying down directions for his patient; but these are so obvious that it is unnecessary for us to enter on them here.

[Some experiments on the influence of different agents in preventing the development of tubercles have been made by M. Coster, who has laid the details before the *Académie Royale de Médecine*, of Paris. He experimented upon dogs, rabbits, guinea-pigs, and fowls, which he subjected to the most injurious hygienic influences; and, to combat these, administered iron, baryta, iodine, bromine, mercury, and tannin. The agent, which always succeeded with him in the prevention of tubercles, was a ferruginous bread, composed of half a drachm of the subcarbonate of iron to a pound of bread. A quarter of a pound of the bread was taken in the day.

The writer is satisfied—and such he believes is the general feeling—that it is a great mistake to regard the tuberculous diathesis as sthenic and requiring depleting measures to prevent its development. It has been lately, indeed, affirmed by M. Paris (*Bulletin Général de Thérapeutique*, Sept. 1841,) that since the discovery of auscultation and percussion, the disease is in general more rapidly fatal. He attributes this to an early decided prognosis, which causes the patient to be put at once upon a medicated diet, by which the blood becomes sooner impoverished; for he regards the very essence of phthisis to consist in a poverty of nutritious principles in the blood,—that its character is chronic, and that its more irregular and rapid progress is owing to the employment of an antiphlogistic treatment, to a dietetic regimen, or to a milk and mucilaginous diet, producing a tone of the digestive organs, and also to the depression of the active moral sentiments. (Dr. James Black, cited in *Amer. Journ. of the Med. Sciences*, April, 1844, p. 448.)]

Remedial Measures.—We have already seen that it is about the period of puberty that phthisis so often occurs and tuberculous cachexia is established; this, therefore, will be the proper place to consider the utility of those remedies which have been adopted for the cure of this morbid state of

the constitution and for the prevention of phthisis. The utility, however, of these remedies is not confined to this period of life; they may be employed at any age, almost from infancy, when the circumstances of the patient indicate their use; and some of them, although ranked among preventives, are often applicable in the early stages of phthisis.

1. *Alteratives.*—We first notice this important class of remedies, both on account of their very general employment, and their beneficial effect on the health.

The remedies which we shall notice under this head are Mercury, Taraxacum, Sarsaparilla, Antimony, Sulphur, Mineral Waters, Alkalies, Lime-water, and the Muriates of Lime and of Barytes.

Mercury.—The influence of this medicine on the secreting functions of the liver renders it, when properly administered, a very valuable remedy in the tuberculous constitution: but if, on the other hand, it be carried beyond its alterative effect on the hepatic system, it seldom fails to prove injurious: it requires, therefore, to be administered with great caution to persons of a tuberculous constitution. We give the preference to its milder preparations, such as the hydrargyrum cum cretâ: this, or the pilula hydrargyri, given in such doses and at such intervals as shall prevent its producing irritation of the mucous surfaces of the alimentary canal, and followed by the employment of some gentle laxative, will be very useful in all those cases in which an imperfect biliary secretion and a torpid state of the bowels are prominent symptoms. It is usually, and we think very properly, prescribed in combination with some narcotic medicine, such as hyoscyamus or conium; and in our opinion it should always be followed by an aperient. Dr. Wilson Philip has recommended mercurial alteratives in small doses for the cure of hepatic congestion in a species of phthisis which he considers to originate in dyspepsia. We have already stated our opinion on this form of disease, but entertain no doubt of the existence of the hepatic congestion as a precursor of tuberculous disease of the lungs. In such cases, a judicious employment of mercurial alteratives with aperients, and a well-regulated diet, may relieve the abdominal plethora, and thus remove congestion of the lungs. Although we cannot adopt Dr. Philip's views respecting the mode in which hepatic disease is communicated to the lungs, we agree with him that minute alterative doses of mercury, if used with judgment and discretion, may often produce the most salutary effects in threatened or incipient phthisis.* Beyond this stage the practice can only be palliative; although it may afford relief, it cannot cure tuberculous disease of the lungs, and unless employed with much discretion, may be productive of mischief.

Taraxacum.—We consider this a very valuable medicine in tuberculous constitutions, from its power of diminishing abdominal plethora, and its especial influence on the urinary and biliary secretions. Hufeland strongly recommends taraxacum every spring in the treatment of scrofula, and the translator of his work regards it as an efficacious remedy in the mesenteric disease of infants, and in the congestions of the abdominal viscera which are the consequences of intermittent fevers; he also cites Zimmerman's opinion that it is the best remedy for the dispersion of pulmonary tubercles.† Kaempf and his followers made extensive use of taraxacum in the form of enemata in almost all the chronic diseases of the abdomen, and with great success, if we may judge from the reputation which their method of treatment acquired. (Op. cit. See our sect. on *Pathology*, p. 324.)

After a few doses of mercurial alteratives, a course of taraxacum, steadily pursued for several weeks during the spring or summer, will often produce a very beneficial effect. The expressed juice is the form in which it is usually given on the continent, where it is considered infinitely superior to every other preparation of the plant, and we think that it deserves a preference when it can be procured. The extract, however, when well prepared, contains, we believe, the virtues of the plant, and is more readily taken than either the expressed juice or the decoction. We usually prescribe it in combination with some tincture of hops and aromatic water, and in this form we find no difficulty in getting children to take it for many weeks. The bowels require attention, and an occasional laxative will generally be beneficial in all cases during its use.

Sarsaparilla. — Although the powers of this medicine have been very differently estimated, and the cases in which it is most beneficial are by no means well ascertained, it has been long used as an alterative. We have frequently found it of service after a course of mercurials or taraxacum, but we think its effects are less salutary when the internal secretions have not been previously improved. Its influence on the skin is most evident, and it is in a defective state of the cutaneous functions that we prescribe it with the greatest expectation of benefit. In a dry harsh condition of the skin, with a disposition to eruptive affections of the slighter kind, a course of sarsaparilla combined with warm bathing seldom fails to produce benefit. We are of opinion that it should always be given after a course of mercurial alteratives; and being a mild medicine, it may, if administered in such doses as will not oppress the stomach, be prescribed to the most delicate patients. The infusion of the root in distilled or lime-water is the preparation we usually prefer.

Antimony has been much extolled for its alterative powers. The once-celebrated anti-hectic of Poterius consisted of oxide of antimony and tin. Hufeland has the highest opinion of antimony in correcting the strumous diathesis. (Op. cit. p. 166.) We have not often administered its preparations alone as alteratives, but very frequently in combination with other medicines of the same class, more particularly with mercury, and occasionally with sarsaparilla. When a disposition to fever with a dry hot skin, or bronchial irritation, exists, we consider antimony a valuable addition to any mild alterative which may be suited to the case.

Sulphur.—The great frequency of cutaneous

* For the effects and mode of employing minute doses of mercury, we refer to Dr. W. Philip's work "On Indigestion," and his more recent work "On the Influence of Minute Doses of Mercury," &c., 1834.

† Traité de la Maladie Scrophuleuse. Traduit et accompagné des Notes par J. B. Bousquet, p. 275, et seq.

affections in strumous constitutions has led to the use of sulphur, and we regard it as a valuable remedy in many cases. We have the authority of Bordeu for the powerful effects of the sulphureous waters of the Pyrenees in the cure of scrofula; and in some forms of strumous diseases we have a high opinion of them. In the cases to which we allude, the skin is coarse and dry, and the whole constitution is of a torpid character; but in the more delicate class of strumous patients with a thin skin, the use of sulphurous waters requires much caution.

We consider the mineral waters of this class the best form of administering sulphur; bathing should generally be combined with their internal use; and when the water does not act on the bowels, they should be kept open by laxatives. Bordeu combined mercurial frictions with the sulphurous waters of Barège; but this is unnecessary when the patient has been properly prepared for the operation of the waters by a course of mercurial or vegetable alteratives, which, if not always necessary, will very generally be useful, and render the course of sulphurous waters more effectual.

Mineral waters.—We consider mineral waters superior in efficacy to all other alterative medicines.

The operation of these invaluable remedies may be so directed as to promote all the secretions and excretions, to influence the functions of almost every organ, and improve the condition of the circulating fluids. In strumous habits, affected with great abdominal plethora, a defective state of the biliary secretion and an unhealthy state of the skin, &c., no remedy with which we are acquainted is so well calculated to produce a full alterative effect on the whole system as a well-directed course of mineral waters, combined with warm bathing. They are not, however, suited to every person of the strumous constitution. In the class of cases we have just described, the advantage of them is at once apparent; but in young persons of an excitable temperament, their operation, even though they be of the mildest kind, will scarcely be borne with impunity. The waters of this class in which we have the greatest confidence, and from which we have observed the most marked benefit, are those of Ems, of Carlsbad, of Marienbad, and Eger.

The purer chalybeate waters have also been esteemed valuable remedies in correcting the scrofulous constitution. Morton considered them the most useful of all preventives of phthisis, and he states that he has seen some cases of evident consumption perfectly cured by the use of these waters, "et sine ullâ recidivatione redditos:" he also found them of great utility in chronic cases of phthisis accompanied with hæmoptysis, when taken daily for a long time in small quantities. (Op. citat. lib. ii. cap. ii. et. ix. lib. iii. cap. v.)

It would be encroaching on another department of this work to go further into detail on the subject of these remedies; but we cannot conclude these few observations without expressing our belief, that when the powerful influence of mineral waters over the extensive class of diseases which have their origin in abdominal plethora and deficient excretion, together with the mode of exhibiting them, is more generally understood, they will be more frequently employed and more fully appreciated.*

Alkalies.—This class of medicines has often been employed as alteratives in the treatment of scrofulous diseases, and chiefly with the view of correcting the constitutional diathesis. The theory which gave rise to the employment of alkalies, namely, that acidity was the chief cause of scrofula, is now exploded; still these remedies are held in considerable repute and are unquestionably useful.

The fixed alkalies are mostly used in this country, the liquor potassæ, the carbonates of potass and of soda being the forms in which they are chiefly used. The mode in which they act is not well understood; they evidently increase the urinary, and appear to have some influence in promoting the bilious secretion, and in rendering that of the mucous membranes more fluid. Their alterative action on the skin is also evinced by their abating cutaneous irritation; and the effects of the liquor potassæ in correcting the disposition to boils is very remarkable. But, whatever be their mode of operation, they are certainly beneficial in many tuberculous affections; they also form valuable adjuncts to purgative medicines.

[Very recently alkalies have been highly extolled by Dr. J. S. Campbell. He recommends the liquor potassæ in the dose of f.ʒss. to f.ʒi. three or four times a day, in milk or water,—care being taken, that no medicine, which might convert it into a salt, is prescribed simultaneously, and that it is persevered in for a long time.

Of late, naphtha has been brought forward by Dr. John Hastings, on faulty chemical considerations (*Pulmonary consumption successfully treated by naphtha*, Lond. 1843. See, also, D. Wilson, *London Lancet*, June 3, 1843, and *Lond. Med. Gaz.* Nov. 17, 1843; or Braithwaite's Retrospect, Pt. viii. p. 47, and Pt. ix. p. 33.) He prescribes it in doses of fifteen drops, three times a day, for an adult, mixed with a table-spoonful of water; after the second or third day, the dose is augmented by about one-fourth, regulating its increase or decrease according to the increase or decrease of nausea, vomiting, or any other untoward symptom referable to its use. As the writer has expressed elsewhere, (*Practice of Medicine*, 2d edit. i. 373, Philad. 1844,) it will probably rank as a revellent with codliver oil. A hope can scarcely be indulged that it will be capable of accomplishing more.]

Lime-water has been long held in estimation: Morton prescribed it in combination with the decoction of sarsaparilla; Hufeland, also, speaks in high terms of its efficacy in glandular swellings, in mesenteric disease, and even in incipient tubercular phthisis. The muriates of lime and of baryta were likewise, at one time, in great repute in the treatment of scrofulous diseases, and are at present too much neglected.

* We are unwilling to quit this subject without calling the attention of our readers to the artificial mineral waters prepared at Brighton, and which supply an accurate imitation of the most esteemed waters of the north of Europe. At this well-conducted establishment an opportunity is given of varying the water according to the state of the patient,—the advantages of which are obvious.

We would here remark, that during the use of all the alteratives we have noticed, the *warm bath* will be productive of considerable benefit. By promoting a free circulation in the cutaneous vessels, it favours the action of those medicines which act specifically on the surface, relieves internal congestion, and thereby indirectly aids also the operation of those alterative remedies which exert their influence on the abdominal secretions.

2. *Purgatives.*—These medicines are chiefly useful in obviating constipation, or in promoting the operation of alteratives; but their employment in the tuberculous subject must be regulated by certain restrictions.

In a torpid state of the bowels with little disposition to irritation of the alimentary canal, active purgatives may be occasionally useful; but we beg to enter our protest against the indiscriminate practice of active purging which still prevails too generally in the early stages of tuberculous disease. It is lamentable to observe the injurious effects of this practice in the debility which it produces, and in the irritation which it establishes in the mucous surfaces.

Although we consider abdominal congestion as forming so important a part in the pathology of tuberculous diseases, we regard the frequent repetition of harsh purgatives as the worst possible means of remedying it: a single dose or two of cathartics often gives relief by the copious discharge which is excited from the liver and mucous surfaces; but their frequent repetition never fails to do injury. Entertaining these views respecting the action of purgatives, we read with much pleasure the strong opinion of Dr. Stokes of Dublin, a valuable contributor to this work, on the same subject. Speaking of the influence of gastro-enteric disease in accelerating the fatal termination of phthisis, he says, "I feel satisfied, that under a different mode of treatment from that ordinarily employed, this complication would be much less frequently observed; as in numerous instances I have known it to be induced clearly by the use of purgative medicines. If ever there was a case in which we should be cautious in giving medicines of this description, it is in incipient or threatened phthisis, on account of the great liability that exists to inflammation and ulceration of the digestive tube; yet, in all those cases, which, in conformity with the prejudice of the day, are supposed to arise from a *disordered state of the stomach—of the digestive apparatus—a depraved state of the biliary organs—atony of the chylopoietic viscera*, &c., &c., a set of terms invented to cloak ignorance, and conveying no single clear idea to the mind, this practice is constantly pursued—a diarrhœa is established, and the digestive apparatus becomes indeed disordered, more from the remedies than the disease." (Dublin Journal of Med. and Chem. Science, vol. ii. p. 59, 60.)

The very prevalent use of active doses of calomel and strong purgatives in delicate strumous children is productive of a degree of mischief which is not sufficiently known: the great error in the administering of such medicines is their excessive dose and too frequent repetition. Where they are given simply as laxatives, and their repetition is regulated according to the nature of the case, especially when a course of alterative medicine forms a part of the treatment, they may be made very useful in the correction of the strumous habit; but no class of remedies requires to be exhibited with more caution in young delicate persons of a strumous constitution.

3. *Tonics.*—In a disease in which debility is one of the principal features, it is not surprising that tonics should suggest themselves to the mind both of the medical attendant and the patient.

There are two periods during which this class of remedies proves useful;—the first, that which precedes the local deposition of tuberculous matter; the second, the advanced stage of pulmonary disease, when the debility and exhaustion are great. In this latter period in particular, tonics often afford great temporary support.

Chalybeates have an excellent effect in some young persons of a tuberculous constitution. In those who have a languid circulation, a soft relaxed state of muscle, and a pale bloodless appearance, they are superior to every other remedy with which we are acquainted; but the indiscriminate exhibition of them in all cases of debility is productive of much mischief. Before benefit can be derived from chalybeates, the digestive organs must be free from irritation; otherwise they will generally do harm, however great may be the debility attending such a state. When such derangement of the digestive organs prevails, proper antiphlogistic measures will be necessary to render chalybeates admissible; and if the case in other respects does not contra-indicate their use, they may then be exhibited with great benefit. But we repeat, that the indiscriminate manner in which the preparations of iron are too commonly prescribed in all cases of scrofula and debility is productive of more injury than is usually imagined: although they may give a temporary support to the system, they will not fail, when injudiciously employed, to confirm the functional derangement, which it should be our first object to remove.

In the advanced stages of phthisis, when the expectoration is copious and the patient is greatly debilitated, without suffering much from gastric irritation or fever, we have seen remarkable effects from sulphate of iron in improving the patient's strength, and abating the expectoration; these were the cases in which Griffith observed so much benefit from his celebrated steel and myrrh mixture. The vegetable tonics are also useful at this period. The sulphate of quinine in small doses, either alone or combined with sulphuric acid, forms one of the best medicines of this class.

4. *Bathing.*—As a means of giving tone to the system, and enabling it to bear the vicissitudes of climate, the *Cold Bath* forms a very valuable remedy. We would strongly recommend that it should be used by children and young persons of a scrofulous constitution during the summer, as one of the best tonics they can employ. Sea-water is to be preferred when it can be obtained, and the air of the coast forms no unimportant part of the benefit which is generally experienced from a course of sea-bathing. The same remarks apply to the cold bath as to internal tonics;—unless the functions of the internal organs are in a healthy state, little advantage will be derived from it. It is always necessary, therefore, before pre-

scribing this remedy, to ascertain that the digestive functions in particular are well performed; and when there are strong indications of abdominal congestion, or a dry harsh state of the skin, it will be proper to employ the warm bath as a preliminary measure. But notwithstanding these precautions, there are some children who cannot bear the shock of the cold bath, and are positively injured by it; hence its effects on children must be closely watched. Unless it is succeeded by a glow, a feeling of increased strength, and a keen appetite, it will do no good, and ought to be at once abandoned, and the warm or tepid sea-water bath substituted.

Delicate persons who cannot bear the cold plunge or shower-bath, will often derive great benefit from having the body rapidly sponged with cold water. This is particularly serviceable to young children, and should in all cases be succeeded by friction over the whole surface. The practice of sponging the chest with sea-water or salt and water daily is also highly useful, and should generally be adopted by delicate persons throughout the whole year. It is a powerful tonic, and a most effective means of diminishing the susceptibility to the impressions of cold.

While on the subject of cold bathing, we must not omit to notice the beneficial effects of *swimming*. When accompanied with this invigorating exercise, the cold bath becomes doubly serviceable. Every boy, as Locke recommends, ought to be taught smimming as a part of his education. The Romans attached so much importance to it, that not to be versed in the art was considered by them as great a reproach as ignorance of reading; *nec literas didicit, nec natare.*

In very delicate children much more benefit will be derived from the tepid than the cold bath. It is, in truth, to them what the latter is to the more robust. The powers of warm and tepid bathing in the treatment of scrofulous children are not sufficiently valued. One of the most powerful means which we possess of relieving abdominal congestion, improving the functions of their skin, and giving tone and vigour to their whole system, is a course of warm sea-bathing, with active friction over the whole surface after each bath; the temperature of the bath towards the termination of the course being gradually reduced till it becomes tepid. The opinion that warm baths generally relax, is erroneous; they are no doubt debilitating when used by persons of a weak and relaxed constitution, or when continued too long, but on the contrary they invariably give tone when employed in the cases to which they are properly applicable. We have already remarked that warm bathing greatly promotes the action of alterative medicines; these two remedies should therefore be combined, when possible.

Of medicated baths we have had no practical experience: common salt and the carbonate of soda are the only substances which we have used in this way, and from both we have observed good effects. Baths of malt, of bark, of hemlock, and other substances supposed to have specific effects, have been particularly mentioned by foreign authors. Hufeland states that he has seen surprising benefit derived from hemlock baths, repeated daily for weeks, in removing glandular swellings, cicatrizing ulcers, &c.; and he considers bark and other astringents, when employed in this way, much more useful than when administered internally.

The excellent article Bathing is so full of information, and lays down such judicious rules on the employment of baths generally, that we consider it unnecessary to enter further upon the subject.

5. *Travelling, Sailing, Climate.* — These are valuable means of improving the health of persons of a tuberculous constitution; and when no local disorder exists to prevent their beneficial influence on the system, they may be made powerful remedies for correcting the disposition to tuberculous disease. But these measures must be used for a long period; a residence for a few months only in the finest climate, or travelling under the most favourable circumstances, cannot be expected to do much in correcting a constitutional disorder which may have existed from birth. Their positive advantages also will depend upon their being adapted to the circumstances of the individual case, and upon a strict attention to those regulations respecting regimen, exercise, &c., which are deemed proper; for neither these nor any other measures which act on the system generally will prove of much permanent benefit, unless those local derangements which almost invariably exist in the scrofulous constitution are removed before they are adopted. It is from a want of due consideration of these circumstances, and from an over-confidence in the unaided effects of the measures to which we have alluded, that so little benefit is often derived from them.

When proper regard is paid to all the circumstances of the patient, and the measure is adopted with the necessary precautions, travelling will be attended with many advantages. Independently of its physical effects, the change of scene and the constant succession of new objects presented to the young traveller, exerts a direct and most beneficial influence on the mental constitution; the mind is thereby engaged, the nervous system is soothed, and a just harmony is established between the various functions of the whole economy. If he happens to be fond of natural scenery, or to take delight in the practical pursuit of any branch of natural history, the beneficial effects of a residence in a mild climate may be much augmented. For this reason we think that a taste for botany, geology, and similar pursuits, which necessarily induce the invalid to take exercise in the open air, should always be encouraged in young persons of a delicate constitution; the study of marine botany and of the various branches of zoology which can only be pursued on the sea-shore, also contributes greatly, when used with proper precautions, to amend the health.

When more distant journeys or voyages cannot be accomplished, short and repeated voyages and excursions, within the limits of our own country, may be made beneficial during the continuance of mild weather. It is chiefly with the view of avoiding the winter that foreign residence is recommended; but this will be more fully considered when we treat of the effects of climate in incipient phthisis.

Sect. XIII.—Treatment of Phthisis.

In entering upon the consideration of the treatment, with a view to lay down rules for its application to the different stages of phthisis, we beg to refer the reader to a former part of this article, in which the disordered states preceding and accompanying the local deposition of tuberculous matter are fully described. We have there endeavoured to pourtray the characteristic features of the tuberculous constitution, and we would now simply observe, that a familiar acquaintance with these is of the first importance to the practitioner, inasmuch as they will assist him greatly in forming a correct judgment of the case, more especially when the signs of local disease are equivocal or obscure. The condition of those organs and functions which are more immediately connected with nutrition claims our particular attention, for it seldom happens that they do not manifest evident derangement; and when such derangement exists, we may feel assured that we shall make little progress in the treatment of the pulmonary affection until it is removed or corrected. There is, no doubt, considerable variety in the manner in which the digestive organs are disordered in tuberculous persons, depending in a great measure on the nature of the causes which have induced such disorder. But there is one prevailing form in which the dyspeptic symptoms have their origin, and which we have already noticed in describing the tuberculous constitution, and referred, for a more full account of it, to the article Indigestion, *Strumous Dyspepsia*. We may, however, observe, that as we consider it to depend on congestion of the whole abdominal venous system and on an irritated state of the mucous surfaces, it will, we believe, be remedied by whatever allays irritation, promotes the various secretions and excretions of the chylopoietic viscera, and induces a more active state of the cutaneous circulation. But these remedial measures, as well as all others which are applicable to the treatment of incipient phthisis, require to be modified according to the predominance of particular symptoms. Thus, in some cases, the disorder of the digestive organs, in others the morbid state of the skin, is the most prominent derangement:—again, in some there is a torpid and inactive condition of the whole system, with a languid circulation and deficient nervous sensibility, while in others the converse of all these prevails. Hence it is apparent that the treatment must be varied to meet the circumstances of each case, although the principles upon which it is conducted are the same, and the same general objects are to be attained in all.

The most efficient general means of correcting the tuberculous constitution and removing functional derangement, have been described in the last section; we shall, therefore, proceed to consider those measures which have been thought to possess particular powers in the cure of phthisis.

1. **General Remedies.**—It would far exceed the proper limits of this article to enter into an account of all the remedies which have been at various times extolled as capable of curing phthisis. The greater number of them had their origin in empiricism; and although they obtained some renown in their day from the credulity of the public, they were, in general, found utterly inadequate to accomplish the cures promised by the ignorant or deceitful pretenders who introduced them. Passing over, therefore, a long list of nostrums which have justly been banished from modern practice, we shall merely notice those remedies whose beneficial effects are tolerably established, either in the treatment of the disease generally, or in the relief of particular symptoms.

1. *Bloodletting.*—Small and frequently-repeated bleedings have been recommended by various authors as a means of curing incipient phthisis. Morton employed bleeding in the early stages of the disease and for the prevention of hæmoptysis, to the extent of from six to ten ounces, and repeated it two or three times at proper intervals, when its repetition was indicated. He considered that it was not only ill adapted, but positively destructive in the confirmed stage of phthisis; but when employed in due season, and aided by the judicious exhibition of other necessary remedies, it was most successful in guarding against inflammation, congestion, and subsequent ulceration of the lungs, and even phthisis itself, with cough, dyspnœa, and its other train of fearful symptoms. (Op. cit. lib. ii. ch. 2.) But the practice of repeated bleedings was first brought into general notice in this country by Dovar, whose extravagant partiality for the remedy, and excessive employment of it, probably led to its unmerited disuse. His plan was to bleed to the amount of six or eight ounces every day for the first fortnight, and gradually to increase the period between each repetition of the measure by employing it at the respective intervals of every second, third, and fifth day for the three successive fortnights. (The Ancient Physician's Legacy to his Country, by Thomas Dovar, M. D. p. 26, Lond. 1733.) Mead speaks strongly in favour of the same practice;—"I have seen cases," he says, "judged almost desperate, where this method of practice succeeded well." (Monita et Præcepta Med. c. i. s. x.) Sir John Pringle says, "In the first stage of a consumption, when the patient complains of pains in his side, constriction at the breast, or hot and restless nights, I have trusted most to small and repeated bleedings: the quantity of blood drawn was from four to seven or eight ounces, once in eight or ten days; and sometimes a vein was opened after shorter intervals." (Observations on the Diseases of the Army, part iii. ch. 3.) Dr. Monro says that the plan of "taking away from four to eight ounces of blood whenever the pain of the breast was troublesome, or the patient was hot and restless at nights from the hectic fever, gave the greatest relief of anything we tried; and these repeated small bleedings were so far from wasting the patient's strength, that they rather seemed to prevent its being exhausted so fast as otherwise it would have been, by allaying the force of the hectic fever." (Account of the Diseases in the British Military Hospitals in Germany, &c. p. 131.) It is to be recollected that Pringle and Monro were army-physicians, and that their patients were more likely to require and derive advantage from bleeding than the generality of consumptive patients in private life. Fothergill always found benefit from repeated venesection, except in delicate constitutions; and

Stoll considered it the best remedy that could be employed. More recently several physicians have spoken favourably of the practice of bloodletting. Dr. Hosack of New York states that he has "in many instances employed it with the most happy effect in incipient phthisis, even when strong hereditary predisposition existed." (American Med. and Philos. Register, vol. ii. p. 470.) Dr. Cheyne of Dublin has also lately written a paper in which he gives a very favourable opinion of this practice in hæmoptysis, and also in incipient pulmonary phthisis: in both of which he states that "these small bleedings may be practised with safety, and often, if I mistake not, with more advantage than any other remedy in use." (Dublin Hospital Reports, vol. v. p. 351 et seq.) Dr. Cheyne's view in adopting this practice is to subdue the inflammatory state of the lungs produced by the irritation of tubercles, and to arrest the progress of the disease in its early stage: he employs small bleedings once every week or ten days in those cases which he conceived to be incipient phthisis, "and with a degree of success which forbids the relinquishment of that practice."

The greater number of the advocates of this practice evidently adopted it not only after tuberculous disease of the lungs had taken place, but after this had become complicated with inflammation. Before the disease has advanced thus far, the circumstance which calls chiefly for venesection is pulmonary congestion. In this case a moderate bleeding will always, we believe, be useful; and when employed as soon as the congestion is evident, will often prevent hemorrhage and inflammation, and perhaps the deposition of tuberculous matter. When the patient has been subject to natural discharges of blood from the nose or otherwise, bloodletting is the more necessary. It rarely happens, we believe, that general bleeding requires to be frequently repeated if the patient be put upon a proper regimen, and the necessary remedies are employed to diminish abdominal plethora. When it is frequently repeated, the quantity abstracted should be diminished each time, and the intervals increased.

We have a high opinion of the beneficial effects of Local Bleeding in cases of this kind, and we believe that the abstraction of small quantities of blood from the chest by cupping will be the most effectual way of relieving the inflammatory action which accompanies tuberculous disease of the lungs, after congestion of the large vessels has been diminished by one or more general bleedings.

2. *Emetics.*—The effects of emetics appear to be so important, and their utility in pulmonary diseases has been so highly commended by some of our best practical writers, that we think it proper to devote some space to the consideration of the practice.

From an early period in the history of medicine, emetics have been employed in the treatment of phthisis; and, although they were prescribed with various views by different practitioners, their beneficial effects when judiciously exhibited have been generally acknowledged. Some considered them chiefly useful in unloading the stomach and biliary system; some used them as the means of suppressing pulmonary hemorrhage and inflammation; while others regarded them as capable of curing phthisis in its early stages. It is our present purpose to examine the grounds upon which this last opinion rests.

We have the positive testimony of several practical physicians in favour of the remarkable benefit derived from the use of gentle emetics repeated at short intervals during the early stages of tubercular phthisis. Morton states that after bleeding they are of great utility in the cure of this disease, and that they will often check it in its early stages; the opinion of this eminent physician is so clearly and strongly expressed that we shall give it in his own words: "A quâ vomitione non tantùm ventriculus humorum saburrâ oppressus relevari, et nausea inde nata tolli, et digestio restitui possint, (quæ omnia non sunt flocci habenda,) verùm etiam moles humorum jam pulmonibus impactorum, harum partium exagitatione inter vomendum, insignitèr expectorari solet, unà cum notabili relevatione ponderis gravativi à molè istâ effecti. Atque hoc ritu non tantùm *plurimos empiricos* vidi, cum successu felici, sese omnem incipientem phthisin curaturos gloriari, verùm etiam ipse ego ratione et experientiâ fretus sæpissimè phthiseos incipientis progressum, eodem modo, brevi temporis spatio, præpedivi." (Op. cit. lib. ii. cap. viii.) Again, in regard to cases complicated with hysteria and hypochondriasis, he says, "vomitoria verò lenia, et ægri viribus æqualia, opitulando cerebro et nervis, in principio morbi, instar miraculi hujusmodi phthisicos relevare solent." (Ibid. lib. iii. cap. iv.) Since Morton's time, emetics have been recommended by several eminent physicians; Dr. Simmons warmly advocates their use, and lays down some excellent directions for their employment; he believed that "the earlier in the disease they are had recourse to, the more likely they will be to do good, and the less likely to do harm." (Pract. Obs. on the Treatment of Consumption, p. 67.) Dr. Parr says that "no remedy is so generally useful as a slight emetic frequently repeated; and could phthisis be ever cured, it would be by the joint action of emetics and blisters." (London Med. Dict. art. *Emetics.*) Dr. Bryan Robinson, (Observations on the Virtues and Operations of Medicines, 1752, p. 146, et seq.) Dr. Thomas Reid, (Essay on the Nature and Cure of the Phthisis Pulmonis, 1782), and Dr. Marryat, (Therapeutics, or, the Art of Healing, 1817, p. 45), have urged the employment of emetics in still more forcible language, and have fully confirmed by their own experience the value of the remedy in the early stages of phthisis. Dr. Dumas, of Montpellier, one of the translators of Dr. Reid's work, also cites several cases in corroboration of the practice; and more recently Bayle, a high authority, has mentioned emetics, frequently repeated, among the most valuable remedies in the early stages of phthisis.

The most recent experiments with emetics are those by Dr. Giovanni de Vittis, chief physician to the military hospitals of the Neapolitan army. In the military hospital at Capua, where the greater number of phthisical patients of the army are sent, antimonial emetics were tried in every case. From the 1st of May, 1828, to the 18th of January, 1832, there were sent out of the hos-

pital perfectly cured (perfettaments guariti) forty cases of *chronic catarrh*, forty-seven of *phthisis* in the first stage, one hundred and two in the second, and twenty-seven in the third, making a total of two hundred and sixteen cures, of which one hundred and seventy-six were cases of phthisis. The mode of treatment consisted in giving every morning and evening a table-spoonful of a solution containing three grains of tartarized antimony in five ounces of infusion of elder flowers, and one ounce of syrup. The patients were at the same time put upon a light farinaceous diet, composed chiefly of rice, chocolate, and biscuits. A second spoonful of the emetic mixture was given at the end of a quarter of an hour when the first dose did not produce vomiting. If it excited brisk purging, it was omitted for some days, and roasted ipecacuan and digitalis, which are said to produce wonderful effects in curing this diarrhœa, were administered in the proportion of one grain of the roasted ipecacuan powder to one of digitalis, and repeated every hour or oftener, until the diarrhœa ceased. We give this report from an Italian medical journal,* as we have not yet been able to procure Dr. Giovanni's work. Although we may be permitted to entertain doubts as to the validity of the cures, especially of those in the advanced stage, we cannot doubt that the practice must generally have produced very beneficial effects.

The extent to which vomiting was carried by the advocates of this practice surprises the practitioner of the present day. Robinson states the case of a consumptive patient, subject to repeated attacks of hæmoptysis, who was kept alive for eight years by taking three ipecacuan emetics every week during that period; Reid says that they may be taken every morning and evening with perfect safety for months; and Ritchter gives the case of a woman, aged forty, who took six hundred emetics in ten years. There can be no doubt that the physicians who employed emetics thus extensively were fully assured of the advantages which they produced, and their patients must have been equally sensible of the benefit derived from them, otherwise it is scarcely credible that a practice so disagreeable would have been prescribed, or persevered in, for so long a period. But if such marked effects were observed to follow the employment of this remedy, it may well excite surprise that it has been allowed to fall into disuse; for at present emetics are merely used as palliatives, and are by no means generally considered of importance in the cure of phthisis. Two causes may be adduced in explanation of this fact; the first, the disagreeable nature of the remedy; the second, the want of firmness and decision on the part of the physician in enforcing a practice, the value and operation of which he could not satisfactorily comprehend. If we can succeed in removing the latter objection by showing how emetics may be made the efficient means of preventing phthisis, the former difficulty will be easily overcome.

* Annali Universali di Medicini, Dicembre, 1832.—"Osservazioni ed esperienze sulla tis polmonare seguite da un metodo particolare per la cura di tal malattia; del dottor *Giovanni de Vittis*, primo medico degli Ospedali militari dell' armata di terra di S. M.—Napoli, 1832."

The minute researches of Dr. Carswell on the morbid anatomy of tubercle, have satisfied him that tuberculous matter is first deposited on the free surfaces of mucous membranes, such as the bronchial membrane in the lungs, and that of the biliary ducts in the liver. It is very probable, as Dr. Carswell remarks, that tuberculous matter is equally deposited, on the surfaces of all mucous membranes, but is speedily removed from many, such as the intestinal canal, by the constant action kept up in them by the passage of foreign substances; while the structure of the lungs is such as to favour the retention of the morbid deposit. For a full account of Dr. Carswell's views on this subject, see the article TUBERCLE; the clear manner in which he has there explained the cause of the more frequent occurrence of tuberculous matter in the lungs than in other organs, and in the upper lobes than in the other parts of the lungs, is so satisfactory, that it is unnecessary for us to enter more into the subject here.

The power of emetics in augmenting the bronchial secretion and ejecting it from the lungs is well established; and, therefore, we can easily conceive how the repeated action of emetics may prevent the deposition, or at least the accumulation, of tuberculous matter in the bronchial ramifications and air-cells, and thus prevent the *localization* of the disease, and give time for the correction of the constitutional disorder. In this manner, it is not improbable that a judicious use of emetics may prove a powerful means of preventing the deposition of tuberculous matter in the lungs.

We cheerfully acknowledge that our attention was first particularly directed to the benefit which may be derived from emetics in phthisis, by Dr. Carswell's researches into the primary seat of tubercle, and whatever advantage may be hereafter experienced from the adoption of the practice, the merit justly belongs to him. If the researches of this enlightened pathologist had led to no other result than the establishment of the important fact, that tuberculous matter is first deposited on mucous surfaces, and that it may be expelled from them in the way we have described, he would have conferred a great benefit on mankind.†

Although we regard the action of emetics on the pulmonary system as one of their most valuable effects, we are not disposed to limit their utility to this, but consider that their determining the circulation to the surface, and promoting the biliary secretion, constitute very important parts of their operation. They equalise the circulation, restore the secretions which are usually deficient in the tuberculous constitution, and tend to diminish abdominal congestion; hence emetics may be ranked, as Dr. Reid justly observes, among the most powerful alterative medicines which we possess.

Having said thus much on the subject of eme-

† We are aware that all morbid anatomists are not satisfied of the correctness of Dr. Carswell's views, and we have seen objections urged against them in the periodical press and otherwise: but the arguments which have been adduced have little weight with us, who know the minute and patient researches of Dr. Carswell, and the pure spirit of philosophical inquiry which directs them; and we hesitate not to predict, that the more thoroughly the subject is investigated, the more fully will his views be borne out and established.

tics and their operation, it is right to state that our own experience of the practice has not yet been very considerable; but we think we shall be held justified in earnestly calling the attention of the profession to it, as one which holds out to us the rational hope of being made one of the most efficient means of preventing the localization of tuberculous disease in the lungs in many cases, and perhaps of removing it in some others. For ourselves, we do not hesitate to say that, resting on the discovery of Dr. Carswell, and on the strong testimony of the respectable writers whose authority we have cited, we shall continue to avail ourselves of every fair occasion to put the practice to the test of experience. That it is a safe practice when adopted with discernment, we have abundant proof, even when it is carried to an extent which we deem unnecessary.

If the observations which we have made should bring into more general use the employment of gentle and frequent emetics in the early stage of phthisis, we trust that the measure will not be adopted without that judgment and circumspection which can alone render any active practice useful, or even safe. To have recourse at once to emetics in every instance of threatened phthisis, without fully inquiring into all the circumstances of the case, would be highly injudicious: we shall find, that although emetics may be freely given in one class of cases, they cannot be safely exhibited in another without preparing the patient for them by bleeding, purgatives, and proper antiphlogistic measures; and that in a third class, where gastric irritation is a prominent symptom, they may be altogether inadmissible. There is a state of the mucous membranes of the alimentary canal which frequently attends phthisis even in its earliest stages, and which we consider as strongly contra-indicating the use of emetics. We have already described this state in a former part of this article, but we may observe here that it is attended with the following symptoms: — the whole internal fauces are red, congested, and swollen, the posterior part of the pharynx, as far as the eye can reach, is also of a deep red, and often partially dry and shining; there is thirst, and generally epigastric tenderness on pressure, with redness of the tongue. We have at this moment two young patients in this state under observation, and although they are in the incipient stage of phthisis, we have not ventured to employ emetics, considering them dangerous when these symptoms are present. We would confine the use of ipecacuan in such cases to minute doses, with the view of promoting the secretion of the bronchial membrane.

When tuberculous matter is deposited in the lungs to any considerable extent, the case will require much more attention before the employment of emetics; the abstraction of blood, both generally and locally, and a discharge established over the part by blisters or other means, will be useful, and may be even necessary in many such cases, as preliminary measures, before emetics can be safely administered; and when there is a disposition to pulmonary inflammation, small doses of tartarized antimony, along with those remedies which favour a free secretion of the bronchial mucous membrane, may be employed with benefit, and, in some cases, may be preferable to actual vomiting. Alkalies have been considered valuable medicines in promoting the secretion of the mucous surfaces, and may, therefore, be advantageously prescribed during the use of emetics. In short, while recommending a cautious employment of emetics in the early stages of phthisis, we would not be understood to advise emetics alone, but merely that they should constitute a part of the treatment. The other remedial means which are adapted to the circumstances of the case must be employed at the same time: indeed, it is no small recommendation of the practice of emetics, that it need not interfere with the general treatment which may be considered most suitable to the condition of the patient.

The choice of emetics, the period of employing them, and the frequency with which they may be repeated, are not matters of indifference. Morton preferred and generally prescribed squills; that used by Marryat, and called by him the "dry emetic," consisted of one grain of tartar-emetic and three of ipecacuan, taken fasting, without drinking any liquids during its operation. When the diarrhœa was severe, his emetic consisted of four grains of ipecacuan and one of sulphate of copper. Reid preferred gentle doses of ipecacuan, sufficient to puke once or twice; and Simmons recommends sulphate of copper as superior to any other. We consider ipecacuan the safest and best emetic for repeated use; it is proper to give it so as to produce a very gentle effect, and we think a very small quantity of fluid only should be taken to promote its action. When the biliary system is much loaded, an antimonial emetic may be useful in the first instance, as it appears to possess more power than ipecacuan in promoting a free discharge of bile.

Morton thought it best to administer the emetic towards evening, and to repeat it every third or fourth day, three or four times, when the patient could bear it and its repetition was indicated. Simmons, Marryat, and Reid regarded the morning as the best time: and when it is considered that the bronchial secretions accumulate during sleep, there are certainly good reasons for coinciding in their opinion as a general rule; although circumstances may occur to render evening the proper time for the exhibition of the emetic: if given before going to bed, it may prevent fever and promote sleep in some cases.

Simmons began by administering emetics twice a week until the symptoms were relieved, and then repeated them every second day, or even every day, for several days together, with good effects. Marryat gave his dry emetic twice or thrice a week: Reid employed ipecacuan every morning, repeating it occasionally in the evening; and he says that this plan may be continued for several months with perfect safety. The repetition of the emetic must, in our opinion, be regulated according to the nature of the case. When it is given with the view of preventing the deposition of tuberculous matter, it may, perhaps, be sufficient to repeat it once or twice a week. When the case is more urgent, and the patient is threatened with the deposition of tuberculous matter in the lungs, or when the presence of this is already suspected, emetics may be much more frequently repeated:

but in all cases it will be necessary to watch their effects on the gastric system, and to suspend the use of them the moment they appear to excite irritation there. During the interval between the emetics, it may promote the end we have in view, to give ipecacuan, alkalies, and other medicines which have the effect of promoting the bronchial secretion, in minute alterative doses.

3. *Digitalis.*—There is not, perhaps, a medicine in the Materia Medica, concerning the virtues of which in phthisis medical writers have differed so much as digitalis; some regarding it as possessed of powers beyond all other remedies, others considering it to have very little efficacy, while a third class have even condemned it as pernicious. No better instance can, perhaps, be adduced of the difficulty of estimating the effects of a medicine. We find Dr. Beddoes affirming that, in general, when he had all possible evidence of the existence of tubercles, the exhibition of digitalis has been perfectly successful:—"If I specify," he adds, "that it has succeeded in three such cases out of five, I believe I much underrate the proportion of favourable events." (Essay on Consumption, p. 118.) Now it is not to be credited that Beddoes would have spoken of digitalis in such terms unless he had observed some very remarkable effects produced by it. At present we may be permitted to doubt his having all possible evidence of the existence of tuberculous disease of the lungs in many of his cases; yet, making due allowance for this, and for his warm imagination and sanguine character of mind, we cannot doubt that he experienced very beneficial effects from digitalis. Its utility in dropsy may afford us some explanation of its effects in abdominal and pulmonary congestion. But, whatever be its effects in phthisis, the medicine has wonderfully fallen in the estimation of the profession since the time of Beddoes; and it is now, we believe, only employed in hæmoptysis, or with the view of reducing increased action of the heart, and of thereby abating inflammation of the lungs and general excitement of the system.

A series of experiments has lately been made in Paris for the purpose of ascertaining the efficacy of digitalis, but they have not added much to our means of accurately estimating its virtues. Medical authors in general are agreed in regard to the power of this medicine in suppressing pulmonary hemorrhage, but differ greatly with respect to its influence in phthisis. We are ourselves equally unable to pronounce a decided opinion. Like several other remedies that have been loudly proclaimed almost as specifics in certain diseases, digitalis has failed to maintain, in the hands of others, the character with which it was introduced to notice by Drake, Beddoes, &c.; and we would require a series of careful observations to enable us to ascertain its real virtues.

Digitalis is evidently a medicine of great power, although it is quite clear that we are not yet acquainted with the peculiar circumstances under which it may be employed with advantage in phthisis. Of its powers in hæmoptysis there can be little doubt; it also possesses considerable efficacy in abating febrile excitement and excitability of the nervous system, and in regulating the action of the heart; hence, when phthisis is complicated with disease of this organ, it is a medicine of great utility.

4. *Iodine.*—The beneficial effects of iodine in scrofulous diseases have led to the belief that it might prove useful in phthisis; and several authors have recommended it in this disease. We have abundant testimony of the alterative powers of this medicine in various forms of scrofula, particularly in those affecting the skin and external glands.* We have experienced its good effects in scrofulous children, but have never used it in phthisis, although we think it very probable that when employed as an alterative it may prove a valuable remedy in correcting the tuberculous diathesis. Its action seems to be exerted chiefly on the nutritive functions, and its beneficial effects in some cases have been made apparent by the improved health of the patient while taking it. But the reverse of this has been too often the consequence of its imprudent employment, or its exhibition in cases to which it was not adapted.† In the recent work of Dr. Morton, an American physician, which has just been put into our hands, we find the strongest testimony in favour of iodine in phthisis that we have yet met with. He states that having used it extensively, he is able to express an unequivocal opinion respecting it. "In a large number of instances," says Dr. Morton, "it has appeared, especially in incipient consumption, to arrest or suspend the tubercular secretion, and with it the hectic, marasmus, cough, dyspnœa, and other urgent symptoms. There are some constitutions in which it does not appear to produce any obvious effects, either for better or worse; but in a majority of cases, even in the second stage of phthisis, I have been much gratified with the results. Thus it often relieves the dyspnœa, improves the complexion, and restores the appetite, even when the advanced progress of the disease precludes all hope of recovery. In some instances it has so obviously improved the nutritive function, that patients have increased in flesh by its use, and at the same time recovered, in a considerable degree, a naturally florid complexion." (Illustrations of Pulmonary Consumption, &c. by Samuel George Morton, M. D., Philad. 1834, p. 130–31.) Dr. Morton is physician to a public hospital, and seems to have had considerable experience. He prescribes the iodine in the form of a solution containing three grains of iodine, and six grains of hydriodate of potash in an ounce of distilled water, from three to five drops of which are given every morning, noon, and night.

The result of the experiments made with iodine in this country does not by any means correspond with that of Dr. Morton. Dr. Baron was, we believe, the first English physician who employed iodine in phthisis; he found good effects result from it in some cases, but whether more extensive subsequent experience has confirmed the favour-

* See the medical researches on the effects of iodine by Alexander Manson, M. D.; the experiments of Lugol, and the excellent report by M. Baudelocque in the Revue Médicale, already cited.

† For an account of the injurious effects of iodine when injudiciously employed, see Dr. Jahn's Report, "De la maladie iodique, ou des désordres qu'entraine à sa suite l'emploi trop long temps contin de l'iode." —Journ. Complément. tom. xxxv.

able anticipations which he formed of the effect of iodine in this disease, we are not aware. (Illustrations of the Enquiry respecting Tuberculous Diseases, p. 228, et seq.) Dr. Bardsley, in his excellent Hospital Reports, after stating the valuable effects of the medicine in scrofula, remarks, "It has been my aim to establish the *real virtues* of iodine in a tuberculous state of the lungs. In fifteen well-marked examples of incipient phthisis, I employed this medicine with a strict attention to its effects. In five instances, it appeared at first to arrest the further progress of the disease, but the amendment was only temporary, for the tubercles passed slowly but progressively through their several stages, and death was the consequence of the extensive disorganization which occurred in the lungs. (Hospital Facts and Observations, &c. p. 123.)

We are of opinion that this medicine, administered as an alterative, may prove highly useful, when we are better acquainted with its mode of operation and with the cases in which it is particularly indicated.

[The writer has used it to a considerable extent, especially in public practice, in the form of the iodureted iodide of potassium, which is as valuable a form as any; in that of the iodide of potassium; of the tincture of iodine; of the iodo-hydrargyrate of potassium, the iodides of mercury, &c.; but the most careful and accurate examination has not enabled him to say, that any beneficial effect was induced, which could be unhesitatingly referred to these preparations.

Codliver oil—*Oleum Jecoris Aselli*—which contains, it is affirmed, a minute quantity of iodine, and which has been highly extolled in scrofula, has been given in tuberculosis, and, it is asserted, with advantage. The dose, to an adult, is from half a spoonful to three spoonfuls, two or three times a day, in coffee or with lemon-juice, or in the form of emulsion. The writer has had no experience of its effects. It is extremely nauseous.]

5. *Climate.*—We have already entered so fully into this subject (see article CLIMATE), and have given such a particular account of the comparative merits of the various places resorted to by pulmonary invalids, that we have little to add here beyond the application of climate to the different stages of tuberculous disease.

a. Since the nature of phthisis has been more fully understood, the expectations from climate as a means of cure have greatly abated, and hence it is much more justly considered at the present time simply as a *preventive* of the disease. When adopted with this view, climate is certainly one of the most powerful remedies we possess for improving the tuberculous constitution, and enabling us to correct the predisposition to the disease. When, therefore, the tuberculous diathesis is strongly manifested, it is most desirable that this measure should be adopted in early life. Children and young persons of a tuberculous constitution, more especially those who suffer much from damp weather, and are very liable to catarrh in this country, escape this by a residence in a mild and drier climate; and by a continued residence therein for several successive winters, their constitution may be so much improved as to enable them to resist the influence of this season on their return. If we were to select the two periods of life at which such a change appears to be most beneficial, we should probably specify that between the third and seventh year, and again that towards the approach of puberty. If the health of the child from the third to the seventh year is maintained in a good state, he is then capable of taking more active exercise in the open air, and various means may be employed to strengthen his constitution, which are inadmissible at an earlier age. The period of puberty in persons of a tuberculous constitution is a very critical one; and a residence in a mild climate towards the approach of this important epoch will prove highly beneficial in favouring the full development of the body, and the establishment of those functions which are naturally called into action at this period of life.

But although a change of climate is attended with such decided benefit at the two ages we have here mentioned, no measure promises greater advantages at any time when tuberculous disease is threatened. One winter at this time spent in a mild climate will do more as a preventive of phthisis than several winters when the health is more disordered.

b. During the *Incipient Stage* of phthisis, that is, after tuberculous matter is deposited in the lungs, the power of climate is much less, and much more caution is necessary in prescribing it. A careful and minute examination of all the symptoms of the case is imperatively called for on the part of the medical attendant, before he recommends a measure necessarily attended by the excitement and exposures which are in some degree inseparable from a long journey or voyage. Proper preliminary means must be adopted to remove pulmonary congestion and bronchial irritation, when these exist, and to induce a healthy state of the functions of the chylopoietic viscera; in short, if due precautions are not taken to improve the local functional derangements before the patient leaves this country, the measure may prove highly injurious.

Even under the most favourable circumstances, change of climate ought only to be considered as a means of placing the patient in a more favourable position for adopting such measures as may be proper for his condition; those remedial means and those plans of treatment, which are required in his particular case during his residence at home, will in all probability be required in that to which he may migrate; but he will derive this additional advantage from the change, that those measures which would have availed him little in his own country, are likely to prove highly useful under the favourable influence of his new position. Hence it will be apparent that this change must not be allowed to interfere with the use of the various remedies which have been suggested in this and the preceding section.

c. In the *Advanced Stages* of phthisis, when tuberculous disease of the lungs exists to a considerable extent and hectic fever is established, change of climate will be of little avail, and will probably be prejudicial, unless adopted under very favourable circumstances. There are, notwithstanding, some chronic cases in which the measure may prove useful at any period of the disease, even when tuberculous cavities exist in the lungs:

we allude to those forms of the disease, already described, in which the tuberculous deposit is very limited, and passes through its various stages of softening, &c. without exciting much local or constitutional irritation.

But, at whatever period the change is adopted, it is of the highest importance to impress upon the mind of the patient and his friends, that if the measure is attended with favourable effects, it ought, in a large proportion of cases, to be continued for several successive years, in order to produce a full and permanent influence upon the constitution; and must at the same time be aided, as has been already remarked, by the adoption of such a regimen and the use of such remedies as are known to improve the general health and correct disordered functions.

d. Particular Climates. — A full account of the various places in the south of Europe, in the islands of the Northern Atlantic, and in our own country, which have been resorted to by invalids, will be found in the article CLIMATE; our remarks, therefore, in this place will be very general.

Of all climates with which we are acquainted, that of *Madeira* is the best for consumptive persons. We have every year an opportunity of becoming acquainted with its effects upon a considerable number of persons who repair to it in different conditions of health, and we see no reason to change the high opinion we have given of it in the article alluded to. The beneficial effects of a residence for one or two winters in Madeira have become much more apparent since the public have been impressed with the necessity of adopting change of climate rather as a preventive than as a means of cure. A few years ago, it was a matter of little moment to select a climate for the consumptive patient, because he was generally in the advanced stage of the disease, without hope of recovery, before the measure was proposed or adopted; and its fatal termination was not infrequently accelerated by the only means to which he looked for safety.

Dr. Renton's report of the effects of the climate of Madeira on the invalids who passed the last winter there has just reached us. The total number of pulmonary invalids who arrived there during the season of 1833–34 was 66. Of this number 15 died; 43 returned to their homes; and 8 still remain in the island. "Of the 15 fatal cases," says Dr. Renton, "13 ought not to have left their homes; of the 43 who left the island for England or other parts of the world, 36 were very much improved; indeed I may say a large majority of them went away *well*." The result was very different a few years since, when persons were only sent to Madeira in the advanced stage of the disease. (See the account of *Madeira* in our work "On the Influence of Climate.")

In point of climate the *Bermudas* and *Canary Islands* approach nearest to that of Madeira. The *West Indies* may be suited to some constitutions as a preventive; but when tuberculous disease exists in the lungs, we can only repeat, that the concurrent testimony of all the medical men whom we have consulted on the subject, and whose opportunities of judging were ample, establishes the fact that consumptive cases sent thither from this country proceed much more rapidly to a fatal termination than in temperate climates.

In Italy, *Rome*, *Pisa*, and *Nice*, afford the best climates for consumptive patients during the winter; but no part of Italy is favourable to such invalids during the summer. In the south-east of France, *Hyères* possesses the best climate; in the south-west, the climate of *Pau* is the mildest and most favourable, particularly during the spring.

In this country, *Torquay* presents, on the whole, more advantages than any other situation as a winter residence. Its peculiar position on the southern declivity of a range of limestone-hills by which it is protected from the north and east, the excellent accommodations for the invalid, and the facility of exercise in the sheltered and picturesque country by which it is surrounded, are all advantages which are enjoyed in an equal degree in no other place in our island. From the extent of sheltered country which the neighbourhood affords, it is also well adapted for exercise on horseback, which we deem of so much importance in the treatment of pulmonary disease.

Undercliff, in the Isle of Wight, possesses great natural advantages, and when suitable accommodations are provided for invalids, and upon a superior scale to those which have been hitherto attempted, it will scarcely be exceeded in this country as a winter residence for the pulmonary invalid. *Clifton* affords a good winter residence for those cases in which the digestive organs are much deranged, and the climate of Torquay might prove too relaxing. *Hastings* and *St. Leonards* are the most sheltered situations on the southern coast; but during the autumn months we consider that the climate of *Brighton* possesses more advantages in a large proportion of cases than any other part of that coast, or perhaps of England. On this account it will be advantageous to many invalids to pass the autumn at Brighton and the winter at St. Leonards or Hastings. The western shores of our island, as the Isles of *Bute* and *Man*, although mild, are too humid to afford good residences to the pulmonary patent.

[St. Croix, in the West Indies, is often visited by the phthisical from this country; and those of the northern states frequently seek the sea-coast or the interior of Florida, Georgia, Alabama, or Louisiana, to escape the rigours of their own variable atmosphere. The writer has, however, expressed himself so fully elsewhere on the subject of the summer and winter retreats of the consumptive, that he will not repeat his observations here.—See art. CLIMATE, vol i. p. 449 of this work; *Practice of Medicine*, 2d edit. ii. 380, Philad. 1844; and especially his *Human Health*, p. 144, 176, Philad. 1844, where the whole subject is examined at length.]

Our observations on climate have hitherto had reference chiefly to the winter. During the summer, our own country affords a variety of residences; but a frequent change of place during this season is much more useful to persons threatened with consumption than a continued residence in the best situation. The interior and mountainous districts during the summer, and the sea-coast in the autumn, afford the best succession of changes. But a tour on the continent, during the summer months, will be productive of still greater benefit.

If the tour be made in the more romantic and picturesque countries, the pleasing and continued excitement which is produced by the great variety and beauty of the scenery exerts a more beneficial influence on the whole economy, in a limited space of time, than any other measure with which we are acquainted. Of course, we now allude to persons free from local disease; when this is established, such a tour must be conducted with more precaution.

Regulated temperature.—The great object of removing to a milder and more sheltered situation is to enable the invalid to be as much as possible in the open air. Change of climate, therefore, presents much fewer advantages to the confirmed phthisical invalid, who must keep within doors during the greater part of the winter wherever he may reside, and who will find the comforts of home in general much more than a compensation for any additional mildness of temperature. Such patients will derive advantage from maintaining their apartments at an equable temperature, and when this can be accomplished throughout the whole house, it will be far more beneficial than confining the patient to one or two warm rooms. This measure is chiefly suited to cases of chronic phthisis in delicate females and in persons in advanced life; but in the young at that stage of the disease when we may reasonably entertain a hope of recovery, such confinement is rarely advisable, — indeed it forms an obstacle to the best means of improving the patient's health.

[The late Dr. Parrish always ascribed his recovery from phthisis at an early period of his life to the employment of vigorous exercise in the open air,—the exercise being pushed so as to amount even to labour, and not allowing the dread of taking cold to confine him on every occasion, when the temperature was low or the skies overcast. This course he recommended to others; and it has been often followed with salutary effects. (Parrish, *North Amer. Med. and Surg. Journal*, for 1829 and 1830; Morton's *Illustrations of Pulmonary Consumption*, p. 142, Philad. 1839; and Wood's *Memoir on Parrish.*) The general rule should be to take exercise in the open air whenever it is dry, and the temperature, even if cool, tolerably equable. On several occasions, the writer has advised this course, and has never witnessed any disadvantage to accrue from it. On the contrary, the invalid has always been benefited by the revulsion. At every exacerbation of his complaint—as Dr. Billing has remarked, (*Principles of Medicine*, Amer. edit. Philad. 1842), he says he has "caught fresh cold," but the same thing happens when he is kept in rooms the temperature of which is regulated by the thermometer.]

II. **Local Remedies.** — The numerous local remedies which have been employed in the treatment of phthisis may be considered under two heads; those which are applied to the external parts of the thorax, and those which act immediately upon the lungs by means of inhalation.

1. *Local bleeding.* — External remedies have been employed in pulmonary phthisis chiefly with the view of preventing or removing congestion and inflammation of the lungs: the abstraction of blood by means of cupping or leeches is one of the most effectual of these applications, and there are few cases in which they may not be productive of benefit at some period of the disease. In young persons disposed to phthisis, and in those cases in which pulmonary congestion is indicated, we consider cupping on the upper parts of the chest a very useful practice. Two or three ounces may be abstracted from time to time, and dry cupping may be also employed over the whole of the upper parts of the chest. If necessary, this practice may be frequently repeated; and when tuberculous deposits are present in the lungs, such small bleedings may be made very beneficial. We consider cupping a more effectual mode of abstracting blood from the chest than leeches, and the dry cupping, which we always employ at the same time, we think of considerable utility. Leeches, however, are perhaps equally beneficial in irritation of the bronchial membrane; and when the larynx or trachea is affected, they may be applied nearer the seat of disease. We would, however, take this opportunity of cautioning the young practitioner not to be too free in the application of leeches in laryngeal irritation; we have known a patient lose his voice entirely by the application of a dozen leeches to the region of the larynx. It is congestion and sub-acate inflammation only which are generally present in consumptive patients, and local bleedings must be employed with circumspection.

2. *Counter-irritants.*—Among the various remedies which have been employed in phthisis, counter-irritants have long occupied a chief place. They differ considerably in effect; some produce a temporary irritation only, without any discharge, as the common rubefacients; others, as cantharides, excite a copious serous discharge; and others, as tartar-emetic, produce deep pustular eruptions; while setons or issues cause a more permanent puriform discharge from the subcutaneous tissue. All the applications which we have mentioned, however different in their action, are useful; and each of them is applicable to particular circumstances.

The simple *rubefacients*, such as camphorated spirits and spirit of turpentine, are chiefly employed in the very early stages with the view of exciting the action of the cutaneons vessels, and may be applied daily over a great part of the chest. We think that they are of considerable use in an inactive state of the skin, accompanied with an irritable condition of the bronchial membrane; they will also often afford relief in slight local pains. *Plaisters* composed of Burgundy pitch and other substances of a similar kind, may be ranked under rubefacients, as they operate chiefly in exciting irritation of the skin; but they also act by effectually protecting the part from cold. We apply them by preference between the scapulæ; they are less inconvenient in that situation, and moreover leave the chest clear for other applications, such as cold sponging, friction, &c.

After rubefacients, *blisters* are in most general use, and when applied in the cases to which they are adapted, and at the proper period, they seldom fail to produce marked benefit. In slight inflammations of the pleura, and in the catarrhal attacks of phthisical patients, blisters give essential relief. In cases where the abstraction of blood, either

local or general, is necessary, blisters should for the most part be avoided until the practitioner is satisfied that the further employment of bleeding is unnecessary; this is, in our opinion, the proper period for the application of blisters. Even in catarrh, they should not be applied early in the disease, nor before the febrile excitement has been reduced by the proper remedies; their effects are then very remarkable in removing the remains of the disease; but if employed in the early stage of inflammatory action, they frequently increase the evil by exciting irritation in the system, especially in consumptive subjects; indeed, we consider that the prevailing error in the use of blisters is their too early application.

A succession of blisters is often recommended in phthisis, and when the skin is not irritable, and the patient does not suffer much inconvenience from their operation, they may be of some use; but we never saw them beneficial when they excited much pain and irritation; and in a disease which is attended with so many distressing symptoms, we ought not unnecessarily to add to these by the injudicious application of external irritants: the less uneasiness blisters give, and the greater the discharge they occasion, the more benefit is derived from them. Blisters, applied to persons with a thin irritable skin, should be covered with a piece of fine muslin, moistened with oil; and they should be removed at the end of six or eight hours: in this way they will produce less irritation.

The *tartar-emetic* ointment has been more generally employed of late as an external irritant than any other application, and in general it answers well; although the sanguine expectations entertained by Dr. Jenner of the effects of this remedy are, we fear, far from having been realized. (See his Letter to Dr. Parry on the Influence of Artificial Eruptions, &c.)

[The writer often employs a saturated solution of the tartrate of antimony and potassa, which may be rubbed on twice a day, until the peculiar eruption is induced. Croton oil is prescribed as a liniment with the same view. To the saturated solution of the tartrate of antimony and potassa, iodide of potassium has been added, with the effect of rendering it more irritating, and perhaps, according to Dr. Williams, (*Op. cit.*) of acting favourably on the constitution by being partially absorbed.

Some practitioners apply one revellent and some another—ammoniated liniments of various degrees of strength; moxas, sponging the whole chest once or twice a day with brandy and salt, or strong vinegar, or the *linimentum catharidis* of the Pharmacopœia of the United States, or with a liniment of oil of turpentine and acetic acid, as recommended in Bronchitis, (q. v.)]

Setons and Issues.—Discharges of matter from the subcutaneous tissue have been generally employed in phthisis, although, in general, their application has been confined to, or at least most frequently adopted in, the late stages of the disease, when they could be of little utility. Issues may be useful in the state of tuberculous cachexia before the deposition of tuberculous matter in the lungs; and even after this period such discharges may have some effect in checking the further progress of the disease, while means are at the same time employed to improve the general health. They are strongly recommended in this stage of the disease by Mudge. "In this critical and dangerous situation," says that judicious practitioner, "I think I can venture to say, from long experience, that, accompanied with change of air and occasional bleedings, the patient will find his greatest security in a drain from a large scapulary issue, assisted by a diet of asses' milk and vegetables."

The cases in which issues are more particularly indicated are full gross habits of body, with little sensibility; and if the patient has been subject to cutaneous diseases or ulcers, so much the more advantage may be expected from them. In such cases issues generally discharge freely, and give little pain; and we agree with Mudge, that when they are applied, they should be so large as to ensure an abundant discharge. In irritable, sensitive, or spare persons with a thin skin, issues, or any other form of external discharge, will not prove of much use; the irritation and distress which they occasion more than counterbalance their good effects. Indeed, we think that local discharges of all kinds must be employed with certain restrictions. When they excite little constitutional irritation, they are most beneficial; but, on the contrary, when they produce long-continued pain, increase the action of the heart, or prevent sleep, we cease to continue them, being well assured that their effects on the system are more likely to do mischief than they can otherwise do good.

In regard, therefore, to the class of external stimulants and discharges, we consider that, with due attention to the restrictions we have laid down on the subject of their application, very great advantage may be derived from their employment in allaying pulmonary irritation, and thus affording time for the adoption of such means as are calculated to improve the general condition of the system. He who expects more from these remedies will, we believe, be generallly disappointed. For a full account of this subject, see COUNTER-IRRITATION.

3. *Inhalation.*—The inhalation of volatilized substances, in the form of dry fumes or vapours, has been supposed to be beneficial in phthisis, from their being applied directly to the seat of the disease.

Dry fumigations.—The inhalation of the fumes of resinous and balsamic substances is a very ancient practice. From the time of Galen and Rhazes, such fumigations have been employed in the treatment of pulmonary disease; they were particularly advocated in this country by Bennet and Mead, but have gradually fallen into disuse in modern times.

It will not be necessary to go much into detail upon this practice, nor to dwell long on the advantages which have been ascribed to it in the cure of phthisis. In chronic bronchial disease, or even in chronic tuberculous disease, the application of gentle stimulants of this kind to the bronchial membrane may be useful; but before we can decide on the particular cases to which they are applicable, we would require a series of experiments conducted by practitioners well acquainted with the nature of pulmonary diseases.

The only substance applied in the way of

fumigation which has attracted much attention in modern times is *Tar*. The vapour of this substance was first recommended to the notice of the profession by Sir Alexander Crichton, who was induced to try it by a conjecture of Mudge, that the salutary effect of sea voyages is greatly assisted by the perpetual inhalation of an atmosphere impregnated with the volatile parts of the resinous and terebinthinate substances in and about the vessel. The vapour is obtained by heating the tar over a spirit-lamp, a small proportion of subcarbonate of potass being previously added to neutralize any pyroligneous acid which the tar may contain. The heat should be moderate, and the vapour diffused equally over the chamber of the patient, which should also be carefully maintained at an equal temperature. The success of the tar-vapour appears to have been remarkable in some cases of pulmonary disease accompanied with cough and expectoration; while in others, which were apparently of a similar nature, it produced no sensible benefit, and was sometimes injurious by irritating the lungs or provoking hæmoptysis. In the appendix to the last edition of Crichton's work, an account is given of some experiments made with this remedy in the hospital of La Charité at Berlin, by Drs. Hufeland and Neümann; it appears "that of fifty-four patients, labouring under pulmonary consumption, four were cured, six left the hospital in a state of convalescence at their own request, sixteen did not receive any benefit from the remedy, twelve appeared to get worse under the treatment, and sixteen died." (Op. cit. p. 243, et seq.)

We are not aware that any well-conducted experiments on tar-vapour have been made on a large scale in this country, except those of Dr. James Forbes, which were not in favour of it, (Remarks on Tar Vapour as a Remedy in Diseases of the Lungs, Med. and Phys. Journ. Oct. 1822); and it is reasonable to believe that the general result of the trials has not been such as to encourage the continuance of the practice. Dr. Morton of Philadelphia, in the work already quoted, gives the following favourable opinion of the efficacy of tar fumigation. "After a fair trial with various substances there is no one which I have prescribed in this form with equal success to tar in combination with subcarbonate of potash, in the manner recommended by Sir Alexander Crichton. In truth, I have seen it act like a charm." In chronic catarrh he knows of no plan of treatment that can vie with this. He also states, that the fumigation was employed by the late Dr. Rush of Philadelphia upwards of thirty years ago. For a full account of the effects of tar vapour, and the mode of employing it, we beg to refer to Sir Alexander Crichton's excellent and sensible work, which will repay the reader, independently of the information it will afford him on the particular subject in question.

Watery and medicated vapours.—The inhalation of the steam of water, either pure or impregnated with the virtues of emollient medicines, is also a practice of some antiquity. Bennet and others recommended the respiration of watery vapours arising from decoctions of emollient herbs in cases of phthisis unattended with expectoration; but the inhalation of vapour was not much employed until the publication of Dr. Mudge's sensible work, in the middle of the last century, introduced it to public notice as a remedy for a catarrhous cough and inflammatory affections of the lining bronchial membrane. (A Radical and Expeditious Cure for a Recent Catarrhous Cough, p. 131 et cet.) After trying the effects of various pectoral ingredients, he found no vapour so inoffensive and grateful to the lungs as the simple steam of warm water; the apparatus which he employed for its inhalation is still in use, and is generally known by the name of "Mudge's inhaler," but much improved by Mr. Reid, the inventor of the stomach-pump.

In a very irritable state of the bronchial membrane, this author occasionally combined opiates with the warm inhalations, and with great relief of the symptoms. The inhalation of warm water impregnated with narcotic substances has been recommended as useful in allaying irritation of the mucous membrane of the larynx and bronchi; but we are inclined to believe that the principal part of the benefit derived from the inhalation of medicated vapours has, in many cases, been produced by the simple effects of the vehicle. When the air of a consumptive patient's room is very dry, the cough frequently becomes more troublesome, and some advantage is derived from a basin of warm water placed near the patient; the vapour softens the air, and renders it less exciting to the irritated surfaces of the air-passages, and saves the patient the irksome labour of inhaling.

Chlorine.—About ten years ago M. Gannal, a French manufacturer, having observed that consumptive patients experienced relief while breathing an atmosphere charged with the chlorine disengaged in the manufacture of printed cottons, suggested it as a remedy for phthisis; and since that time numerous experiments have been made with chlorine in France and this country. M. Gannal, in several memoirs presented to the Academy of Medicine, relates numerous cases in which marked relief was obtained from its employment (See Potter's Translation of Gannal's Memoirs, Lond. 1830); and a case is given by M. Cottereau, in which a cicatrix was found after death in a part of the lung where pectoriloquy and "gargouillement" were distinctly heard eighteen months before:—the patient died of gastric fever. (Journ. Hebdom. t. ii. 1831.) Numerous other instances of apparent success of the remedy have been recorded in the French periodical publications. (See Archives Générales de Médecine.) In this country, however, the trials made with chlorine have not been attended with such beneficial results: it has frequently afforded great relief, but rarely effected a cure. We have tried it in many instances, and it has in several apparently suspended the progress of the disease; but the cases in which we employed it were in the advanced stage, when tuberculous cavities already existed in the lungs. Many of the cases recorded by others were also far advanced; and there can be no doubt that the cures which have been related as effected by the inhalation of chlorine occurred in persons whose lungs were diseased to a very limited extent only.

The symptom which we have found chlorine most decidedly relieve is dyspnœa; in all the cases

in which it was beneficial, the freedom of breathing which it produced was one of its most obvious effects;—it also appeared to allay the cough in some cases;—in others we were obliged to abandon its use from the irritation which it excited; and in the majority of the cases it produced no sensible amelioration of the symptoms.

The mode which we adopt in the use of chlorine is to direct the inhalation to be continued for five minutes only, and to be repeated frequently in the course of the day. We find that a longer period produces a sensation of fatigue, and the patient returns to it with less readiness. We begin with five drops, and gradually increase the quantity to forty, but rarely go beyond this. The inconveniences which we have observed from it are soreness of the mouth and an increase of the bronchial irritation. As a palliative, chlorine may be employed in combination with other remedies calculated to abate pulmonary irritation.

These observations will, we think, apply with equal or greater force to the inhalation of *Iodine* and substances in the *gaseous* form.

[The addition of a little tincture of conium was found by Sir Charles Scudamore (*London Med. Gazette*, Feb. 17, 1838, p. 804, and Feb. 7, 1840, p. 750. See, also, Dr. J. E. Coxe, *Practical Treatise on Medical Inhalation*, pp. 51–85, Phil. 1841,) to be beneficial in subduing the irritating qualities of the gas.

The writer's experience is not favourable to iodine in this form, and such has been the case with that of others. It has been suggested by Mr. A. Leigh, (*Lond. Med. Gaz.* May, 1841,) to apply a sufficient quantity of iodine ointment on the ribs and under both axillæ, and to cover the head with the bed-clothes, in order that the iodine, volatilized by the heat of the axillæ, may be breathed. This method is stated to have arrested the progress of the disease. (See the writer's *New Remedies*, 4th edit. p. 389, Philad. 1843.)]

Hydrogen and carbonic acid gases, and even oxygen and nitrous oxide, have been employed in phthisis, but without any such advantages as entitle them to consideration. When more rational and just views of the pathology of phthisis are generally entertained by the profession, we shall cease to hear it asserted that this disease is to be cured by local applications. We do not, however, condemn such measures as useless; on the contrary, we consider them valuable as palliatives, and of great service as adjuncts to those remedies which are directed to amend the condition of the general health, and to correct the tuberculous diathesis: but we certainly disapprove of any local remedy being relied on as the principal means of curing a disease which depends upon a morbid state of the constitution. Such an error is founded on imperfect views of the real nature of tubercular phthisis, is productive of much mischief in practice, and cannot be too strongly reprobated.

[*Arsenic.*—An able therapeutist, M. Trousseau, has advised the employment of arsenic in phthisis in the way of inhalation. The remedy is not new—the sulphuret of arsenic having been administered in fumigation centuries ago. M. Trousseau recommends that the arsenious acid should be used in the form of *Cigarettes arsénicales*, which are made in the following manner:—A sheet of white paper is dipped in a solution of one part of arseniate of soda, and thirty parts of water. The paper is then made into small cigars of the length of a finger, and the patient is directed to smoke one or even two daily, so that the fumes may pass into the lungs. The cigars burn readily, the arseniate facilitating the combustion; and in this manner "the empyreumatic oil of the paper is inhaled, united with the metallic arsenic, reduced by the contact of the charcoal formed by the burning of the cigar." M. Trousseau does not pretend to cure pulmonary tubercles by this agent, but he thinks the general symptoms may be so far modified by it as to produce decided improvement in the condition of the patient; which may, however, be questioned.]

III. **Treatment of Particular Symptoms.**

Cough.—The relief of this symptom is one of the first indications in the treatment of phthisis; but before we employ any remedies for allaying it by abating the sensibility of the respiratory organs, it will be desirable to examine into the causes which produce the cough, with a view to adopt more effectual means to palliate or remove it.

If we find that it depends upon bronchial irritation, which is usually the case, the application of leeches followed by rubefacients and blisters over the upper part of the sternum, are the most direct remedies which we can employ. In other cases when it depends upon gastro-hepatic irritation and congestion, leeches and a few alterative doses of mercury with laxatives will be the best means of relieving it.

But it does not often happen that the cough is severe at this early period of the disease; it is as this advances and the local disorganization extends, and this symptom becomes frequent and distressing. In addition to the general means employed in the treatment of the disease, it will then be necessary to give medicines to abate the cough and procure sleep; with this view, the usual narcotic medicines should, we think, be tried before recourse is had to opium, which, though it is one of the most valuable medicines we possess in the treatment of phthisis, should be used as sparingly as possible in the early period of the disease, in order that it may be more beneficial in the later stages. One of the greatest errors committed in the treatment of phthisis is, in our opinion, a too early and too frequent use of opium in large doses: we have often obtained the full effects of an opiate from four or five drops of the solution of the muriate of morphia without any subsequent inconvenience; indeed it is always desirable to begin with the smallest doses, because, as the disease advances, it is generally necessary to increase the quantity, and vary the preparation, as it often becomes in the last stages the chief solace of the patient amidst his multiplied sufferings.

When the cough is kept up by an accumulation of mucus in the bronchi, and the patient has much difficulty in expectorating, a gentle emetic will often afford great and almost immediate relief, and save the patient hours of harassing cough, and a restless night.

Hæmoptysis.—The pulmonary hemorrhage which attends the early stages of phthisis, we believe to be in almost every case dependent upon

congestion of the lungs, and hence we consider venesection the most effectual remedy. The quantity of blood abstracted must be regulated by the urgency of the symptoms and the constitution of the patient; and when due attention is paid to these circumstances, we believe that venesection is always useful and generally necessary. Until the sanguineous congestion and the increased action of the heart which generally attends active hemorrhage is somewhat abated, medicines given with the view of suppressing the hemorrhage will for the most part produce little effect. We have never had occasion to regret the employment of bleeding, nor have we observed in our practice any evil consequences result from it. The quantity of blood abstracted need not in any case be great; but if the hemorrhage should return, and especially if the excitement of the circulation should continue, venesection may be required frequently, and at short intervals, before the hemorrhagic action ceases. When there exists a disposition to frequent returns of hæmoptysis, small bleedings repeated from time to time form the most effectual and, in some cases, the only means of arresting the hemorrhage. One of the most striking cases illustrative of the efficacy of this practice is recorded by Dr. Cheyne, in the fifth volume of the Dublin Hospital Reports. As the gentleman who was the subject of this case was under our care for some time before he became Dr. Cheyne's patient, and his case is altogether a very interesting one, we shall give some account of it here. This gentleman had been subject to hæmoptysis for many years; but, after his return from Italy, where he had been for some time under our care, it greatly increased. During four months he had every day from three to four attacks, and at the end of February, 1825, was reduced to such a state of weakness and emaciation that he was unable to move from his chair to his bed without assistance. It was in this condition, after having experienced the inefficacy of other remedies, that Dr. Cheyne had recourse to frequent small bleedings. Six ounces of blood were taken from the arm, which had the effect of suspending the return of hæmoptysis for four days, when he had a slight relapse; six ounces were again abstracted, and no return of hæmoptysis occurred for ten days. From this time three or four ounces of blood were regularly taken from the arm every week for a year, and once every month or six weeks for another year. During the first eighteen months the blood was invariably cupped and buffy, but after that time it assumed the natural appearance. The pulse during the whole period of the complaint was never much accelerated; the most unpleasant symptom was a sensation of weight in the chest in the recumbent posture. Another circumstance deserves notice:—the digestive organs, which had been constantly deranged during his illness, improved immediately after the bleedings were commenced and the hæmoptysis was checked. In reviewing the whole history of this case, we have little doubt that the abdominal circulation was the primary seat of congestion: the early attacks of hæmoptysis were preceded by constipated bowels, and the patient suffered from pain in the region of the liver, with dyspepsia, headach, and depression of spirits.

We are enabled, by a communication just received from this gentleman, to give an account of his health subsequent to Dr. Cheyne's report (1827). He states that he enjoyed good health, with the exception of an occasional slight attack of hæmoptysis, for which the lancet was used, up to April 1830, when the hemorrhage returned in a greater degree, and continued to recur frequently for two months unchecked by bloodletting. When reduced to great weakness he tried carriage exercise in the country, which appeared to have the most beneficial effects in allaying the hemorrhage; and in the course of two months he was able to return to his clerical duties. In May 1831 he had another attack, and again in December 1832; since which time he has had no serious return, and has not used the lancet since December, 1833. He adds that he is now, October 8, 1834, quite well, between twelve and thirteen stone weight, takes much exercise on horseback, and feels no inconvenience whatever from reading the service and preaching twice on the same day. There cannot be a stronger instance of the beneficial effects of small bleedings in suspending hemorrhage than this case affords, and if this practice had not been so judiciously adopted by Dr. Cheyne, the patient must inevitably have sunk under the continual recurrence of pulmonary hemorrhage. But we are disposed to think the remedy was relied on too exclusively in this case; and the faith of the patient in its efficacy is now somewhat shaken.

The practice of small bleedings may be adopted, we believe, in other hemorrhages with advantage, as in hemorrhage from the bowels, menorrhagia, epistaxis, &c.

Local bleeding, especially by leeches, in the early stage of hæmoptysis, or even when there exists a congestive state of the lungs, with a disposition to hæmoptysis, is, in our opinion, a dangerous practice, and likely to produce the effect it is intended to remove or prevent. This was exemplified in the patient whose case we have just recorded: while at Rome, leeches were applied to the anus, with the view of relieving abdominal plethora, and before they had ceased to bleed, the patient was attacked by copious hemorrhage from the lungs, which it required several general bleedings to subdue. In a slighter degree we have frequently observed this effect produced by leeches, and we consider the practice of abstracting blood in this manner from a person threatened with hæmoptysis or apoplexy not free from danger. In all cases where the object is to relieve congestion of the large vessels, general bleeding is the proper mode of abstracting blood in the first instance: when, on the other hand, we wish to promote or restore suppressed secretions in plethoric persons, local bleeding by leeches is the best measure. After the plethora has been reduced by one or more general bleedings, local bleeding may often be employed with advantage.

Various medicines have been used in hæmoptysis from a belief in their specific powers in checking hemorrhage: (see article Hæmoptysis.) When the circulation is excited, and more especially when there is reason to apprehend pulmonary inflammation, tartarized antimony combined with nitre forms one of the most efficient remedies;

it is recommended by Dr. Cheyne as superior to all others "in cases of hæmoptysis with inflammatory symptoms." It may be given to produce nausea: a quarter or often an eighth of a grain with five to ten grains of nitre every hour will generally prove sufficient to abate the increased action of the heart and induce some nausea. The other remedies in most estimation for the cure of hæmoptysis are digitalis, superacetate of lead, ipecacuan, nitre, sulphuric acid, and opium, which last is often useful when there is much nervous irritation or alarm. We consider purgatives of great utility in pulmonary hemorrhage, which in the consumptive constitution is often connected with hepatic congestion; and accordingly we have found that the hemorrhage did not generally cease till the biliary secretion assumed the natural appearance; hence in all cases of hæmoptysis we would recommend attention to the functions of the liver. Aperients of the least irritating kind deserve the preference; the saline laxatives generally answer best.

After bleeding and other means have checked hæmoptysis, there is some danger of inflammation supervening; and a blister will be beneficial in preventing this. Even during the continuance of the bleeding, blisters are often useful. We consider the application of cold water or ice to the chest a very doubtful measure; and the cold affusion over the whole body, which has been recommended, highly objectionable. Ice, or iced water, may be given internally with advantage. When the hemorrhage has been great and the patient's strength is much reduced, mild tonics may be employed with benefit as soon as the hemorrhage has ceased. Bark with sulphuric acid we consider the best tonic in such cases: in the slighter forms of hæmoptysis, the preparations of iron are good remedies.

The cure of pulmonary hemorrhage in persons threatened with phthisis, is not merely to be considered as the removal of a symptom; it may be the means of preventing the occurrence of phthisis, if advantage is taken of the removal of pulmonary congestion to adopt such measures as shall prevent its return, and at the same time improve the general health; the means by which this may be best effected have been already pointed out. It is particularly necessary to watch the state of the pulmonary circulation after an attack of hæmoptysis; and when congestion of the lungs is indicated, a small bleeding, employed in season, may prevent a return of the hæmoptysis.

Pain of Chest.—The pain which occurs during the progress of phthisis is seldom very severe, unless when it is complicated with acute pleuritic inflammation. The abstraction of a few ounces of blood by cupping, or the application of leeches or a blister, will generally be sufficient to remove it; but of all local applications we have found the mustard poultice most convenient and effective in relieving the pains which accompany the latter stages of phthisis. In persons with a very irritable state of skin, we find a warm poultice of linseed meal with a very small proportion of mustard have considerable effect in mitigating pain without exciting much external irritation. When the pain is fixed, a plaister of burgundy pitch applied over the part will be very useful; and in slight pains, friction with stimulating or opiate liniments, or the application of æther, will often relieve them.

Dyspnœa.—Severe dyspnœa, except during the last weeks of the disease, is not productive of much distress. During the paroxysms which occur at this period, a combination of æther and opium often proves useful; and if they are very harassing and the pulse admits of depletion, a small quantity of blood may be abstracted with advantage. Laennec recommends belladonna in these cases, but we have never seen it produce decided relief; we have found the extract of stramonium, given in small doses of a quarter or a half a grain every day in cases where the dyspnœa was constant, a far more efficacious remedy.

External applications are sometimes beneficial, particularly when the dyspnœa returns in paroxysms; a mustard poultice is quickest in its operation, and may be applied either to the chest, arms, or feet. When the stomach is loaded, an emetic will afford more relief than any other remedy: the inhalation of æther, either alone or combined in solution with some narcotic substance, is also occasionally useful; but in the last stage of the disease, when the oppression of breathing often becames very distressing, especially towards night, we have found opium and æther afford more effectual relief than any other remedy.

Nausea and Vomiting. In a small proportion of phthisical cases, this forms a very distressing and obstinate symptom. Indeed there is no symptom more difficult of relief than the extreme irritability of the stomach which occasionally accompanies phthisis: we have known it prevail for years, the quantity of food retained during the whole of that period being wonderfully small. All the cases of this affection which we have seen, have occurred in young females of a strongly marked tuberculous constitution. A strict adherence to a mild diet, the avoidance of every thing which is found by experience to irritate the stomach, and the use of food in the smallest possible quantity at a time, will often relieve the vomiting or reduce its frequency. In some cases we have derived decided benefit from the use of prussic acid, and in others from lime-water or liquor potassæ. Seltzer water is also occasionally useful. External remedies, such as blisters and sinapisms, produce temporary relief only.

Hectic Fever.—When this symptom occurs in the early stages of phthisis, and especially when it is accompanied with pain or tightness of the chest, it may be necessary to have recourse to venesection; but in general small doses of tartarized antimony combined with nitre or saline medicines will be the most effectual remedies. When the hot stage is strong, sponging the hands and feet with tepid vinegar and water will afford relief; but the cold fit frequently forms the principal and most distressing part of the febrile paroxysm. Bark occasionally relieves this stage, although its effects are generally temporary. When the chill comes on at a particular hour of the day, its severity may often be abated by keeping the patient warmly covered in bed till the paroxysm has passed. But the best means of controlling the hectic fever is a well-regulated diet.

Perspirations. — The copious perspirations of the consumptive patient during sleep form one of his most distressing symptoms during the advanced stages of the disease.

In many cases medicine has little power in diminishing these perspirations. Sulphuric acid is commonly used for this purpose; and when the debility is great, and there are no objections to its exhibition, much advantage will be derived from a combination of the acid with an infusion of bark, or with small doses of sulphate of quinine; small quantities of this medicine being much more beneficial as a tonic than the larger doses. When there are objections to the bark, infusion of sage may be advantageously combined with the acid; and acetic acid may sometimes be substituted for the sulphuric. Fouquier thinks that acetate of lead possesses a specific effect in diminishing night-sweats: the dose in which he usually gave it was from four to eight grains, increased even to twelve grains a day. We have seen the expectoration diminish under the influence of this remedy, but we have not used it much in perspirations. The most effectual plan of moderating the perspiration consists in regulating the patient's diet, which should be mild and moderate: and much warm fluid, particularly towards night, should be avoided. When the perspirations are very copious, the patient should sleep in flannel or calico; and it is often necessary, and at all times a great comfort to him, to be wiped with warm flannels, and to have his clothes changed frequently.

Diarrhœa.—Although the bowels are frequently irritable and easily deranged during the whole progress of phthisis, diarrhœa in general does not occur in a severe degree till an advanced period of the disease: the expectoration is generally abundant, and the perspirations are copious before it appears.

In the earlier stages diarrhœa often depends on an irritated and loaded state of the alimentary canal, produced by errors in diet or other causes. This will be remedied by gentle aperients, such as rhubarb combined with carbonate of soda; or when the stomach is much oppressed, an emetic may be preferable; and a strict attention to regimen will very generally prevent its return under such circumstances. But when the diarrhœa depends on ulcerated bowels, which happens in a large proportion of cases, as we have already shown, it becomes of course very obstinate, and stimulants and rough astringents aggravate and increase it; while a mild diet, consisting chiefly of farniceous food, such as rice, arrow-root, and sago, soups, milk, and light animal food, diminish it and even prolong the patient's life. It is not sufficiently considered that the diarrhœa of the latter stages of phthisis depends upon diseased bowels; and that the almost constant existence of internal ulcerations forbids the practice of loading the stomach with large quantities of chalk mixture, kino, catechu, and stimulating aromatics and exciting food, but rather calls for the employment of a mild regimen and soothing medicines. Ipecacuan in combination with some mild narcotic, or with the compound ipecacuan powder, forms a very useful medicine; sulphate of copper is also occasionally useful; and an enema of starch and opium frequently suspends the diarrhœa for a considerable time, and produces sleep more effectually than any other remedy.

External applications, such as stimulating and opiate liniments, will often give relief to the uneasy sensation in the bowels which sometimes remains long after an evacuation.

Complications.—The treatment of the various diseases which complicate phthisis in its progress, such as laryngeal irritation, bronchial inflammation, catarrh, pneumonia, &c. does not differ from that usually employed in those diseases; and we refer for full particulars respecting it to the articles under those heads. It must, however, be kept in mind, in treating all the intercurrent diseases which attend phthisis, that they are merely complications, and require cautious treatment in proportion to the advanced state of the tuberculous disease and the debility of the patient.

IV. **Treatment of the advanced stage.**—As phthisis advances, the case becomes more complicated, and consequently the treatment requires to be more varied. The extension of the tuberculous disease in the respiratory organs renders them less capable of performing their functions: the pulmonary circulation is carried on with increasing difficulty, the lungs are more subject to congestion and inflammation, and hence the increase of cough, dyspnœa, and pain, — symptoms which generally become more urgent with the progress of the disease. With the extension of the local disease, the hectic fever, and especially the perspirations, increase: the digestive organs, partly from sympathy, but more from the advance of tuberculous disease, become deranged; and nausea, vomiting, and still more frequently diarrhœa, add greatly to the patient's sufferings. According to the predominance of one or more of these symptoms, must the means of relief be varied: hence the treatment of the advanced stages resolves itself chiefly into the treatment of particular symptoms, which has been considered in the last section. We would only observe, that the patient's life may be prolonged, and the remaining term of his existence deprived of much of its discomfort and distress by observing a strict adherence to a mild regimen, avoiding whatever excites the circulation or irritates the digestive organs. If these precautions are neglected, the hectic fever, the perspirations, and the diarrhœa will be increased; the patient's mind also becomes irritable under an exciting regimen, and he is fretful and impatient under his sufferings; a circumstance which adds not a little to his own uneasiness, and is moreover most painful to the feelings of those around him: hence the great object of our treatment should be to soothe and tranquillize both mind and body.

V. **Regimen.**—The great difficulty of directing the regimen of persons of a tuberculous constitution depends upon the discrepancy which exists between the wants of the system and the powers of the digestive organs. The former appears to call for a strongly tonic diet; while its employment never fails to aggravate the weak and irritable condition of the latter, and depress still further the powers of the constitution: hence it is evident that the food which is best adapted to the digestive organs, is that which will ultimately contribute most effectually to the strength of the system. A disregard to this obvious law of the eco-

nomy has given rise to the great diversity of opinion which still prevails respecting the regimen of tuberculous patients. We have already stated our opinion regarding the diet of children, and alluded to the prevailing error of over-feeding young persons of the strumous constitution. The strongest and most exciting kinds of animal food frequently constitute their diet, whether their stomachs are strong or weak, irritable or otherwise; the delicate puny girl of seven years of age has the same dinner as the robust lad of seventeen, and both are generally fed upon a kind of meat which is adapted only to persons of adult age and matured strength, who take active exercise the greater part of the day in the open air.

During the early stage of phthisis the diet ought to be mild, and in cases where there is a tendency to pulmonary congestion it should be strictly antiphlogistic; but the diversity of the prevailing symptoms renders it impossible to lay down any general rule on the subject. We would simply remark, that when, from any cause, it is necessary to reduce the diet, its subsequent increase should be made with great caution and very gradually.

As phthisis advances, the diet must be regulated according to the circumstances of each case: one person will bear and derive advantage from a diet that would excite fever in another; and, therefore, any general rule that could be laid down on this subject would be weakened by so many exceptions that it would be useless. Too much importance is attached to the food, and too little to the state of the digestive organs; and hence it is most erroneously supposed that the emaciation and wasting of the patient may be checked by an additional quantity and richer quality of food; by which means derangement of the digestive organs is induced along with a new train of symptoms, which tend to complicate the case and add to the distress of the patient.

Although a mild diet is that which is most generally suited to the advanced stages of phthisis, cases may occur in which it is advisable to adopt a more exciting regimen; and instances are on record where the consumptive patient, after long lingering under a spare diet, has rapidly improved in strength and been apparently cured by a diet of an opposite quality. That this has occurred we do not doubt; but the patient has probably been as much indebted to the mild diet as to that which followed it. The patients who have been cured in this manner have no doubt been persons in whom the tuberculous disease of the lungs was limited, and advancing to a cure before the change of regimen was adopted. In many such cases, however, a change from a mild to a stimulating diet would do mischief, and interfere with the curative process going on in the lungs; indeed the proportion of cases is very small in which it will prove useful, and even then much judgment and discernment will be necessary on the part of the practitioner in deciding on the proper period for its employment. When such a change of diet is made, it should generally be accompanied by an increase of exercise in the open air; Salvadori combined his salt meat and generous wines with exercise on horseback, and promoted perspiration artificially by placing his patients near the fire.

The cases that are likely to be cured by the stimulating plan of treatment,—by beef-steaks and porter,—bear so small a proportion to the many that will be injured by it, that we do not consider it deserving of further notice in this place. Many more patients have been preserved by the early adoption of a milk and vegetable diet, with a residence in the country; and there are numerous instances in which this regimen, adopted in the very commencement of tuberculous disease, proves more suitable than any other. The jelly of some of the mosses has been recommended as a nutritious article of diet for the cure of consumption; of these the Iceland moss jelly has been generally preferred: it affords a light form of nourishment, and its bitter qualities render it useful in some states of the stomach. Asses' milk and goat's whey are well-known articles of diet in such cases; but on this part of our subject it is unnecessary to go into detail in this work.

In bringing this article to a conclusion, we feel that, although we have exceeded the limits which we had originally assigned to it, the subject, in the extended view which we have taken of it, is one of such deep interest, involves so many important considerations, and embraces so wide a range, that we may have omitted some things, and passed lightly over others; but we believe that we shall be found to have attached its due value to every point which is of real consequence. If, in the accomplishment of our object, we have dwelt more particularly on some parts than on others, we have been induced to do so from a full conviction of their paramount importance. Our great aim has been to point out the sources of tuberculous diseases, and to impress upon our medical brethren the necessity of directing their chief attention to the origin and causes of phthisis, a knowledge of which can alone lead to the means of preventing that disease, and of diminishing the frequency of tuberculous diseases generally

JAMES CLARK.

[TUBERCULOSIS.—See TUBERCLE.]

TYMPANITES, from τύμπανον, *a drum*, occasionally referred to by the early writers under the term of dry dropsy, and classed by them with anasarca and ascites.* Emphysema tympaniticum, *Young*; emphysema abdominis, *Good*. Distension of the parietes of the abdomen, continuing the same under different positions of the body, not yielding readily to pressure, but, when that is applied, returning immediately to its former state on its removal, and, when struck, emitting a sound like that produced by a drum, the distending medium being air confined within or external to the alvine canal: there is consequently no sense of fluctuation, and that of weight is infinitely less to the feelings of the patient than the increase of bulk would lead him to expect. By these characters tympanites is to be distinguished from physconia and other tumefactions of the abdomen, the absence of the symptoms of each of which will further serve for its identification.

* Atque ejus (ὕδρωπα) tres species sunt. Primum τυμπανίτην: secundum λευκοφλεγματίαν vel ὑπὸ σάρκα; tertium ἀσκίτην Græci nominarunt. *Celsus*, lib. iii. cap. xxi.

Nosology has been encumbered by the enumeration of several species of tympanites, distinguished according to the locality in the abdomen occupied by the distending volume of air. The most natural, and those which have been generally adopted, have referred to its presence either within or external to the alvine canal, and have been named accordingly tympanites intestinalis and tympanites abdominalis. Sauvages has given the name of tympanites enterophysodes to the presence of air between the coats of the intestines; a very rare occurrence, and still more rarely, if ever, we conceive, existing to such an extent as to occasion tympanites: if it has, it is probable that it has been secondary to tympanites intestinalis, the air having been derived from the canal; an accident which seems possible if the mucous membrane were eroded, even though the quantity should not be excessive. It has been regarded as a fourth species when the tympanites intestinalis and tympanites abdominalis have been co-existent; but it may be presumed that the former has always been the primary condition, and erosion or rupture of the intestines an intermediate occurrence. The combination of tympanites abdominalis with ascites has been enumerated by Sauvages as a fifth species, under the name of tympanites asciticus; but although in most examinations after death of bodies in which tympanites has been present, serum has been found in the sac of the peritoneum, it would be inconsistent with every purpose of nosology to discuss such a combination as a distinct form of disease. To obtain a clear view, however, of tympanites in its several relations, it will be well to consider the modes in which air is received and collected in the abdomen, as well as the means by which its riddance is effected. It may not be inappropriate also to this place to record our knowledge of the nature of the intestinal gases, for it is possible that it may hereafter suggest more rational methods of relieving those who suffer from their presence in excess than any that have been hitherto devised.

A chief source of air developed in the alimentary canal is undoubtedly the aliment which is received into it, and of this, from abundant experience of its effects within the body, and from knowledge directly as well as indirectly obtained from without, we are certain that it is extricated in greatest quantity from vegetable substances: these, it is well known, contain it in variable proportions, and are freed, as are the constituents of diet generally, from considerable quantities of it by culinary processes, through the medium of the heat to which they are subjected. In a healthy state of the digestive function, and with due care as to the selection and preparation of food, the air belonging to it for the most part disappears after it is taken into the stomach, and is probably transferred, still in its combined state, with the chyle to the blood, the latter being known to contain it in considerable proportions; according to Hales and Haller, as one part in thirty-three, and all the other fluids in variable proportions. When digestion, however, is imperfect in consequence of a faulty state of the organs concerned in that function, or of improper food, air is extricated in such quantities as to lead to an uncomfortable distension of different parts of the alimentary canal. The stimulus of distension excites in the first place the vermicular and peristaltic action of the parietes of the canal to transfer it, in aid of its own elasticity, from one portion to another, and eventually to the riddance of so much of it as has remained unabsorbed. In failure of this effect, the muscles of the abdomen are excited to the same end, and irregular actions are also induced, such as singultus, eructations, &c. When the increase in the volume of the confined air becomes still more excessive, accumulates, and is retained, the state induced constitutes tympanites intestinalis.

But besides the extrication of air immediately from the ingesta, John Hunter conceived that it might be derived from the blood-vessels by a process analogous to or in every respect incidental with that of secretion. This hypothesis, which has been generally admitted, is founded on the established fact of air being detected in localities into which it could not have been introduced directly from without the body, and where it could not be referred to putrefaction.* 2dly. On the analogy afforded by certain kinds of fishes possessing a sound or bladder commonly used for the purpose of balancing, and next apparently for that of raising themselves to the surface of the water; and the presence of which cannot be accounted for as in the bones of birds, where an immediate communication is to be traced with the air-cells of the lungs. Lastly, on the constant separation and absorption of gas by vegetables, as proved directly by multiplied experiments, and further confirmed by the well-known fact of the inflation by air of the pods and capsules of a variety of plants common in our gardens.

In the act of deglutition it is probable, that besides the air contained in the food, a small portion is swallowed with it. Dr. Gosse of Geneva (and several physiologists have repeated his experiments with the same results) has shown that even large quantities of it may be swallowed; and Gerardin, in his essay on intestinal gases, has related an instance in which, by this faculty, an individual was enabled to simulate tympanites so as to deceive several respectable practitioners.

The manifestation of sudden and excessive evolutions of gas in the alimentary tube, particularly in some instances of hysteria, has been referred, and apparently with reason, to the secreting process; but when we reflect on the immense volume of air which is separated from vegetable substances in a state of fermentation,† to which, moreover, they are partially subjected in the animal body in defect of healthy digestion, the necessity of any other source is at least not very obvious.

The nature of the gases that are found in different parts of the alimentary canal has been ex-

*Magendie and Gerardin included a portion of intestine between two ligatures and returned it into the abdomen: air, nevertheless, was found occupying it, although care had been taken that it should be divested of any matter containing it. Cambalusier, Belg, and Glisson have made similar observations. Dict. des Sc. Méd. article *Pneumatose*. Division of the pneumo-gastric nerves is often followed by an accumulation of air in the stomach, as demonstrated by the experiments of Willis, Ducrotay de Blainville, Haller, and Dumas. Ibid.

† It appears from the experiments of Dr. Hales, that an apple, and many other kinds of aliment, give out six hundred times their own bulk of an elastic gas during fermentation.

amined by Jurine and Chevreul. Jurine's results showed, that as we recede from the stomach, the proportion of oxygen and carbonic acid decreases, while that of nitrogen increases; and that the proportion of hydrogen is greater in the large than in the small intestines, and less in these than in the stomach. (Mem. Roy. Med. Soc. t. x. p. 72 et seq.) M. Chevreul analysed the gas in the stomach, the small and large intestines, with the following results.

In the stomach.

Oxygen	11.
Carbonic acid	14.
Hydrogen	3.55
Nitrogen	71.45
	100.0

In the small intestines in three different subjects:

Oxygen	0.0	0.0	0.0
Carbonic acid	24.39	40.0	25.0
Hydrogen	55.53	51.15	8.4
Nitrogen	20.08	8.85	66.6
	100.00	100.00	100.0

Gas in the great intestines of the three first subjects:

Oxygen	0.0
Carbonic acid	43.5
Carburetted hydrogen, with a trace of sulphuretted ditto	5.47
Nitrogen	51.03
	100.00

Of the second:

Oxyen	0.0
Carbonic acid	70.0
Hydrogen and carburetted hydrogen	11.6
Nitrogen	18.4
	100.0

In the cæcum of the third:

Oxygen	0.0
Carbonic acid	12.5
Hydrogen	7.5
Carburetted hydrogen	12.5
Nitrogen	67.5
	100.0

In the rectum of the same:

Oxygen	0.0
Carbonic acid	42.86
Hydrogen	0.0
Carburetted hydrogen	11.18
Nitrogen	45.96
	100.00*

We are not aware of any analysis having been made of the intestinal air in cases of tympanites; but there is no reason to presume that any peculiar variation in the nature of its constituents is a condition of this disease, although their proportions are constantly subject to the modifying effects of different kinds of food, and respond to the fluctuating condition of the secreted products of other organs of the body.

Tympanites intestinalis sometimes occurs in fevers accompanied with much cerebral disturbance; [it is one of the prominent symptoms of the typhoid affection;] and in this, as well as in other diseases in which the nervous system is particularly implicated, it has been observed to take place very suddenly: under such circumstances it has received the particular appellation of *meteorismus*, a condition which, to a certain extent at least, may be accounted for by a suspension of nervous stimulus to the muscular coat of the alimentary canal. Tympanites is symptomatic also of gastritis, of enteritis, and of peritonitis; diseases in which it is obvious that the propelling power of the intestines is impeded, although from a different cause. In acute diseases of the thoracic as well as of the abdominal viscera, tympanites occasionally occurs, and is to be accounted for by an excessive extrication of air from the food, in consequence of the common suspension of the digestive powers under such circumstances, and the impediment offered to the action of the muscles auxiliary to the function of the canal itself. In obstinate constipation, and other mechanical obstructions, direct impediment to the transfer of the gaseous fluid occasions its accumulation, and sometimes excessive distension of some part of the alimentary tube. In ulcerations of it, and other local diseases, its vermicular and peristaltic actions are arrested, and a tympanitic state of the intestines is a consequence. In ileus and hernia it occasionally produces extreme discomfort; but in these, and under the before-mentioned circumstances, its consideration belongs to that of the disease from which it arises; and though relief may be afforded by some of the means presently to be pointed out, their selection must be subject to the principles on which the original disease is to be treated.

Whether tympanites intestinalis should be regarded as a disease distinctly idiopathic has been questioned, and, as we conceive, not without reason. The deference, however, which is so largely due to the authority of Cullen, and the conviction that he has faithfully pourtrayed a chain of symptoms of occasional occurrence and demanding particular consideration, induce us to give a place to his description of it as such in this article. "I cannot perceive," observes this writer, "that it arises in any peculiar temperament, or depends upon any obvious predisposition. It occurs in either sex, at every age, and frequently in young persons. Various remote causes of it have been assigned; but many of these have not commonly the effect of producing it; and although some of them have indeed been the antecedents, I can in few instances discover the manner in which they produce the disease, and, therefore, cannot certainly ascertain them to have been causes of it." The following he states to be the phenomena of the idiopathic form of intestinal tympanites. The distension sometimes takes place suddenly, and seldom in the slow manner of ascites; occasionally, however, its advance is gradual, and is accompanied by the various manifestations of flatulence, frequently together with colic pains, especially

*System of Physiology, by John Bostock, M. D., vol. ii. p. 491. *Magendie*, Phys. t. ii. p. 85, 104, 5, 112,3.

about the umbilicus, and upon the sides towards the back; but generally with the progress of the disease these pains become less considerable, and there is almost a constant desire to get rid of air, but it is effected with difficulty; and although with some relief to the sense of distension, such relief is commonly very transient. When this kind of tympanites is coming on, some inequality of swelling and tension is perceptible in different parts of the belly; but the latter soon becomes equal over the whole, and exhibits the characteristic phenomena already mentioned. At this time, as well as during its progress, the bowels are constipated, and the fæces generally dry and hard. The urine at first is usually very little changed in quantity or quality, but after a time it is so in both these respects; sometimes strangury and even ischuria come on. It has seldom advanced far before the appetite is much impaired and digestion ill performed; and the whole body (the abdominal distension continuing) becomes considerably emaciated. Together with these symptoms there is thirst, an uneasy sense of heat, and a considerable frequency of pulse, which continues throughout. When the distension is considerable, the respiration becomes difficult, and is attended with a frequent dry cough; the strength declines, and the febrile symptoms daily increasing, death at length ensues, sometimes probably in consequence of the intestines becoming gangrenous.

This form of disease is generally, but not rapidly, fatal. Errors in diet, the long-continued and exclusive use of crude vegetable aliment, the abuse of spirituous liquors, repelled eruptions, and the suppression of customary evacuations, have been considered chiefly conducive to its occurrence.

With regard to its pathology, Cullen, in common with other writers, and consistently with prevailing opinion, refers it to a loss of tone in the muscular fibres of the intestines. "Even in those cases of tympanites," he observes, "which are attended at their beginning with flatulent disorders in the whole of the alimentary canal, as we know that a firm tone of the intestines both moderates the extrication of air, and contributes to its re-absorption or ready expulsion, so the flatulent symptoms which happen to appear at the coming on of a tympanites, are in my opinion to be referred to the loss of tone in the muscular fibres of the intestines, rather than to any fault in the digestive fluids." It is probable, he adds, that the passage of air along the course of the intestines is in some places interrupted, in consequence of spasmodic constrictions in certain parts of them; but whether these arise as a consequence of the remote causes of the disease, or of some degree of previous atony, he acknowledges himself at a loss to determine.

Examinations of the bodies of those in whom tympanites has been present immediately before death, have shown the intestines to be very considerably larger in their calibre than natural, but most generally the cæcum and colon. De Haen (Ration. Med. p. ii. cap. 5,) refers to the dissection of a male subject who died after three years' suffering from this affection: the colon, he states, was greatly dilated, so that in some places it was equal in size to the arm, in others to the thigh of a man; and all the smaller intestines, as also the stomach, were twice or thrice the natural size; so that from excessive distension the shape of the thorax was much altered, and both the lungs and heart were compressed. In some instances, after excessive distension, rupture of the stomach has been known to take place. (Dict. des Sc. Méd. art *Pneumatose.*)

The treatment of tympanites intestinalis consists in procuring present relief by the removal of the distending volume of air, and in the substitution of a healthy state for that condition of the alvine canal on which its regeneration and accumulation depend. It is obvious that whenever any morbid state to which this condition is secondary can be recognised, the treatment of the tympanites must be secondary to that of the original disease, whatever it may be; but under any circumstances the relief of distress arising from excessive distension should, if possible, be effected. Dr. Darwin has proposed for this purpose that a pipe (such, for instance, as is commonly used for the injection of enemata) should be introduced into the rectum, so as to take off the resistance which in some cases is offered by the contraction of the sphincter ani muscle. Trnka (Historia Tympanitidis, 4to. Vindobonæ, 1788,) proposed that the removal of the gas should be effected by an air-pump; and the practicability of this remedial measure has been most satisfactorily demonstrated by Dr. Osborne, in Sir Patrick Dun's Hospital in Ireland. The patient, a female, aged twenty-two, was admitted on the 23d of January, 1831, into Dr. Osborne's ward, on account of various hysterical symptoms, attended with obstinate constipation; these, although relieved, were followed by tympanitic distension, which produced the greatest distress, and for which the employment of leeches, carminatives, and various other remedies proved wholly unavailing. It became an object of importance to examine the abdominal viscera, in consequence of some symptoms of doubtful import which at different times had occurred. Dr. Osborne having introduced a gum elastic tube of nearly three feet in length, with a button and hole at its extremity, and applied to it an air-tight stomach-pump, proceeded to pump out the gas, and was enabled to do so with but few interruptions, which were speedily overcome either by shifting the place of the tube in the intestine, or by injecting warm water to clear the holes from accidental stoppages. In about an hour the abdomen was reduced to nearly the natural size, with complete relief of the painful distension, and thus an opportunity was afforded of ascertaining that no visceral enlargement had taken place. In passing the tube through the rectum and sigmoid flexure, it was occasionally retarded by folds of the mucous membrane, but was soon freed by injecting warm water, and thus procuring distension at those parts. Very little inconvenience was experienced by the patient, although she felt the end of the tube in the left hypochondrium. The same process was repeated upon her more than once, and with the same effects. Dr. Osborne remarks, that portions of the intestines distended by flatus beyond their power of contraction, resemble the bladder when

reduced to a paralytic state in consequence of a retention of urine, and cannot contract effectually until a diminution of their contents is first obtained; hence it is probable that this method may not only prove a temporary relief, but may contribute to the permanent removal of many cases of torpidity of the bowels.* In some instances it seems not improbable that relief may be obtained by similar means applied to the œsophageal extremity of the canal. The extreme distension which is occasionally caused in the stomachs of cattle in consequence of the sudden extrication of air from green succulent food which they have consumed too greedily, familiar to agriculturists by the term *hoven*, is commonly indeed relieved by the simple introduction of a flexible tube through the gullet into the stomach, which is allowed to remain for some length of time, and affords a convenient passage for the excessive quantity of air which is generated.

[Instantaneous relief is often afforded by passing up a hollow bougie through the annulus of the rectum into the colon; after which a tight bandage may be applied round the abdomen to prevent re-distension of the coats of the intestine, by affording them adequate pressure. A good plan would probably be, to force air into the intestinal canal, and then suddenly withdraw it.]

Temporary relief may further be attempted by the medicines commonly termed carminatives, the sensible qualities of which, and their sudden volatility, render them instantaneously stimulant to the fibrous structure of the alimentary canal, enabling it to overcome the distension, to dispel the distending gas, and perhaps partly to lead to its absorption. The aromatic vegetables containing much essential oil, such as juniper-berries, the seeds of anise, caraway, coriander, and cardamoms; cloves, also; the roots of ginger and zedoary, the volatile oils themselves, and preparations of these, will be adapted to the purpose. To these may be added stimulant and antispasmodic medicines, such as the carbonate and compound spirit of ammonia, ether and its preparations, camphor, assafœtida, and the other strongly odoriferous gums, combined or not, according to circumstances, with opium or some of its preparations.

The more general treatment by which the cure of tympanites intestinalis is to be attempted is, by restoring to the alimentary canal its lost or diminished power; and this has appeared to us so generally consequent to disordered function of the liver when tympanites, either partial or complete, has been present, that although we do not profess to consider it in its secondary relations in this place, we cannot but observe, that to secure the natural secretion from this organ, if it should have been defective, is an essential preliminary to the cure of the morbid condition we are more immediately considering. The accumulation of excrementitious matter, which must add to the difficulties already existing by exhausting the contractile power of the intestines, is to be prevented by warm aperients, which will be further conducive to the same end by promoting the due digestion of the food; for this purpose purgative doses of spirits of turpentine, either alone or combined with castor oil, the compound decoction of aloes, combinations of the powder with compound tincture of rhubarb, the compound pill of aloes and myrrh, combinations of the compound extract of colocynth with hard soap, and the addition of a drop or two of the volatile oil of juniper or of caraways, or of cloves, will be suitable. Their operation may, if occasion require, be assisted by gentle enemata, and by rubbing the abdomen with soap liniment, oil, soap-lather, &c.

The wants of the constitution generally, and the presumed loss of tone in the muscular fibres of the intestines, alike suggest the use of tonics; and their efficacy being well established in the common forms of abdominal distension from flatus, they have been commonly resorted to in that extreme degree of it which constitutes tympanites. The preparations of steel have been found especially useful in disorder of this kind, as have also the aromatic bitters. The recorded experience of their use in tympanites, however, has been too scanty to enable us to draw conclusions in favour of particular preparations; and from its very rare occurrence the superiority of one above another remains to be determined. An instructive case of tympanites was published by Dr. Graves in the first volume of Medical Facts, p. 90, in which he attributed the cure, and apparently with good reason, to the internal use of eighteen grains of *prepared steel* (ferri carbonas) twice in the day; in three or four days the distension having considerably diminished, and two days afterwards entirely disappeared. The only sensible operation it produced was violent and frequent eructations of wind, and that immediately after the first dose had been swallowed. Three grains of calomel and a scruple of rhubarb had been given as a preparatory dose. Dr. Monro has also left a case on record, accompanied with irregular menstruation, in which recovery soon followed the exhibition of steel; simultaneously, however, with assafœtida and other anti-hysteric medicines, so that it is impossible to appreciate the precise advantage obtained by this medicine. A combination of four grains of carbonate of iron with two grains of rhubarb, two of powdered ginger, and two of extract of gentian, taken three times a day, (a suggestion obtained some years ago, we believe, from the London Medico-Chirurgical Review, we have found particularly useful in cases of flatulent distension occurring in dyspepsia; and according to the present state of our knowledge, it is on medicines adapted to corresponding forms of the last-mentioned disorder that our reliance is to be placed in the treatment of tympanites intestinalis. (See INDIGESTION.)

It is to be remembered, however, that the substantial forms of medicine will in most instances be preferable to their simple solutions, as the remedial action of the former will be continued to a greater distance in the tract of the alvine canal than could reasonably be anticipated from the latter. "But as no tonic remedy," says Cullen, "is more powerful than cold applied to the surface of the body, and cold drink taken into the stomach; so such a remedy has been thought of in this disease. Cold drink has been constantly pre-

* Lond. Med. Gaz., v. vii. p. 825. Dr. Graves has noticed the efficacy of similar means in two cases. See Lect. in Lond. Med. and Surg. Journ. v. ii. p. 781.

scribed, and cold bathing has been employed with advantage: and there have been several instances of the disease being suddenly and entirely cured by the repeated application of snow to the lower belly." (First Lines: See *Cambalusier*, Pneumato-pathol. p. 428 et seq.) The use of a thin flannel bandage or belt drawn with moderate firmness round the abdomen, in cases of distension from flatus, is often productive of much comfort, and reason points it out as an article of essential advantage in excessive states of it.

The diet should be selected from those articles which are not prone to fermentation, or otherwise to the extrication of large quantities of air; hence vegetable food in general, but especially peas, beans, turnips, greens, &c. as well as the various fermented liquors, sweet wines, pastry, and the like, should be avoided; and in furtherance of the same view, the bulk of a meal, even of animal food, should be small, and accompanied with the usual dietetic stimulants.

In obstinate and desperate cases the operation of paracentesis has been proposed; but for the mere evacuation of any present quantity of air in the intestines, the advantage it promises is infinitely inadequate to the hazard which must attend it. We know only of one instance in which it has been performed with success, and that entirely dependent on constipation, of which it is rather to be considered an example than of tympanites. The patient, a female, was seventy years of age, and after a diarrhœa of four months' duration, became constipated to such a degree that the strongest purgatives were exhibited without effect; the belly swelled and became painful. Evident symptoms of gangrene supervened, and death seeming inevitable, it was determined that the operation should be tried. Mr. Fine, an eminent surgeon in Geneva, cut into the most prominent part of the swelled abdomen, and retaining the intestine on the surface of the wound by means of a thread, which was passed through the mesentery, and fixed on the sides of the belly with sticking-plaister, he opened the intestines and gave passage to a large quantity of fæces; the tympanites and symptoms of gangrene subsided, and, with the inconvenience only of an artificial anus, the patient was enabled to attend to her usual avocations for a whole year. She then became dropsical and died. On examination of the body, a tumour was found compressing the rectum at its origin, so as entirely to obliterate the passage. (Manuel de Méd. Pratique, par Louis Odier. D. et. P. M. Edin. Med. and Sur. Journal, vol. ii. p. 452.)

Tympanites abdominalis, independent of perforation of the alvine canal, is a morbid condition, of the occurrence of which during life considerable doubt has been entertained; and those who have admitted it acknowledge that it has been very rare. Cullen observes, "from several dissections it is unquestionable that such a disease has sometimes occurred;" "nor can we suppose," says Good, "such accurate pathologists as Heister, (Wahrnehmungen, I. art. xv.), Lieutaud, (Hist. Anat. v. p. 432), and Bell, (On Ulcers and Tumours, vol. ii.), who have respectively given examples of it, to have been successively deceived upon the subject. Admitting it to be produced by secretion, its occasional causes are still very obscure. It has been said to follow upon jaundice and morbid affections of other abdominal viscera; upon debility produced by fever; upon hysteria, violent passions, or other emotions of the mind."

The ordinary natural cure, continues the last-mentioned writer, seems to consist in an escape of air from the umbilicus, by an outlet produced by an abscess or ulceration of this protuberant organ, or a sudden and fortunate rupture of its integuments. Morgagni and several later writers (*Guisard*, Pratique de Chirurgie, tom. i. p. 134) give us well-authenticated cases of an occurrence of the first of these, and Stoerck of both. (Ann. Med. p. 190, 193, 194.) From the protruded state of the umbilicus, the lancet may conveniently be introduced at this point. The belly should at the time of the operation be well swathed with a broad girth, which may be tightened at option, and should be kept as tight as the patient can well bear it, as well for the purpose of general support, as for that of expelling the air within and preventing its entrance from without.

Van Swieten dissuaded his pupils from this operation, (Ad sect. 1251,) and Cambalusier (Pneumato-Pathol. p. 503; *Dusseau*, Journ. de Med. 1779) and a few others have since asserted that it does not answer. But in most of these cases, observes Good, the seat of the disease was mistaken, and the flatus was situated in the intestinal canal rather than in the sac of the peritoneum.

Antecedently, however, to the operation of paracentesis, it has been recommended to try the effect of electric shocks to the abdomen; of cold applications also, and of cold drinks. The latter plan is said to have answered occasionally. (*Thedeu*, N. Bemerkungen und Erfahrungen, ii. p. 251.) It is obvious, adds the writer to whom we are much indebted for our remarks on this part of the subject, (*Mason Good*, M. D., Study of Medicine, first edit. vol. iv. p. 432,) that a tonic regimen, with free exercise, particularly equitation, and, where it can be had recourse to, sea-bathing, should be entered on as soon as the tympany is dispersed.

WILLIAM KERR.

[TYPHOID AFFECTION.—See FEVER, vol. ii. p. 169.]

TYPHUS.—See FEVER.

URINE, INCONTINENCE OF.—*Enuresis*, from *ἐνουρέω*.

History of the Disease.—In man, the excrementitious secretions, although taking place continually, are discharged from the body only at intervals; and some of them have appropriate reservoirs for their reception. To this law there are two exceptions, the cutaneous perspiration and the exhalation from the lungs. The saliva, the schneiderian mucus, and the tears may be considered as finding their way, in part at least, down the gullet, and are retained in the body by the sphincter of the alimentary canal. The urinary bladder constitutes an important reservoir of this nature, which by the due performance of its retentive function, saves us from a very loathsome and painful infirmity, named *incontinence of urine*. In every case where the urine, though but a small quantity be collected in the bladder, is forced off without the voluntary effort of the individual, or flows from him unconsciously, he is truly said to

labour under incontinence of it, or *enuresis*. The urine thus constantly escaping from the bladder, soon produces in the surfaces with which it comes in contact, redness, minute vesicles, pustules, excoriations, and at length ulcerations. The patient's clothes, being kept moistened with the same fluid, exhale an offensive ammoniacal odour; and thus he is not only subjected to the distressing itching and pain of the excoriations, but becomes an insupportable annoyance to those around him. The urine being decomposed by exposure to the air, the phosphates are formed and deposited in the surface over which it flows, and hence we have often in cases of enuresis small particles and thin crusts of gravelly substance, which serve to increase the irritation of the excoriated parts.

Incontinence of urine exists in different degrees, being in some cases so complete that the fluid drains off continually by the mere effect of gravity, as if the bladder and urethra were without life; in others it is discharged at short intervals in small quantities, by the involuntary contraction of the bladder; or this occurs only during sleep; or the urine is retained by the patient while at rest, but when he moves about, it flows off, notwithstanding all his efforts to retain it. Sometimes the degree of exercise required to produce incontinence of urine is considerable, as in the instance of a woman cured of vesico-vaginal fistula, who was a servant in a small tavern: she could retain her urine perfectly excepting on market-days, when she was subjected to much fatigue, running up and down stairs. (Edin. Med. and Surg. Journal, vol. xxi. p. 62.)

Causes. — The immediate cause of enuresis is in all cases a greater or less defect in the muscular fibres which close the external orifice of the bladder, and to which the name of sphincter may with perfect propriety be applied.* This defect in the muscle which opposes the escape of the urine may be either positive or relative. Positive defect in the sphincter may consist in a debilitated or paralysed state, or in its inefficiency from an aperture existing in some part of the bladder. Relative defect in the sphincter, on the other hand, consists in its inadequacy to resist the strong and sudden contractions of the expulsor of the urine, which thus overcomes the closing muscle, and reduces matters to the same state as if the sphincter were actually debilitated. But we are inclined to think, that in most of those cases where the body of the bladder is morbidly irritable and prone to contract on a slight stimulus being applied, the sphincter is in like manner prone to dilate and to yield to the pressure of the urine, which indeed is quite in accordance with the natural sympathy of the parts.

Paralysis of the sphincter of the bladder arises from the various diseases and injuries of the brain and spinal cord which give origin to other palsies; and it is occasioned likewise by injury or disorganization of the nerves which immediately supply the neck of the bladder. A state of debility, or an approach to paralysis of this part, may arise from injuries inflicted upon itself or its immediate vicinity: such as the operation of lithotomy, the dilatation of the part in the extraction of calculi without incision, repeated laborious parturition, suppurations in the vicinity of the neck of the bladder, the operation for fistula in ano, injury of the bladder by its displacement, as in cystocele, prolapsus of the uterus and rectum, pressure from the gravid uterus. Many females in the latter stages of pregnancy cannot cough or laugh loudly, or make any sudden movement without causing the involuntary discharge of a small quantity of urine. The sphincter of the bladder may also be so weakened as to produce enuresis, by a long continuance in the cold bath, by habits of immoderate indulgence in sexual intercourse, and by solitary vice; the first of these causes acting as a direct sedative; the two last as indirect ones, by inducing at intervals excessive and prolonged turgescence of the genital organs, and consequent debility.

The retaining power of the sphincter of the bladder is completely destroyed by the formation of an aperture in that organ in or beyond its neck; as in vesico-vaginal fistula, in fistulous openings between the bladder and rectum, or between the bladder and the external surface of the abdomen, and in fistula communicating with the ureters or kidneys. The same will be the effect in all those cases of deficient congenital formation where the cavity of the bladder communicates directly with the surface of the body, (*Duncan.* Edinburgh Med. and Surg. Journal, vol. i. *Baillie,* Morbid Anat. *Meckel,* Handbuch der Patholog. Anat. b. i.) and where the urachus remains open with an orifice at the umbilicus, or has become so in the progress of disease.

Instances of the relatively deficient power of the sphincter of the bladder are presented by most of those cases of nocturnal emission of urine which are met with in children; and the same morbid sensibility of the bladder occurs also in old men, and is productive of the same consequence—enuresis.

The irritability of the bladder may be augmented by many causes, of which the most frequent are calculus and disease of the prostate gland; fungous growths within the bladder have also the same effect; and it is produced likewise by the presence of worms within the rectum, and by other irritations of neighbouring parts. Enuresis depending on a convulsive contraction of the muscular tissue of the bladder takes place during the paroxysm of epilepsy, and, in a less severe degree, occasionally in chorea and hysteria; also from the sudden impression of cold in the genitals, and from the influence of sharp unexpected pain. It is told of an Italian coachman that, when he wished his horses to stale, he seized their ears between his teeth and bit them smartly, which never failed to produce a flow of urine. The effect of piercing sounds, as the notes of the Scotch bagpipe, in causing involuntary contraction of the urinary bladder, has often been remarked; and common observation must convince us how powerfully this organ is influenced by fear and anxiety of mind.

Enuresis in children usually ceases after the second dentition, and very rarely persists beyond the full development of the genital organs at puberty; except, indeed, in cases of mental imbecility,

* See Treatise on the Urethra, &c., by Sir Charles Bell, for the true anatomy of the sphincter of the bladder.

where its continuance is to be referred to the same cause which produces the inability to retain the saliva, and the tottering step and awkward movements of the idiot.

Incomplete enuresis may also be produced by a diminution of the cavity of the bladder, which renders it impossible for the person to retain more than a very small quantity of urine; and in such cases there usually exists at the same time a morbid irritability of the body of the organ.

Treatment.—In enuresis, as in most other symptoms of disease, the mode of treatment will depend on the cause of the affection; and by its removal we shall in general accomplish a cure. When the power of the sphincter of the bladder is positively weakened, we must employ the most approved means of restoring the nervous energy of the part, as friction, rubefacients to the loins and sacrum, the affusion of cold water on the spine, blisters to the lumbar and sacral regions, electricity, galvanism, stimulating enemata; the internal use of cantharides, [especially when associated with tincture of opium or tincture of hyoscyamus, (Guy, *Lond. Med. Gazette*, Sept. 30. 1841), internal and external use of] strychnine, tonics, such as quinia, nitrate of silver, arsenic, steel, copper, zinc, and the vegetable bitters. When incontinence of urine depends on the existence of a fistulous opening in any of the urinary cavities, the aid of surgery must be called in; but if all attempts at a cure fail, one of the many ingenious mechanical contrivances for such cases must be had recourse to, and the situation of the patient rendered as comfortable as this distressing infirmity will permit. Under these circumstances the greatest attention must be paid to personal cleanliness; and the ammoniacal smell which is so liable to be produced ought to be corrected by means of one of the vegetable acids, such as the acetic or tartaric. In almost all cases of enuresis from malformation, this palliative plan is the only one which affords any prospect of benefiting the patient.

When enuresis proceeds from a disproportion between the contractile power of the body of the bladder and that of the sphincter, or, in other words, from a morbid sensibility of the bladder to the stimulus of the urine, attention to the general health and to the state of the bowels is especially required. The irritability of this organ must be allayed by large doses of opium and hyoscyamus given in enema or suppository, and, if necessary, by the mouth; and all irritations of neighbouring parts, such as from worms in the rectum, must be removed. As this form of involuntary discharge of the urine occurs most readily during sleep, certain precautions are required before the patient goes to rest.

Nothing of a diuretic nature should be taken at any time of the day, and no liquids swallowed for some hours before bed-time: the patient's bed should consist of a mattress with a moderate covering of bed-clothes, and he should recline on his side and rather on his face, for the contractions of the bladder seem to be excited by the urine resting on the sensitive surface between the orifice of that organ and the openings of the ureters. (*C. Bell*, Treatise on the Urethra, &c.) Nocturnal enuresis occurs under different circumstances—from the sleep being so profound tha the child is not awakened by the stimulus of distension which precedes the expulsion of the urine, or from his dreaming of voiding it, or, lastly, from an indolent disposition, which prevents him from attending to the first call to evacuate the bladder. The importance and necessity of cleanliness must be carefully impressed on the youthful mind; for by mistaken indulgence we may prolong the habits of early infancy into the period of advanced childhood. We are, therefore, clearly of opinion that when the frame is not debilitated, and when the precautions already noticed have been taken, a little wholesome chastisement will in such cases of enuresis be highly proper: it will render the sleep less profound, the dreams less delusively vivid, and serve to dispel the apathy of the indolent and the slothful. But far be it from us to recommend the revival of those punishments invented by the cruel ingenuity of former times, such as causing children subject to this infirmity to crush mice to death in their hands, to submit to the loathsome infliction of having live toads suspended from their necks, and to sit by the bedsides of the dying. When the habit of nocturnal enuresis is deeply rooted, punishment, even the mildest, cannot be frequently repeated; but an attempt should be made to correct it by calm admonition, and endeavouring to awaken a sense of shame. If increasing years do not bring with them a cure, great benefit will be derived from forcibly confining the urine within the bladder: it will tend at once to interrupt the habit, and to rouse the irritability of the sphincter. Where the jugum penis has failed, a speedy cure has been accomplished by strapping a bougie along the lower surface of the penis, so as to render the canal quite impervious to the urine. (*Hyslop*, London Medico-Chir. Trans. vol. vi.)

The urethra of females being short, and the bladder often subjected to great distension, enuresis is with them sometimes very obstinate, and requires for its cure a certain turgescence of the genital organs. Thus, when the disease does not yield to the change produced at the period of puberty, it may be removed by the internal use of cantharides and by marriage. The following fact will serve to illustrate the efficacy of turgescence of parts on the functions of the bladder. A middle-aged female, who had suffered for years from calculus, and was voiding her urine in driblets every few minutes, had the stone extracted by dilatation, and for a fortnight thereafter retained her urine like one in health; but when the swelling from the operation subsided, incontinence came on, and continued for months to resist the various remedies employed for its cure.

When enuresis in the aged depends on a morbid sensibility of the bladder, we have found great benefit from the use of balsam of copaiba; but in many of these cases the functions of the bladder are disordered by habits of intemperance, which must be corrected before we can expect any remedy to produce permanent relief.

[In very obstinate cases, where all other means have failed, it has been advised to introduce a bougie into the bladder; and some have recommended, that it should be coated at the point with a stimulating substance, as the tincture of cantha-

rides, applied in layers, one coat being permitted to dry before the other is laid on. The cases must be rare indeed where such a severe remedy could be considered necessary; and the same may be said of the different *juga*, and other mechanical contrivances which have been applied for the purpose of preventing the discharge of the urine. Some risk always attends their employment, and they do not strike at the root of the mischief. Dr. Willis (*Urinary Diseases and their treatment*, Amer. edit. p. 220, Philad. 1839), thinks the best of the mechanical contrivances is that in which a firm, but not a hard, pad is kept applied, by means of a spring, to the urethra in the perinæum. It has been proposed to apply the nitrate of silver to the orifice of the urethra, so as to excite acute inflammation of the part,—and a successful case has been reported. When the urine passed over the inflamed surface, the pain produced by it was sufficient to awaken the patient, and arouse the sphincter vesicæ to the more energetic exercise of its function. The caustic was repeated, and a cure shortly effected.]

W. Cumin.

URINE, SUPPRESSION OF, *Ischuria Renalis*.—The generic term ischuria has been employed not only by medical writers in general, but by professed nosologists, men of high reputation, to designate two very different affections. Thus by Sagar, ischuria has been defined "retention or suppression of urine secreted by the kidneys, or suppression of the secretion in the kidneys." Sauvages, in his definition, uses the term *retention*; Cullen, that of *suppression* only. The first of the above-mentioned authors seems indeed to have recognised a distinction between the one and the other affection, though he has not laid it down with sufficient perspicuity. Sauvages and Cullen evidently regarded retention and suppression as equivalent terms; yet to distinguish them accurately is of great importance, and, in treating of the only species of ischuria which belongs to the province of the physician, it shall be our endeavour to avoid confusing the one with the other. We would tread in the steps of modern writers, eminent for the soundness of their views and justness of discrimination; of Dr. Good, among others, who has assigned to complete suppression of urine the appellation of "paruria inops," while to obstruction or retention of the secretion in the kidneys he has given the name of "paruria retentionis renalis." In accordance with his view of the subject, yet retaining the term ischuria as one more familiar to the medical world, we may speak of the former under the title of *ischuria renalis suppressionis*, and of the latter under that of *ischuria renalis retentionis*. Suppression or destitution of urine may occur as an idiopathic affection, or as the result of other local or general disease. The causes of idiopathic suppression are involved in considerable obscurity; probably, however, they are to be sought for in some affection of the brain and nervous system, producing palsy of the kidneys, or in a congested state of the emulgent veins.

Cases of idiopathic suppression are certainly rare, though perhaps not so rare as some authors have imagined them to be. The affection may be described, sufficiently for every practical purpose, in very few words. In an individual, generally one of full habit, inclined to corpulency, and past the meridian of life, the secretion of the kidneys becomes suddenly and completely suspended; but as there has existed little or it may be no previous indisposition, as there is no provocation to pass water, no pain or sense of weight in the lumbar region, no fulness of the hypogastric region, or of any part of the abdomen, the patient probably disregards the suppression for several hours, till, being seized by a rigor, or experiencing an unusual degree of heaviness and oppression, he deems it prudent to resort to medical advice. The medical man finds his patient complaining of some nausea, and of torpitude of the whole system, and with a pulse somewhat slower than natural, yet still with so little pain and so free from distension or any other very distressing or urgent symptom, as to entertain no apprehension respecting the result himself, and to be regarded perhaps by his friends as fanciful and nervous. The catheter is employed, it passes freely into the bladder, but no urine follows. At this juncture, whatever may be the impression of the patient or his family, or of unscientific observers, the experienced practitioner will descry no small danger. His prognosis will be decidedly unfavourable. He is well aware that the constituent principles of the urine cannot long be retained in the blood without being productive of serious mischief. To save the patient, the kidneys must be roused to action, and that speedily; they must resume their functions, or their important office must be assumed by some other organ. Now to stimulate the palsied kidneys to action is by no means an easy task, and the remedial efforts of nature or the resources of art may prove too feeble or too tardy to compensate effectually for the destitution of the discharge from the kidneys. In a few hours vomiting and hiccup supervene, the torpor of the system increases, the brain especially is oppressed, and generally on or about the second or third day from the commencement of the suppression, the patient dies comatose, as in a state of apoplexy.

In some of these cases a strong urinous smell is perceptible before death, evidently proving that nature was endeavouring to convert the exhalants of the skin into a substitute for the palsied kidneys, but was not able completely to succeed.

Such, usually, is the rapid and fatal course of idiopathic suppression of urine, which, as has been already observed, is generally a disease of elderly people. Cases, however, are on record where the suppression continued for a much longer period without danger, and the subjects of which were young persons or children. As a striking example of these chronic and less dangerous cases may be adduced one, copied from a foreign journal into the Medico-Chirurgical Review for April of the present year. The subject of this singular history was a boy, twelve years of age, who, it is stated, secreted no urine for seven weeks, though all that time he partook freely of liquids. The bowels acted naturally every second or third day; there was no increase of perspiration, but the contrary; the appetite was tolerable, the sleep sound, the boy was to all appearance healthy. It is added that there was no suspicion of deception

either on the part of the patient or of his friends. At the end of the seven weeks, turpentine injections and frictions were employed, and balsam of copaiba was administered internally. Why these remedies were not had recourse to earlier is not explained; it would appear, however, that they had the effect of exciting the action of the kidneys in two days. To this certainly marvellous relation the able editor of the Medico-Chirurgical Review has subjoined one very similar, which fell under his own observation. In this latter case it was impossible deceit could be practised; the catheter was introduced almost every day, but a few drops of blood only followed. There was no affection of head, nor is any mention made of increased perspiration or of diarrhœa. Various other instances of complete suppression of urine, which subsisted for a long time, and were unattended with danger, are recorded by Dr. Parr, Dr. Richardson, &c. Nay, some cases have been mentioned where the affection has been coeval with the birth of the individual. May it not, however, be suspected that a more severely critical examination of such cases would have led to the discovery that *some* urine (a very small portion it might have been, but that *some* urine) was secreted and passed? We must always remember, as has been justly remarked by Sir Henry Halford, that a very small measure of urine is sufficient for the exigencies of the constitution, and that it is the *total cessation* of the secretion that is so uniformly fatal.

Or, if it be conceded that in these cases not a drop of urine was passed by the natural channel, or discharged at any foreign outlet; if, in a word, it be conceded that no *urine* whatever was secreted, might not more accurate investigation have determined them to belong to the ischuria suppleta of Sauvages?

It may be proper in this place to say a few words respecting this latter variety of ischuria renalis, in which the want of the secretion in the kidneys is compensated by a vicarious discharge, as also of that variety in which urine itself is thrown off by some foreign outlet. Cases of either description are uncommon, and, among those which have been published, some perhaps have been simulated; yet a sufficient number, distinctly related, and by writers of good authority, remain to entitle the ischuria suppleta of Sauvages and the paruria erratica of Dr. Good to our consideration.

The more usual emunctories which take up the office of the kidneys, are the skin and bowels; and several well-authenticated histories are to be met with in which we are assured that while not a drop of urine was secreted in the kidneys, there were most profuse perspirations, or diarrhœa, to such an extent as would, under different circumstances, have reduced the patients to an alarming degree. Occasionally the system has been relieved by vomiting of a fluid resembling urine as to colour, but yet altogether devoid of urinous smell or taste. But one of the most singular cases of vicarious discharge is that quoted by Sennertus from Platerus, of a girl thirteen years of age, in whom the secretion of the kidneys was compensated by a very copious flow of serous fluid from the right ear, which continued during several days. The relation occurs in the Medicina Practica of Sennertus, lib. iii. cap. 10.

That the suppression of the proper secretion of the kidneys should sometimes be compensated by a vicarious discharge, or, in other words, a secretion of a different kind, may not appear very extraordinary or difficult to comprehend; but when we approach the subject of erratic urine, there is much which we are at a loss to explain. If we suppose the kidneys not to secrete at all, how or where are we to imagine the urine to be separated from the blood? If we adopt what seems the more probable conclusion, that in cases of *uroplania* the fluid is first secreted in the kidneys, and afterwards is re-absorbed by the increased activity of the urinary lymphatics, still how are we to account for its being carried to the salivary glands, to the stomach, to the axillæ, &c.?—how are we to explain the fact of its having been detected in the ventricles of the brain? By what path and in what manner is it conveyed to the foreign outlet or the remote situation?

In the treatment of idiopathic suppression of urine, we should bear in mind the great probability of its depending upon a congested state of the brain or of the vessels of the kidneys themselves; and, if the subject of the affection be a person of full habit, if the pulse be slow and full, if there be a considerable oppression of head, we should not hesitate to employ general bloodletting, and that freely; if the above-mentioned symptoms be less marked, and the patient less plethoric, cupping from the neighbourhood of the head or from the loins may be sufficient. The abstraction of blood should be promptly followed up by the exhibition of a brisk purgative, as calomel with the compound gamboge-pill, succeeded, if need be, by a saline cathartic draught. In the event of these or other purgative medicines being rejected, remedies of a similar description must be administered in the form of enema, as, for example, oil of turpentine with castor oil.

Having premised these general remedies, our attention should be next directed to the kidneys more particularly. We should employ stimulating diuretics, as small doses of oil of turpentine or balsam of copaiba, repeating them at short intervals; or, should these medicines prove offensive to the stomach, the tincture of cantharides, with spirit of nitric ether in camphor mixture, may be given. Of the rest of this class of remedies the most important, perhaps, are the infusion and spirit of horse-radish, squill, and spirit of juniper. Of the pyrola umbellata and certain other reputed diuretics, our experience is far too limited to enable us to speak with confidence; and in an affection so important, and generally so quickly fatal as idiopathic ischuria renalis, we should scarcely think of resorting to remedies so little known, while others of acknowledged efficacy are within our reach. Digitalis has been recommended; but the only form in which its diuretic powers can be depended upon is that of infusion; and where a great disposition to nausea exists, we should be cautious in advising its exhibition in that form. If digitalis be employed at all in the present disease, it should be in combination with spirit. ætheris nitrici, tinctura cantharidis, spirit. armorac. comp., or other stimulants.

Opium has been proposed, under the notion of spasm existing in the vessels of the kidneys. Under such a view we should not have recourse to it, but in its combination with some other medicines, as ipecacuan for example, it may prove useful; for in the treatment of the disease under consideration, we must ever recollect that the excretions of the skin may assist those of the kidneys, and that, therefore, it is an important part of our duty to endeavour to excite the former, by active diaphoretics, to take upon themselves for a time the office of the latter, and carry off the urea which should be discharged by the kidneys.

Before concluding this part of our subject, we must strongly insist upon the importance of external remedies; of these the principal are electricity and galvanism, blisters, cataplasms of mustard and horse-radish, and terebinthinate frictions. The hot-bath may also be employed, or the sudatorium; the use of the latter, followed up by a full dose of Dover's powder or other powerful diaphoretics, will seldom fail to excite profuse perspiration.

But suppression of urine may occur as a result of other local or general disease; and then, of course, it will be attended by several symptoms in addition to those which are observed in the idiopathic affection. Thus, when it arises in consequence of renal inflammation, there will necessarily be considerable pain and tenderness in the lumbar region, with other symptoms of nephritis, hereafter to be noticed when we come to speak of that disease more particularly. When it proceeds from transferred gout, there will also be severe pain in the loins; and when it is caused by calculus, there will be weight and dull pain. Suppression of urine may also take place at the commencement of inflammatory fever. In all these cases our remedial measures must be directed to overcome the original disease. In proportion to the intensity and duration of the latter, will be the degree and duration of the suppression: with the cessation of the primary disease the suppression will cease.

Suppression of urine sometimes occurs towards the fatal termination of certain diseases. Under such circumstances, nothing can be done.

Retention of Urine in the Kidneys.—We have now briefly to notice retention of urine in the kidneys. In this, as in the affection we have just been considering, there is no flow of urine; but in other respects it differs materially from suppression. In suppression the kidneys no longer secrete; in retention the secernents are not inactive, but the secreted fluid is obstructed in its passage. The obstruction may arise from a variety of causes. It may arise from spasm, from inflammation, abscess, or scirrhus of the kidneys; from hydatids from calculous concretions, grumous blood, or viscid mucus in them; or from spasm or inflammation of the ureters; from calculi or other matters filling up their cavities; from their obliteration in consequence of ulceration; from tumours pressing upon them. The urine, though secreted in sufficient abundance, may be prevented from flowing into the pelvis of the kidney, or from thence into the bladder, by great enlargement of the gland. The same effect may also be produced by considerable extenuation of the kidney. Under this latter circumstance, though a small portion of urine may still be separated from the blood, yet, as the sinus of the organ contracts with its body, not a single drop may be able to pass into the ureter.

In most, if not in all, of the cases above mentioned, there will be dull pain, or a sensation of weight and uneasiness in the loins; and sometimes, as, for example, when the kidneys are greatly enlarged, there will be a fulness perceptible to the touch, or even to the eye; generally, however, owing to the peculiar situation of those organs, no intumescence is to be detected.

Complete renal retention is a very serious disease, inasmuch as it rarely takes place unless either both kidneys are simultaneously obstructed, or, one having previously been rendered incapable of performing its functions, the other, which had done double duty, becomes completely obstructed. It is not a common occurrence for both kidneys to be simultaneously affected; and in cases of absolute retention we may therefore conclude, or at least we may strongly suspect, that one of those glands has for some time been useless, or that one ureter has been impervious. Still, however, we must recollect that fatal retention has occasionally happened, though one kidney and its ureter have been wholly free from disease. For this we can account in no other manner than by supposing that the sound kidney is affected by sympathy; the irritation produced by calculous concretions or other causes in the one organ may excite spasm in the other.

In the management of renal retention of urine we must be regulated by the cause, so far as we are able to ascertain it. Thus, if from the accompanying fever, and the violence of the pain, we judge it to arise from inflammation, we must employ general or topical bleeding, followed by mild aperients, and relaxants, and anodynes. If it appear to depend on calculus, mild aperients and relaxants may be all that the case demands; but here also, if there be considerable pain, venesection must not be neglected; and after venesection recourse must be had to anodynes. If the retention be in consequence of enlargement or hypertrophy of the kidney without evidence of inflammation, we are not to expect much from medicine. If both kidneys be thus affected, the case may indeed be regarded as hopeless. If one only be enlarged, the other probably will, for a time, take upon itself the whole duty; and a cure of the diseased organ may be attempted by the persevering exhibition of small doses of mercury, and the application of the emplastrum ammoniaci cum hydrargyro to the lumbar region. The well-known power of iodine in promoting absorption would point it out as an appropriate remedy in this state of disease; it may be employed in the form of its tincture; the dose being at first five or six minims, which may be gradually and cautiously increased to twenty minims or more,* three times a day, or

* The words, *or more*, are added because we know much larger doses have been given, and, it is said, with impunity. Our own experience, however, is against large doses of that powerful medicine. Our astonishment has been very great on reading the treatment of a case of epilepsy by Dr. Franklin of New York, who, it seems, gave *one hundred drops* thrice a day for a month. See Lancet for July 30, p. 554.

the ointment of iodine, or of hydriodate of potass, may be rubbed in twice a day over the region of the enlarged gland.

If from the course of the pain, and the sense of weight, together with numbness of either lower extremity, and retraction of testicle, we suspect the obstruction to exist in the ureters, the only remedies from which we are to expect relief are relaxants and opiates. In this variety the retention is very rarely complete, for it is extremely uncommon for both ureters to be obstructed at the same time, or, when one is obstructed, for the other to be so affected by sympathy as to offer a total impediment to the flow of urine.

H. W. Carter.

URINE, MORBID STATES OF THE.—The urine is the fluid which is secreted by the kidneys, and after being deposited for some time in the bladder, is discharged by the urethra. It is one of those secretions to which the term excrementitious has been applied, from its having been supposed to consist essentially of the substances which are separated from the mass of the circulating fluids, for the purpose of being discharged from the system as superfluous or useless, and, if retained, producing injurious effects. (*Blumenbach*, Inst. Physiol. sec. 34. *Adelon*, in Dict. de Méd. t. xxi. p. 64. Bostock's Physiol. vii. p. 371. [Dunglison's *Human Physiology*, 5th edit., ii. 281, Phil. 1844.]) The kidney has been considered as among the most important of that class of organs which have been styled vicarious or compensating—those which possess the power of temporarily fulfilling the office of some other organ. Thus, for example, if the cutaneous perspiration be suppressed, the aqueous matter is discharged by the kidney;* if an unusually large quantity of fluid be received into the stomach, and taken up by the absorbents, the kidney is the organ through which it finds a natural exit; and even with regard to various articles of food or medicine, although the intestinal canal affords them the most obvious means of being removed from the system, a portion of their elements is generally carried off by the kidney. It must be considered as in some degree owing to this circumstance, as well as to the specific office of the kidney, that the urine is the most compound of all the animal secretions, and, at the same time, the most variable in its contents. This latter property is further increased by the nature of the proximate principles which enter into its composition, many of which are readily decomposable, while they are likewise disposed to act on each other, and, during their continuance in the bladder, are placed in a situation which is favourable to this action. These various circumstances would naturally lead us to conclude that the urine must differ considerably in different individuals, and that, in the same individual, under the various circumstances in which he is placed, both those of ordinary occurrence, and more especially in the morbid conditions of the body, these differences would exist, and would be indicative of the causes by which they are immediately produced. We accordingly find, that observations on the pathology of the urine were among the first which were noticed by the ancients: that they have at all times occupied a considerable share of attention among the most intelligent medical practitioners;† and that, by the vulgar and the uneducated, they have even been considered as alone sufficient to ascertain the nature of a disease, and as superseding all other pathognomonic symptoms.

On the present occasion, we propose to commence by an account of the urine in its healthy state, and after attempting a classification of its morbid states, to offer some remarks on their immediate cause, and the relation which they bear to the derangements of the system. We do not think it necessary to enter upon the consideration of the medical treatment, because, on this subject, little would remain for us but to refer to the various articles which have appeared in the preceding volumes of this work, where the state of the urine has formed a characteristic symptom of disease, or an indication of the effect of remedies upon it.

1. **Of the healthy Urine.**—It will be unnecessary to describe at length the appearance and external characters of the urine in its ordinary state. Its quantity varies much in different individuals, and in the same individual under different circumstances, and this without exceeding the limits of what may be strictly regarded as the state of perfect health. Physiologists have attempted to form an average estimate of the quantity voided during the diurnal period; but this investigation, simple as it may appear, is attended with considerable difficulty. Haller, after collecting a number of observations made by different individuals, fixed the quantity at forty-nine ounces. (Elem. Phys. 26, 4, 6.) The writer of this article, proceeding principally upon the observations of Rye, which appeared to him the most numerous and the most accurate on record, was induced to lower it to forty ounces; (Rogers on Epidemic Diseases, Appendix to Med. Chir. Tr. vol. iii. p. 110;) while Dr. Prout, whose opinion on every point connected with this subject is of the highest authority, reduces it to thirty-two ounces. (Inquiry into the Nature of Gravel, &c., p. 35. [*On the Nature and Treatment of Stomach and Renal Diseases*, Amer. edit. from the 4th London, Philad. 1843.) On the average, it may perhaps be estimated at 2½ pounds.]

The specific gravity of urine, as might be supposed, is at least as variable as its quantity. It has been found, in some cases, not very much to exceed that of water, being as low as 1005, while in others it rises as high as 1040 or even 1050. (*Cruickshank*, ubi supra. *Berzelius*, Traité de

* We have an interesting series of observations by Lining, on the relation between the urine and the cutaneous perspiration in the different seasons; Phil. Trans. for 1743 and 1745. Observations of a similar kind have been made by other physiologists, but perhaps we have none that are equally numerous and correct.

† With respect to the ancients, it will be sufficient to refer to the second book of Hippocrates's treatise De Prædict., and to Galen's De Crisibus. As we approach to our own times, we may select from the more celebrated of the moderns, Willis's Exerc. de Urinis, and Bellini's work De Urinis et Pulsibus. Since the improvements of modern chemistry made us acquainted with the constitution of the urine and the nature of its constituents, the attention of many of our most eminent pathologists has been directed to this subject with much success. Among the first and most valuable of their productions, is the essay of Cruickshank, "On the manner of distinguishing Diseases by the Urine," which contains, in a short compass, much accurate and original observation. Rollo on Diabetes, and Tilloch's Phil. Mag. vol. ii. p. 240 et seq.

Chimie, par Esslinger, t. vii. p. 342.) Both these extremes, however, especially the latter, are to be regarded as indicating a diseased state of the system, in which not only the relative proportion of the solid and the fluid part of the urine is affected, but where the nature of the solids themselves is changed. Dr. Henry is disposed to consider 1030 as a fair average of what may be regarded as healthy urine, (Elements of Chemistry, vol. ii. p. 490,) while Dr. Prout makes it no more than 1025, (Inquiry, p. 5); perhaps we shall not be able to fix upon a standard more likely to be generally applicable than 1020, which is not far from the mean between these numbers. (Brande's Manual, vol. iii. p. 191; Berzelius adopts the estimate of Dr. Prout, ubi supra. [See, also, *The Kidneys and Urine*, translated from Berzelius, by M. H. Boyé and F. Leaming, M. D., Philad. 1843.)

Dr. T. Thomson (*Brit. Annals of Medicine*, p. 5, Lond. 1837,) found it in an individual, from 50 to 60 years of age, and in perfect health, to be, on the average, 1013,—the lowest specific gravity, during ten days, being 1004, and the highest 1026. (For various estimates, see the writer's *Human Physiology*, 5th edit., ii. 294, Philad. 1844.)]

With respect to the chemical constitution of the urine, notwithstanding the elaborate examinations of it which have been made by chemists of the first eminence, there would appear to be still some degree of uncertainty. The analyses of Dr. Henry and of Berzelius, who have cultivated the department of animal chemistry with so much success, although essentially coinciding, differ in several minute points, both as to the substances which are actually present in the urine, and the mode of their combination. According to Dr. Henry, there are twenty-one substances which "have been satisfactorily proved to exist in healthy urine," (Elem. p. 490); the list of these we subjoin, and compare it with that given us by Berzelius,* which, as will be seen, is somewhat different:

	Henry.	*Berzelius.*
1.	Water.	Water.
2.	Free phosphoric acid.	
3.	Phosphate of lime.	Phosphate of lime.
4.	Phosphate of magnesia.	Phosphate of magnesia.
5.	Fluoric acid.	
6.	Uric acid.	Uric acid.
7.	Benzoic acid.	
8.	Lactic (impure acetic) acid.	Free lactic acid.
9.	Urea.	Urea.
10.	Gelatine.	
11.	Albumen.	
12.	Lactate (acetate) of ammonia.	Lactate of ammonia.
13.	Sulphate of potash.	Sulphate of potash.
14.	Sulphate of soda.	Sulphate of soda.
15.	Fluate of lime.	
16.	Muriate of soda.	Chloruret of soda.
17.	Muriate of ammonia.	Chloruret of ammonia.
18.	Phosphate of soda.	Phosphate of soda.
19.	Phosphate of ammonia.	Biphosphate of ammonia.
20.	Sulphur.	
21.	Silica.	Silex.
		Extract of meat soluble in alcohol.
		Extractive matters soluble only in water.
		Mucus of the bladder.

On comparing the two lists, we find that of the twenty-one ingredients enumerated by Dr. Henry, fourteen may be considered as recognised by Berzelius, while there are seven, viz. uncombined phosphoric acid, the fluoric and benzoic acids, the fluate of lime, albumen, gelatine, and sulphur, which are not included by him. On the other hand there are three substances, extractive matter soluble in alcohol, extractive matter soluble in water, and the mucus of the bladder, which are enumerated by Berzelius, but are not recognised by Dr. Henry. On these discrepancies we shall venture to remark, that there appears to us to be scarcely sufficient evidence of the existence of uncombined phosphoric acid in healthy urine, and that the presence of benzoic acid, in human urine,† of the fluoric acid,‡ and of course of fluate of lime, may be regarded as somewhat problematical. The existence of sulphur in urine, although omitted by Berzelius, appears to be fully established by the experiments of Proust. (Ann. Chim. t. xxxvi. p, 258–60.) With respect to two of the additional substances introduced by Berzelius among the constituents of urine, we feel disposed to admit of their existence; the extractive matter soluble in alcohol we believe to be either identical with, or to be very similar to the uncoagulable matter of the serosity of the blood, and to be nearly related to the proximate principle which has been styled *osmazome*. The mucus of the bladder, if not an essential constituent of the urine, we believe to be very generally present in it; and although it is not admitted by Dr. Henry into his list, yet he remarks, in a subsequent paragraph, that it exists in healthy urine. (Elem. v. ii. p. 493.) As to the "extractive matters soluble only in water," we confess that we are altogether uncertain to what principle or substance Berzelius here refers,

* Traité, p. 392, 3. Berzelius arranges the substances found in urine under the two heads of the ordinary constituent principles, and the accidental principles; but the latter are chiefly composed of the substances that are found in the urine in its various morbid states: p. 343 and 399. Mr. Brande reduces "the substances that are always found in urine," to twelve; water, carbonic acid, phosphoric acid, uric acid, phosphate of lime, phosphate of ammonia, phosphate of soda, phosphate of magnesia, common salt, sulphate of soda, albumen, and urea; Manual, v. iii. p. 191. Fourcroy extends the number to thirty, but the existence of some of these he considers as doubtful, at least in the natural and recent state of the urine; System of Chem. Knowledge, by Nicholson, v. x. p. 185.

† The principal authority for the existence of benzoic acid in human urine is Thenard; Ann. Chim. t. lix. p. 270. Dr. Prout, however, remarks "that it does not exist in healthy human urine;" Inquiry, p. 19. Berzelius informs us that the substance which had been supposed to be benzoic acid is a compound of this acid with urea, to which he gives the name of uro-benzoic acid, p. 363: it may be presumed, however, that he does not conceive it to exist ready formed in the urine, as he does not place it in his list of its constituents. See also some experiments of Liebig, who detected a peculiar acid in the urine of the horse, but which appeared not to be the benzoic; p. 365. We may remark that Fourcroy and Vauquelin admit of its existence, but in an extremely minute quantity; Ann. Chim. t. xxxi. p. 62, 3.

‡ The fluoric acid seems to have been admitted on the authority of Berzelius; Ann. Chim. t. lxi. p. 256; also Med. Chir. Tr. v. iii. p. 258. He, however, as appears above, does not enumerate it among the constituents of urine in his last work.

nor can we well conceive of any to which this description can be considered as appropriate.

Besides the substances mentioned above, there are others which have been supposed by some chemists to enter into the composition of healthy urine. This is the case with the carbonic and the acetic acids, the former of which, if not essentially present, is at least frequently detected in urine that exhibits no other morbid character;* while the latter, which has been announced by Proust, Thenard, and others, (*Thenard*, Traité de Chimie, t. iii. p. 728, and Ann. Chim. t. lix. p. 275; *Henry*, v. ii. p. 493; *Berzelius*, t. vii. p. 361, 2,) we may conceive to be the same substance with the lactic acid of Berzelius. To these we may add a certain principle or principles, which give the urine its peculiar colour and odour, neither of which would appear, from the experiments of Dr. Prout, to be necessarily connected with the urea.† We may further remark on the constitution of the urine, that we doubt whether albumen should be considered as forming one of its constituents while in the healthy state, and that we are not acquainted with any experiments which afford unequivocal evidence of the presence of gelatine.

The urine in its natural and healthy state always exhibits acid propensities, as is shown by its effects on test-papers. We are disposed, however, to agree with Dr. Prout, that this excess of acid arises, not from any portion being in an uncombined state, but that certain of the alkaline and earthy bases are not neutralized, but are in the state of super-salts. This remark applies equally to the lithic and the phosphoric acids; the former of which we conceive exists in the form of super-lithate of ammonia, and the latter in the same state of combination with the alkalies, and probably also with the earths that are present in the urine. The same remark may apply to the lactic and the acetic acids; for in this case, as in the former, if we conceive them to be absolutely uncombined, they would precipitate the whole of the lithic acids. (Prout's Inq. p. 11–15.)

One of the most important circumstances connected with the chemical constitution of the urine is the state of solution in which the phosphate of lime is held, in consequence of the excess of acid to which we have referred above. If this excess be neutralized by the addition of ammonia, the phosphate of lime is precipitated without decomposition, in the form of a white impalpable powder. The phosphate of magnesia is likewise precipitated without decomposition, but it unites with a portion of the ammonia, forming a triple salt, the ammoniaco-magnesian phosphate, as it has been usually termed. These two salts enter largely into the composition of certain urinary calculi, and it may be presumed that the deficiency of acid in the urine is, in this case, the immediate cause of their formation. Dr. Henry informs us that the average quantity of phosphate of lime in urine is about half a grain in each ounce of the fluid, (Elem. vol. ii. p. 491,) thus affording nearly twenty grains per day; a quantity amply sufficient to lay the foundation of a calculous concretion, were there not an appropriate solvent provided.

The presence of sulphates in the urine is clearly ascertained by the appropriate tests, (*Berzelius*, in Med. Chir. Tr. vol. iii. p. 259–62); and as neither the sulphuric nor the phosphoric acids exist in the blood, it has been conjectured, with great plausibility, that one essential office of the kidney is to acidify the bases of these acids, (*Berzelius*, ubi supra; Prout's Inq. p. 30, 1,) the ultimate object of which may probably be, to remove the excess of earthy matter which remains after the employment of that portion of it which is necessary for the formation and support of the bones.

A much more important office of the kidney, what may perhaps be distinguished as its appropriate function, is the removal from the system of the superabundant nitrogene. (Bostock's Physiol. vol. ii. p. 372.) It appears to be essential to the existence and well-being of the animal fabric that an ample supply of this element should be always at hand, in order to contribute to the formation of the various solids and fluids into which it enters, as one of the most abundant constituents. The main source of this supply is introduced through the medium of the digestive organs; but as it is necessarily very variable, in consequence of the difference both in the quantity and in the quality of the ingesta, it follows that, on ordinary occasions, the supply is greater than the demand. The superfluous quantity is separated from the blood by the kidney under the form of the urea, the substance which may be regarded as the specific secretion of the organ, and as composing the essential ingredient in healthy urine.‡ It will not be necessary, nor would it indeed be proper for us in this place, to enter upon a minute description of urea, or of its relation to the various chemical re-agents; it will be sufficient to observe, that nitrogene enters more largely into its composition than into that of any other organic body, constituting very nearly one-half of its weight.§

* *Proust*, Ann. Chim. t. xxxvi. p. 260, 1; *Vogel*, ibid. t. xciii. p. 71 et seq.; *Marcet*, in Calc. Dis. p. 168-70; Prout's Inq. p. 19; *Henry*, v. ii. p. 495; *Brande*, Manual, v iii. p. 192.

† Med. Chir. Tr. v. viii. p. 529, and Inq. p. 8–10; *Berzelius*, Traité, t. vii. p. 371, 2, and Journ. Roy. Inst. v. i. p. 401. See also Wohler's experiments on the mode of obtaining pure urea, in Ann. Chim. t. xliii. p. 64. et. seq.

‡ We are indebted to Cruickshank for our knowledge of the urea as a distinct proximate principle: Rollo on Diabetes, and Tilloch's Phil. Mag. ubi supra; its properties were afterwards more fully ascertained by Fourcroy and Vauquelin: Ann. Chim. t. xxxi. p. 68–71. The only other specific secretion of the kidney is the lithic acid: for a full account of this substance and its chemical relations, we may refer our readers to the valuable inaugural dissertation of Dr. Henry, De Acido Urico, and to the abstract of it in the second volume of the Manchester Memoirs.

§ The ultimate analysis of urea has been made by Berard, Dumas, and Dr. Prout: these two latter eminent chemists agree very nearly in their estimate, the former making the nitrogene 46·9 per cent., Ann. Chim. t. xliv. p. 273 et seq.; and the latter 46·66; Med. Chir. Tr. vol. viii. p. 535, and vol. ix. p. 483; Henry's Elem. vol. ii. p. 430; and *Berzelius*, Traité, t. vii. p. 378. According to the analyses of Henry, p. 496, and Berzelius, p. 392, 3, the urine, in its average state, contains 3 per cent. of urea, which will be very nearly 1·5 per cent. of nitrogene. Taking the specific gravity of the urine at 1020, and assuming that two pounds and a half are voided in the diurnal period; we shall have not much less than one ounce weight of nitrogene removed from the system daily. A portion of nitrogene, although very inconsiderable compared to that in the urea, is likewise carried off from the system under the form of lithic acid, of which it composes between 30 and 40 per cent.; *Marcet*, p. 73, *Berzelius*, p. 350. The nitrogene discharged in this way will not exceed two-thirds of a grain daily.

Another important circumstance to be attended to in the chemical constitution of the urine is its tendency to spontaneous decomposition, and to the reciprocal action of its various constituents upon each other. When the urine has been voided, and left at rest for some hours at the ordinary temperature of the atmosphere, it generally begins to deposit a portion of the salts which it previously held in solution. The immediate cause of this effect would appear to be the generation of a quantity of ammonia, arising from the partial decomposition of the urea; the ammonia thus produced is in part united to carbonic acid, which is also generated, while another portion of it saturates the excess of the acids in the super-salts, and in this way precipitates the lithic acid and the earthy phosphates. This process is considerably promoted by an increase of temperature; and it appears that it is carried on, to a certain extent at least, in the bladder, when the urine is by any cause detained for an unusual length of time in that cavity. (*Fourcroy and Vauquelin.* Ann. Chim. t. xxxi. p. 58, 60. *Berzelius,* t. vii. p. 342.)

At the same time that these changes are going on, or perhaps in a later stage of the process, a quantity of acetic acid is also generated, which unites with another portion of the ammonia; thus the acetate and the carbonate of ammonia, the neutral phosphate of lime, and the ammoniacal phosphate of magnesia, constitute the immediate products of the spontaneous decomposition of the urine. If we admit the speculation of Berzelius, which appears to be supported by many powerful considerations, that the kidney is the general outlet by which the effete or decomposed materials of the system are removed from the body after they have discharged their respective functions, (View of Animal Chemistry, p. 16, 82; Traité, t. vii. p. 339,) we shall have an additional source of diversity in the composition of the urine, and also, in proportion to the heterogeneous nature of its constituents, we may expect that there will be an increased tendency in its component parts to react upon each other.*

[The appearances presented by the urine under the microscope, have been referred to under the head of Calculi, Urinary (vol. i.) Further details are contained in the productions of Donné, *Cours de Microscopie,* p. 213, Paris, 1844); Dr. Golding Bird, (*Lond. Med. Gaz.* Feb. 10, 1843, p. 678, and in his work entitled "*Urinary Deposits, their diagnosis, pathology, and therapeutical indications,* Lond. 1844); Mandl, (*Manuel d'Anatomie Générale,* p. 504, Paris, 1843), and Prout, (*On the Nature and Treatment of Stomach and Renal Diseases,* 4th edit. p. 517, Lond. 1843, or Amer. edit. Philad. 1843.)]

II. **Morbid states of the Urine.** — Before we attempt an arrangement or classification of the morbid states of the urine, it will be necessary to form a clear conception of the nature of those changes in the fluid which may be entitled to this appellation. It would probably be impossible to form a classification which should include every casual or temporary alteration in the properties of the urine, nor if it could be accomplished, would its value be in any degree commensurate with the difficulty of the execution. Our object must be to characterize those conditions of the urine which are well marked, which have a certain duration, where its constituents bear a new chemical relation to each other, and where this is connected with an altered state of one or more of the animal functions. Proceeding upon this basis, we shall endeavour to arrange all the morbid states of the urine under the seven following species, naming them from the circumstance from which they derive their most obvious properties: 1. the aqueous; 2. the sub-aqueous; 3. the lithic; 4. the phosphatic; 5. the purpuric; 6. the albuminous; 7. the saccharine. To these we must add, as a kind of appendage, an eighth section, in which we may include various miscellaneous or incidental circumstances connected with the constitution of the urine, which are not capable of being reduced to any assignable or recognised species.

1. *Aqueous Urine.*—[*Hydruria.*]—This may be characterized as a state of the secretion, where the proportion of the fluid to the solid contents is morbidly increased, and which is frequently, although not necessarily, attended by an increased quantity of the urine that is discharged. And here we must be careful not to confound those incidental or temporary changes in the state of the fluid, such as are produced by the application of cold to the surface of the body, or by certain mental emotions, with the watery urine, which proceeds from a permanent or constitutional cause. Among the causes of this description, perhaps the most frequent and the most efficient is that state of the system which has been denominated the nervous temperament, and more especially the peculiar modification of it which gives rise to the hysteric paroxysm. Here we have an unusually large quantity of urine discharged, and this often containing less than the ordinary proportion of solid matter, and as far as has been ascertained, without any other essential change in the nature or proportion of its constituents. The aqueous urine will be often found to exist in that state of the system, where, without any specific disease, the powers both of the mind and the body begin to decline, and when the gradual decay of all the organs indicates the approach of old age.† Here

* For a more minute account of the properties of the urine than would be consistent with the object of this article, as well as for an historical detail of the successive discoveries which have been made respecting it, the reader is referred to Aikin's Dict., in loco; Thomson's System, vol. iv. p. 331 et seq.; Henry's Elements, vol. ii. p. 489 et seq.; Brande's Manual, vol. iii. p. 190 et seq.; Turner's Elements, p. 775 et seq.; *Thenard,* Traité de Chimie, t. iii. p. 723 et seq.; *Berzelius,* Traité, t. vii. p. 339 et seq.; and Med. Chir. Tr. vol. iii. p. 257 et seq.; *Montfalcon,* in Dict. des Scien. Méd., article *Urine;* to which is appended a copious list of references by Vaidy, which is very complete for the earlier writers, but less so for the more recent authors, and especially for the English; t. lvi. p. 332, 4; *Orfila,* in Dict. de Méd., article *Urine,* in loco; *Andral,* ibid. article *Urine Sémeiotique,* in loco; we have a series of valuable experiments on the urine, many of them of a statical nature, by Chossat, in Magendie's Journ. t. v. p. 65 et seq. Fourcroy's great work contains a most minute account of the urine at the period when it was written, but later discoveries and experiments have led to an alteration or modification of many of the statements; System, vol. x. p. 129 et seq.

† The late Dr. Heberden, in his invaluable volume, enumerates the frequent passing of urine among the symptoms of what he styles Valetudo Conquassata; Comment. chap. 94; in this state we believe the urine will be found to be much increased in quantity, and to be aqueous.

the functions of the kidney are among the first to feel the effects of that decay, which gradually undermines every part of the system, and which terminates in its dissolution. We are not aware of any specific cause of this particular condition of the urine, independently of the general irritability and debility of the system; nor do we know that it leads to any specific indication either of prognosis or of treatment. We believe, however, that it is an actual and not a very unfrequent occurrence, and that it is one to which the attention of the practitioner may be advantageously directed, as it may assist him in forming an opinion respecting the general state of the vital energies of the system, and of the degree in which the organs of digestion and assimilation are capable of performing their functions.

2. *Sub-aqueous Urine.*—This, in its specific character and its appellation, may be considered as directly the reverse of the former state, and yet, in its pathological cause, is somewhat closely connected with it. In certain cases of increased discharge of urine, it will be found, that besides an augmentation in the quantity of the secretion, it contains even more than the ordinary proportion of solid contents, and thus, both from its quantity and its quality, carries off from the system an unusually large proportion of the ingredients which ought to be applied to its growth or support. The sub-aqueous urine is sometimes found to exist in the decline of life, and would appear to be one cause among others by which a premature state of decay is effected. But it more frequently occurs at an earlier period in constitutions that have been debilitated by various causes, and particularly by excesses of all kinds; by long-continued violent exercise, by stimulating diet, and especially by large potations of wine and fermented liquors, and perhaps, more than any other cause, by excessive sexual indulgence. This state of the urine is occasionally met with in persons whose constitutions have been injured by a residence in tropical climates.

The sub-aqueous urine is often found to be connected with the albuminous, or to alternate with it; and it would appear to be, to a certain extent, the result of the same causes acting upon a different constitution, and exhibiting themselves in a more chronic form, consequently with less of febrile action, and without the specific derangement of any particular organ. To this species we are disposed to refer the variety of diabetes which has been termed *insipidus*, where we have an increased flow of urine, of high specific gravity, with the constitutional symptoms of the disease, both as to the state of the digestive organs and the skin, but where the urine does not contain any saccharine matter.* We believe it will be found upon examination that the sub-aqueous state of the urine is not unfrequently a precursor of its saccharine state, and that, in some cases, which may be correctly styled diabetes, the disease never proceeds beyond this state, in consequence of some change being effected in the constitution, either by natural causes or by the operation of remedies.

3. *Lithic urine,* [*Lithuria.*]—This is characterized by the spontaneous deposition of lithic acid, constituting the principal part of what is generally termed the sand or gravel of urine. The immediate cause of this deposition is the presence either of some other acid in the urine, which may precipitate the lithic acid naturally contained in it, or merely an increased quantity of the lithic acid itself, or rather the super-lithate of ammonia, so as to be more than can be held in solution in the urine, especially when it is reduced in temperature, after being discharged from the bladder. It appears, that this latter, which is the simplest form of the disease, is also the most frequent, and in fact that there are few individuals in whom it does not occasionally exist, (Prout's Inquiry, p. 121): we find, indeed, that any cause which deranges the digestive process or interferes with its due action, may produce the deposit of lithic acid. Among the most frequent of these causes we may enumerate an excessive quantity of food taken into the stomach, food of an indigestible nature, exercise taken immediately after a full meal, the application of cold to the surface of the body or to the feet during digestion, an undue quantity of liquid taken into the stomach.

In the most simple form of the disease there is a deposit from the urine, as it cools, of a brown sediment, which is either pulverulent, or consisting of a mixture of the powder with minute crystalline spiculæ. When this deposit, as is frequently the case, assumes a pink or purple colour, it depends upon a combination of the purpuric with the lithic state of the urine. In the less simple form of the disease there would appear to be an additional agent in the urine, besides the superabundant lithic acid, which produces the deposit in question. Dr. Prout supposes that the precipitation may be effected by various acids, but most generally by the phosphoric, and occasionally by the sulphuric, the nitric, or the carbonic, as well as by some other acids which are the peculiar product of the renal secretion. (Inquiry, p. 128.) In this case the lithic acid is precipitated in more or less of a crystalline state, and forms the greatest part of what has been termed urinary gravel. This gravel, like the sand in the former variety, may be tinged of a pink or purple colour, depending in like manner upon the combination of the purpuric with the lithic urine.†

With respect to the pathology of the lithic urine, it may be generally considered as a symptom of an imperfect state of the digestive organs, either induced, in each individual case, by a specific cause acting upon the stomach and the chylopoietic viscera, or by a peculiar condition of the

* The writer of this article presented a case of this description to the Medico-Chirurgical Society, where the urine contained no saccharine matter, but where its specific gravity was 1034, while the quantity discharged daily amounted to five quarts. By an analysis of the urine it appeared that the patient was discharging daily seven and a half ounces of urea, which may be considered as at least three times the natural quantity. Med. Chir. Tr. vol. iii. p. 107 et seq.

† For a very complete account of this variety of the urine, and of the state of the system which produces it, the reader is referred to the valuable treatise of Dr. Philip, first published separately in the year 1792, and afterwards, in an altered form, in the sixth volume of the Transactions of the College of Physicians, and to the third chapter of the second section of Dr. Prout's Inquiry. Both these writers refer to a work, published nearly half a century ago by Forbes, which appears to possess very considerable merit, when we consider the imperfect state of chemical science at that period. [See, also, Willis on *Urinary Diseases, and their Treatment*, Philad. 1839.]

constitution, more especially by the gouty diathesis.* It is this state of the urine which lays the foundation for a large proportion of the calculi which are occasionally formed in the bladder, or other parts of the urinary organs. We find, by chemical analysis, that the most frequent species of these concretions consist essentially of lithic acid, and that in many others, where the bulk of the calculus is composed of the phosphates, the nucleus consists of lithic acid.† (See CALCULUS.)

4. *Phosphatic urine* [*Ceramuria.*] — This, when considered in its chemical relations, may be regarded as the opposite state to the lithic, consisting essentially in an excess of the phosphoric salts, and essentially of the phosphates of lime and of magnesia, with a comparative deficiency of the lithic acid. Hence it is characterized by the deposition of the phosphates in the form of a sediment, which is generally white, and of an earthy or chalky appearance, although occasionally assuming the crystalline state. The chemical constitution of the phosphatic urine appears to differ considerably in different cases, all of which, however, agree in the characteristic circumstance of the excess of the phosphoric salts. Sometimes there is a deficiency of the urine in proportion to the saline ingredients, and at other times there is an absolute deficiency of both the urea and the salts, reducing the urine to the aqueous state, but still maintaining the relative excess of the phosphates.

The pathological condition of the system which produces the phosphatic urine is less easily characterized than the lithic, as it would appear that a variety of circumstances, which have no very obvious connection with each other, both of a constitutional and a local nature, agree in producing this morbid change in the state of the urine. The phosphatic urine is frequently observed in sickly and ill-fed children, in those that inherit a scrofulous constitution, or where we have reason to suspect the existence of diseased mesenteric glands. Again, in the decline of life we find that various circumstances, which contribute to break down the constitution, and affect the digestive and assimilative functions, diseases of the glandular system, and especially local injuries of the parts contiguous to the kidney, are among the frequent causes or concomitants of the phosphatic urine. It would appear also to be produced by mechanical irritation of the bladder; for it has been observed that a considerable number of the calculi, which are principally composed of the phosphates, possess a nucleus of lithic acid, or some substance which has been accidentally introduced into the bladder, and which appears, by its action upon that organ, to have contributed to the production of the excess of the phosphates, and their consequent deposition. As in the case of the lithic urine, so the phosphatic is sometimes connected with the purpuric state, thus affording deposits of various shades of colour.‡ We also find that the lithic and the phosphatic urine not unfrequently alternate with each other: it is this state of things which gives rise to one of the species of calculi which have been termed, from their mechanical formation, alternating. (Marcet, pp. 59, 96.) Upon the whole, we must consider the phosphatic urine as indicating a greater derangement of the system, and one which is less under the influence of curative means, than the lithic.§

5. *Purpuric urine* [*Porphyruria*]. — This is characterized by the colour of its deposit, which, in its ordinary state, has obtained the name of the lateritious sediment. It was recognised as the indication and concomitant of the febrile state of the constitution, among the earliest observations that were made on this fluid, and one which has always been regarded as among the most decisive pathognomonic symptoms of an increased action of the arterial system. The first attempt to ascertain the immediate cause of the change of the urine appears to have been made by Proust, (Ann. Chim. t. xxxvi. p. 265–9,) but not with any great success, as he does not appear either to have ascertained the exact nature of the change, or the means by which it is effected. For the more correct information which we possess on the subject, we are indebted to Dr. Prout, who investigated it with his accustomed acuteness, and proved that a new substance, possessing the properties of an acid, is produced in the urine, which, from the colour of its combinations with the alkaline bases, he termed the purpuric acid. (Phil. Trans. for 1818, p. 420 et seq., and Med. Chirurg. Trans. vol. ix. p. 481, 2.) He also rendered it probable that all the shades of colour which were observed in the urinary deposits, from reddish brown to pink and purple, may be referred to the mixture of the purpuric with the lithic acid, or with the phosphates of lime and magnesia.

With respect to the pathology of the purpuric urine, it may be simply characterized as the urine produced by that increased action of the arterial system which constitutes inflammatory fever; which, therefore, may occur either in its simple state, or in combination with the lithic or the phosphatic urine, when any circumstance induces febrile action while either of these states is present. It has been supposed that the purpuric urine is more immediately connected with the diseases of certain of the abdominal viscera, but we conceive there is reason to doubt whether this opinion be tenable, and we undoubtedly find that

* We are indebted to Wollaston for the discovery of the chemical nature of the gouty concretions, which had been previously termed chalk stones, as consisting of the lithate of soda. Phil. Trans. for 1797, p. 389. These bodies had been previously examined by Berthollet; but it appears that this eminent chemist, who on most occasions is so remarkable for his accuracy, in this instance proceeded rather upon theory than actual experiment. He supposed that the urine of gouty patients was deficient in phosphoric acid, and that the acid was deposited in the joints in combination with lime. Journ. Phys. t. xxviii. p. 275. In connection with the subject of gouty urine we may refer to the work of Sir C. Scudamore, who performed a series of experiments on this subject.

† *Fourcroy and Vauquelin*, Ann. Chim. t. xxxii. p. 217; *Philip*, Trans. Coll. Phys. v. vi. p. 176; *Pearson*, in Phil. Trans. for 1798, p. 38; *Marcet*, ch. v.; Prout's Inq. p. 95 et seq; *Henry*, Med. Chir. Trans. v. x. p. 132; *Smith*, Med. Chir. Trans. v. xi. p. 10; *Egan*, in Tilloch's Phil. Mag. v. xxiii. p. 199 et seq.

‡ The combination of the phosphatic and the purpuric deposits may in most cases be distinguished from that of the lithic and the purpuric, by the latter being tinged with the brown colour of the lithic acid, while the former being a mixture of a white and a purple substance, are of a purer pink colour.

§ Perhaps one of the most valuable parts of Dr. Prout's work is his chapter on what he styles "the phosphatic or alkaline diathesis;" although, were we inclined to be hypercritical, we might object to the term *alkaline* as applied to this state of the urine.

the purpuric urine exists, in the most marked form, where we have been unable to discover any traces of local inflammatory action. The existence of the purpuric urine in its various shades and combinations is almost as frequent an occurrence as the lithic, and is in many cases produced by very slight derangements of the system. But when, on the other hand, it exists in a high degree, and continues for a long time without interruption, it indicates a morbid derangement of the functions, which it is often difficult to remove, and which must be regarded as leading to an unfavourable prognosis.

6. *Albuminous urine* [*Albuminuria*] is distinguished by its exhibiting the presence of the proximate principle from which it derives its specific appellation, when the appropriate tests are applied to it. The albumen sometimes exists in so great a quantity as to render the fluid more or less opaque when it is discharged from the bladder; but it may be frequently detected in the fluid by exposing it to heat or to certain chemical re-agents, when it is not otherwise visible. It seems to have been first distinctly brought into view by Cruickshank, in the essay to which we have referred above (Rollo on Diabetes, and Tilloch's Phil. Mag. vol. ii. p. 248): it was afterwards very carefully described by Blackall, who considered it as a pathognomonic symptom of a peculiar species of dropsy, which, as he conceived, required a specific mode of treatment,* and has more lately been made the subject of consideration by Dr. Bright, in the series of his valuable pathological observations.† So ample an account of these observations, and of the discussions connected with them, has been given in the former parts of this work, and more especially in the article Dropsy, that it will be necessary for us to do little more in this place than to refer to them. We shall only remark that the albuminous urine is symptomatic of increased action of the arterial system, connected with visceral derangement; generally of the kidney, (when it is frequently attended by dropsy,) and occasionally of the liver, so as to constitute a very formidable disease. In other instances, however, it would appear to be produced simply by a morbid condition of the digestive organs, unconnected with any structural disease, and in this case to be of transient occurrence, and to be indicative of a slight derangement of the functions.

7. *Saccharine urine* [*Melituria*], like the albuminous, derives its specific name from the presence of the proximate principle which is found to exist in it, and which constitutes the most remarkable pathognomonic symptom of the ordinary form of diabetes. The disease has been very correctly described by the ancients; but although they noticed the increased flow of urine, its peculiar condition, as containing a quantity of saccharine matter, was first pointed out by Willis. Of late years, since the chemical constitution of the animal fluids, both in their healthy and their morbid states, has been more attended to and better understood, the saccharine urine of diabetes has been the subject of very numerous experiments. The result appears to be, that the urea is in a great measure deficient, while in its place the kidney secretes a substance which has every property of sugar, both as ascertained by the spontaneous changes which it undergoes, and by the action of chemical re-agents upon it.‡

With respect to the pathology of the saccharine urine, we may make the same remark as in the last section, that it has been so fully and ably discussed in the former part of this work in the account of Diabetes, that nothing remains for us but to refer our readers to that article, where they will find detailed every circumstance of importance connected with the peculiar state of the urine, the symptoms and prognosis of the disease, and its treatment. The only point on which we feel it necessary to offer any remark respects the nosological question, whether it be proper to confine the term diabetes to that state where the urine contains sugar, and which has been styled the diabetes mellitus. We have already given it as our opinion that we believe a state of the constitution exists which is intimately connected with the diabetes mellitus, and is indeed frequently the commencement or first stage of it, where we have every symptom of the disease, both general and local, except the saccharine state of the urine. As a question of technical nosology, it may be of little importance; but we are disposed to think that, if the practitioner were aware of the possibility of such an occurrence, he might perhaps, in some cases, be able to check the disease at the outset, and prevent it from acquiring the saccharine state, when it becomes so formidable in its symptoms, and so extremely difficult to remove.

8. In this section, devoted to the consideration of the various miscellaneous or incidental circumstances connected with the state of the urine, we shall merely enumerate some of the substances which are stated to have been occasionally observed in this fluid. Of these we may mention blood in its entire state, perhaps, in some instances, the red particles alone, without the other constituents, pus, mucus, bile, and various articles of food or medicine, or rather certain principles immediately derived from them. To these we may add certain substances which have not hitherto been noticed among the ordinary constituents of urine, which enter into the composition of some of the urinary calculi, all of which we may presume exist in the urine in some part of its course from the kidney to the urethra. These various occurrences are all of them more or less important, and deserve to be noticed by the pathologist and the practitioner, as indicating the existence of derangements, either constitutional or local, and as consequently directing us in our prognosis and guiding us in our treatment. The only general conclusion which we can form on the subject is, that the renal secretion is peculiarly liable to be affected by causes, both internal and external, of

* Observations on Dropsy. We have a judicious critique on this work in the Edin. Med. Journ. vol. ix. p. 334 et seq.

† In connection with the account of the albuminous urine, which is contained in Dr. Bright's Medical Reports, the reader is referred to Dr. Christison's remarks in the Edin. Med. Journ. vol. xxx. p. 107 et seq. and to the observations of Dr. Gregory in vol. xxxix. p. 54 et seq.

‡ In the eighth volume of the Med. Chir. Trans. p. 537, Dr. Prout has given the analysis of the saccharine urine: see also Chevreul, Ann. Chim. t. xcv. p. 319, and Bostock's Physiol. vol. ii. p. 361.

all descriptions; and that, although the observation of its changes has been frequently resorted to as the means of imposing on the credulity of the vulgar, there is perhaps no one circumstance connected with the animal economy, which is more worthy of the attention of the enlightened practitioner, and which is more likely to repay his researches by affording him an indication of the state of the functions, and of the effect of the curative means by which he endeavours to correct their various morbid states.

[In disease, it is often of importance to distinguish between the substances that cause some of the various colours possessed by the urine: and the following table has been drawn up by Dr. Golding Bird with this view. (*Urinary Deposits*, &c. p. 24, Lond. 1844.)

Colour.	Causes of Colour.	Chemical and Physical Characters.	Pathological Indications.
Red. A.	Purpurine.	Nitric acid produces a deposit of uric acid almost immediately;—no change by heat.—Alcohol digested on the extract acquires a fine crimson colour. Density moderate.	Portal congestion; it is generally connected with organic mischief of liver or spleen.
B.	Blood.	Becomes turbid by heat and nitric acid, its colour changing to brown. The microscope discovers floating blood-discs.	Hemorrhage in some part of the urinary passages. Fever.
Brown. C.	Concentration.	Nitric acid precipitates uric acid readily. Density high. The addition of hydrochloric acid to some of the urine previously warmed, produces a crimson colour.	
D.	Blood.	See B. Coagulation by heat and nitric acid less marked.	
E.	Bile.	A drop of nitric acid allowed to fall in the centre of a thin layer of urine on a white plate, produces a transient play of colours, in which green and pink predominate.	Obstruction to the escape of bile from the liver or gall-bladder; and the presence of some or all the elements of bile in the circulation.
Greenish-brown. F.	Blood.	See B; occurring in alcaline urine.	
G.	Bile.	See E; occurring in very acid urine.	
Grass-green. H.	Excess of Sulphur?	Unchanged by heat or nitric acid.	Presence of cystine.]

J. Bostock.

URINE, BLOODY; *Hæmaturia*, (from αἷμα, *sanguis*, and οὐρέω, *mingo*,) *mictus cruentus*; bloody urine; hemorrhage from the urinary organs. The name of hæmaturia has generally, since the time of Sauvages, been applied to this kind of hemorrhage, but with somewhat different latitude of meaning by different authors.* According to its etymological sense, it should be restricted to cases in which blood is effused by the vessels of the kidneys, ureters, or bladder, and discharged along with the urine; excluding from the definition *urethral* hemorrhage, in which the blood flows by drops or in a continuous stream from the orifice of the urethra, which is not a *mictus cruentus*. We shall, in the present article, treat of hæmaturia in this restricted acceptation, for which we have the authority of Frank; and, independently of correctness of nomenclature, it is more convenient to adopt this distinction, because urethral hemorrhage, both as regards its causes and its treatment, belongs entirely to the province of the surgeon, and its consideration does not therefore properly come within the plan of this work.

Hæmaturia, therefore, in the sense in which we are to employ the term, includes hemorrhage from the kidneys, ureters, or bladder. The most common cause of such hemorrhage is the irritation or mechanical lesion of the texture of these organs occasioned by calculous formations. Less frequently it is the consequence of other diseases of these organs, as of the malignant degeneration of the kidney termed fungus hæmatodes, and of various forms of disease or chronic irritation of the bladder. It is also met with as a symptom in some diseases affecting the general system, and particularly in adynamic fevers, confluent smallpox, purpura, and scorbutus. In other instances, its cause is less evident, and it can only be referred to local congestion, as in the case of hæmaturia supervening on suppression of habitual hemorrhoïs in males, or the suppression or cessation of the menses in females. In some cases of this kind, and in others where the hemorrhage has appeared to belong to that class termed *constitutional*, (see Hemorrhage,) it has been observed to recur at regular periods, or at distant and uncertain intervals, without any detriment to the health of the individual. Such cases, however, are of rare occurrence.

The existence of idiopathic hæmaturia was doubted by Cullen; and the extensive clinical experience of Frank shows it to be at least extremely rare. Out of four thousand patients in the clinical wards of Pavia, only six cases of "spontaneous hæmaturia" were observed. In the clinical institution of Vienna, 1913 patients afforded only a solitary case; and in the general hospital of that city, one only, out of 13,647 deaths, was recorded to have ensued from this disease. (*Frank*, de Curandis Homin. Morbis, tom. i. pars ii. p. 250.) It should also be kept in mind, as Cullen justly observes, that from the frequent obscurity of the causes of hæmaturia, and especially of the symptoms denoting calculus or other diseases of the kidneys, it may often be supposed to be a primary affection, where in reality it depends on an undiscovered cause, and in particular on a calculus, or organic disease, the existence of which is only revealed by dissection. (See Calculous Diseases, and Kidneys, diseases of.)

The diagnosis of hæmaturia consists, first in ascertaining the presence of blood in the urine; and, secondly, when this has been ascertained, in determining the organ from which the hemorrhage proceeds. But our inquiries are incomplete, until we further satisfy ourselves as to the cause, whether of a local or general nature, which gives

* In the nosological system of Vogel, *hæmaturia* denotes hemorrhage from the kidneys exclusively; that from the bladder being termed *cystirrhagia*. Sauvages includes under hæmaturia every discharge of blood from the urinary organs.

rise to the hæmaturia; as on the knowledge of this, the rational indications of treatment will chiefly depend.

Blood is met with in the urine in large or small quantity, fluid or coagulated, more or less intimately mixed with the urine, and sometimes accompanied with pus, mucus, or calculous deposits, according to the circumstances in which the hemorrhage takes place, and the organ from which it proceeds. When the blood is in considerable quantity, and separates readily from the urine, there can never occur any difficulty in recognising its presence.

When the proportion of blood is scanty, and it is intimately blended with the urine, or when its fibrin and colouring matter are deposited in an altered condition, some attention and care will be requisite to discriminate between the appearances which it presents and those which arise from morbid changes in the constituents of the urine. When this fluid is of a deep or reddish colour, in consequence of the excess of its saline ingredients, and especially of lithic acid, it is transparent when expelled from the bladder, and becomes turbid on cooling. Blood, on the contrary, in however small quantity, renders the urine less transparent from the first; and the application of heat, instead of restoring its transparency, coagulates the albuminous portion of the blood. A reddish tinge, easily to be recognised, is imparted to a piece of linen immersed in the urine, if it contains even a small quantity of blood. These simple tests will, in general, prove with sufficient accuracy the presence of blood in the urine, and supersede the necessity of any more elaborate chemical investigation. When blood is poured out in small quantities by the kidney, it is sometimes coagulated in the ureter, and is found in the urine in the form of threads or tubes of fibrin, moulded to the shape of that canal, and which have not unfrequently been mistaken for worms. It has also occasionally happened that a bulky coagulum has been formed in the bladder, occasioning sensations of weight and uneasiness referable to that organ, and sometimes giving rise to retention of urine.

We now proceed to the next step in the diagnosis, the investigation of the symptoms which denote the hemorrhage to have proceeded from the kidney, ureter, or bladder respectively, and of the causes on which hemorrhage from each of these organs more particularly depends.

Hemorrhage from the kidney, it is probable, scarcely ever takes place except in consequence of calculus or organic disease. It has already been noticed, that the symptoms of renal disease are frequently so obscure as not to lead the practitioner to a knowledge of its existence. But where there is reason to believe that calculus or any other disease of the kidney exists, and hæmaturia suddenly occurs after any violent exertion, or after exercise which particularly affects the muscles of the loins, as riding on horseback or in a carriage, it may be suspected to have its source in the kidney, especially if the flow of blood be copious, and if it be generally diffused through the urine, particularly if the bladder does not appear to labour under any disease.

Hemorrhage from the ureter probably never takes place except in consequence of the passage of a calculus, or its becoming impacted in some part of this canal, in which case it will be attended by the symptoms which denote the descent of a calculus, viz. nausea, vomiting, rigors, pain shooting down in the direction of the ureter towards the thigh, and retraction of the testicle.

Hemorrhage from the bladder is of more frequent occurrence, as this viscus is liable to be affected by more numerous causes of disease. When a calculus is lodged in the bladder, particularly if its surface is rough, and when it lies loose in the cavity, it is very liable, on any motion of the body, to produce abrasion of the vascular mucous membrane, and consequent hemorrhage. When it has remained in the bladder for some time, its irritation causes an abundant secretion of glairy mucus, which in some degree defends the membrane, and renders hæmaturia a less frequent accident. The calculus becoming fixed, either from its large size, or from the formation of a cyst, it is also less liable to excite hemorrhage. (See Calculous Diseases.)

The symptoms denoting the existence of a calculus in the bladder are too distinct to leave any doubt as to the nature and seat of hæmaturia proceeding from this cause. In other diseases of the bladder, such as the fungous excrescences described by Dr. Baillie, and in the different forms of chronic cystitis, or, as it has been usually termed, *catarrhus vesicæ*, the urine is not unfrequently tinged with blood; but no considerable hemorrhage occurs in these cases. (See Cystitis.) The hæmaturia which occurs in consequence of suppressed hemorrhoïs, or from other constitutional causes, most probably takes place from the mucous membrane of the bladder, though in such cases there are no symptoms indicating an affection of this organ. In fevers, purpura, &c., the blood may be poured out by the vessels both of the bladder and of the kidneys, and it is the result of a general hemorrhagic tendency; but it probably proceeds chiefly from the extensive mucous surface of the bladder. The name of *hemorrhoïdes vesicæ* was given by the older writers to a form of hæmaturia occurring in hemorrhoidal subjects, attended with symptoms of painful congestion around the neck of the bladder, which are relieved by the occasional or periodical occurrence of hemorrhage. It was considered by Frank as a milder form of chronic cystitis.

From what has now been stated respecting the causes and symptoms of renal and vesical hæmaturia, it may be understood that, unless there exist evident symptoms of a morbid affection of the kidney or bladder respectively, it will often be difficult to determine from which of these organs the hemorrhage proceeds. Affections of the kidney, even of the most serious kind, are often, as we have seen, unattended by evident symptoms. From the greater sensibility, as well as the more superficial situation of the bladder, its diseases are more easily recognised. We must, however, in all cases, keep in mind the sympathy which prevails between all the parts of the urinary system, and the readiness with which not only the sensations of pain, heat, weight, &c., which indicate disease, but also disease itself, is propagated from one part of this system of organs to another. Hence, even where the symptoms appear to indicate the blad

der or the kidney respectively to be the seat of the hemorrhage, we cannot draw from them a certain conclusion. Provided, however, that the state of the constitution, and the cause of the hemorrhage, as far as this can be ascertained, be kept in view, this uncertainty will not be attended with any material difficulty or disadvantage with regard to the treatment.

The **predisposing** and **exciting causes** of hæmaturia are mostly referable to those of the local or constitutional diseases of which it is a symptom. General plethora, and the other common causes of hemorrhage; hereditary predisposition to calculous complaints, or to hemorrhoidal congestion; intemperance; hard riding; hot climates; excessive venereal indulgences; may be enumerated among the most usual predisposing causes of hæmaturia. The exciting cause, in calculous cases, is commonly over-exertion, or long-continued exercise affecting the loins or pelvis, especially riding on horseback, or the motion of a carriage over rough roads or pavements. The same causes, perhaps, sometimes excite hæmaturia, where no calculous complaint exists. Contusions or penetrating wounds, in which the urinary organs are implicated; the wounding of the bladder by a sound or other instrument rashly or unskilfully introduced; acrid substances received into the stomach, particularly those which have a specific action on the urinary organs, as canthades and turpentine; all these act as occasional causes of hæmaturia. Both sexes are liable to hæmaturia; but males are more generally exposed to the action of the causes which produce it. It never occurs in young children, except in consequence of a calculus. It is chiefly an affection of middle life, though in its more chronic forms old men are subject to it, from their proneness to disease of the bladder.

Prognosis.—Hæmaturia, when it arises from any slight occasional cause, or when it appears to be vicarious of a suppressed constitutional hemorrhois, is not attended with danger. Instances are related of its having proved fatal from the profuseness of the hemorrhage; but such are exceedingly rare. Yet in old and enfeebled subjects, it must be considered an unfavourable occurrence. In febrile diseases, it has perhaps sometimes occurred as a salutary crisis; but much more frequently, especially in adynamic fevers and confluent smallpox, it denotes serious lesion of the vital powers, and is a symptom of the most unfavourable character. In purpura, it seems to have in some instances proved salutary, or at least to have been followed by recovery; but where the prostration of strength is great, and much previous hemorrhage has occurred, it is a symptom of great danger. When hæmaturia arises from calculus, the prognosis will necessarily depend on the circumstances of the primary disease. When it is dependent on organic disease of the kidney or bladder, we need not add that the case is hopeless.

Treatment.—In most cases of hæmaturia, the treatment must be almost exclusively directed to the primary disorder. When it appears as a *constitutional* hemorrhage, it does not, unless it becomes excessive, require the interference of medicine. When it arises from suppressed hæmorrhois or interrupted menstruation, it will be best combated by having recourse to the most effectual and safe means of restoring these evacuations. When there is evidence of general plethora, or of an inflammatory diathesis, venesection, mild purgatives, and an antiphlogistic regimen will of course be advisable. Topical bloodletting, by cupping or leeches, will be proper where the symptoms of local congestion or irritation are considerable, though they do not amount to actual inflammation. In all cases of this kind, copious draughts of diluent liquids will be beneficial, but especially in calculous cases, and in those in which hæmaturia has been occasioned by the ingestion of acrid substances, such as cantharides. Rest, or the gentlest exercise on foot, are to be enjoined in all, but especially in calculous cases; and the greatest caution as to exercise, especially on horseback, should be recommended to patients who have suffered from calculous hæmaturia. When the discharge is profuse, has continued for some time, and has put on a passive character, astringents must be resorted to as in other cases of passive hemorrhage. Of internal astringents, Dr. Elliotson gives a decided preference to oil of turpentine in moderate doses, as from twenty to thirty drops every four or six hours. He does not hesitate to employ this remedy, even in cases of hæmaturia connected with organic disease of the kidney; combining it with opiates to allay irritation and pain, and to procure rest. (Medical Gazette, xii. 723.)

[The iodide of iron may be found, in such cases, a valuable agent. It possesses not only tonic properties, but adds to the coagulability of the blood,—increases, in other words, the action of the system of nutrition of the vessels, and prevents their parietes from being so permeable; and, by increasing the consistence of the blood, renders it less penetrative. The tincture of chloride of iron has likewise been strongly recommended in such cases.]

In this, as in other forms of passive hemorrhage, it will be essential to employ proper means of supporting the strength of the patient. Where the profuseness of the hemorrhage requires more powerful means to arrest it, which is not often likely to be the case, the administration of enemata of cold water, and the application of cold water and vinegar to the loins and pubis, will be proper, if employed with due moderation and caution. When the blood has coagulated in the bladder, and forms an obstacle to the passage of the urine, it will be necessary to have recourse to surgical aid for its removal. This must be attempted in the first instance by the introduction of a catheter of large size; and if this expedient is not successful, tepid water should be injected into the bladder, to break up and dissolve the coagulum.

GEORGE GOLDIE.

URTICARIA. An exanthematous eruption of the skin, so called from the resemblance which its patches or wheals bear to those produced by the contact of the common nettle, (*urtica dioica*). This is now accepted generally as the classical appellation, but the disease is distinguished in authors by various titles. The Arabians first called it essera, or rather, according to Good, *eshera*, a word which has descended to recent times, and been employed for its designation by

Heberden and Underwood. It is the febris urticata of Vogel, purpura urticata of Juncker and the scarlatina urticata of Sauvages. The French commonly denominate it *fièvre ortiée* or *porcelaine;* and its German name, *Nesselauschlag*, is synonymous with our vulgar English, nettle-rash.

Urticaria is an affection very distinct in its phenomena and history, from other diseases of the skin, and especially from those called exanthematous. Its general characteristic is an assemblage of large patches somewhat elevated above the skin, and contrasting with the latter by a pale red colour. These elevated patches have in their centre a white speck, resembling a flat vesicle, and by running into each other form what are called wheals, the appearance of which is accompanied by an intense itching and tingling heat, entirely similar to that produced by the stinging of nettles. The disposition of the patches is irregular; at one time they affect a round form with well-defined edges; at another they run out into long streaks, and occasionally they form considerable knobby swellings which disfigure the face, and produce alarming symptoms by the tumefaction and pressure of the skin of the neck. The invasion of the eruption is for the most part sudden, and its duration indeterminate; the individual patches are generally fugitive, fading and reviving often in the course of a few hours. It is not communicable by contagion, and is for the most part secondary to irritation in the stomach and alimentary canal, although in some cases this cannot be established. The fever which most frequently accompanies it is of a remittent type, and is very varied in its acuteness.

The circumstance which is probably of the greatest importance in considering the nosological division of uticaria, is the being accompanied, or not, with fever. There are, however, many other phenomena comprehended in its history, which deserve to be prominently distinguished. The different writers of authority who have treated of this disease, have seized, some on one and some on another of these phenomena as the basis of their arrangement, but they are all referable to differences in the form and disposition and the duration of the eruption. J. P. Frank recognises fever as a discriminating condition worthy of attention; but considering the uncertainty of its presence, and the variety of its character, he gives it no place in his division, which he founds entirely upon the form of the exanthem. He comprises its description under three species, viz. urticaria *maculosa*, *vesicularis*, and *tuberosa*. Rayer, whose work appears to us to be founded chiefly on the labours of Willan and Bateman, generally modifies their subdivisions. He has accordingly given its history without observing any specific distinction, or only alluding to them *en passant*.

Mr. Plumbe, whose plan is so widely different from the artificial method, makes his also one general description. He testifies, however, to the utility of Willan's arrangement, and subjoins the consideration of urticaria according to his species. In the work of Cazenave and Schedel, derived mainly from Biett's lectures, the classification of Willan is preserved, with this difference, that the six species of the latter are compressed to three, viz. *urticaria febrilis, evanida,* and *tuberosa,*—a division which, we may remark, is founded on three distinct pathological conditions. In other articles on cutaneous disease, (see Lepra, Lichen, and Scabies,) we have given reasons for adopting the specific divisions as well as the general arrangement of Willan. He resolved urticaria into six species, for which division, (admitting, as we have done, the advantage of his principle,) we find no necessity for substituting any other.

Urticaria febrilis.
——— evanida.
——— perstans.
——— conferta.
——— subcutanea.
——— tuberosa.

They have all some distinctive marks, which entitle them to a separate notice; and although, if we judge rigidly, it must be confessed that some of them stand on a weak support to constitute species, yet there is a great facility afforded to the description and to the study of the disease by this subdivision; and, moreover, it seems to us that by contracting it we deprive ourselves of the chief benefit of an artificial arrangement, some sort of which, however, by the practical admission of all accurate authors, is indispensable to the faithful delineation of the disease.

Urticaria Febrilis, *Febrile Nettlerash.*—The eruption of this form generally consists of wheals arising in the midst of irregular patches of a red efflorescence. In other instances, there appears only a rash of crimson papulæ, not unlike the form of those of lichen, but deeper in colour. It is for the most part defined by the elevation of the patch above the rest of the surface, and circumscribed by a border caused by the swelling of the skin within the inflamed area. The appearance of the rash is accompanied by great heat and itching, which incommodes the patient, especially during the night, or on exposing the parts to cold air; for it seems to be a peculiarity of this eruption, as remarked by Vogel, that it comes out more in the cold, and is rather allayed by heat.

Before the rash makes its appearance, the individual is affected for two days or more with headach and languor, together with pains in the limbs, slight shiverings, and sickness in the stomach. The anxiety and oppression are, in some cases, exceedingly great; and not uncommonly, in severe cases, syncope takes place. The feverish symptoms, particularly the pain and sickness of the stomach, are invariably mitigated by the coming out of the eruption; and throughout the course of the disease there generally exists an inverse proportion between the internal disorder and the cutaneous exanthem. During the day-time, the fever as well as the eruption mostly subsides; but on the return of the evening, both re-appear, and continue during the night, which is spent in restlessness and anxiety, on account of the heat and itching. While the febrile action is present, the pulse is full and frequent, but seldom strong; and during the remission it sometimes sinks even below the healthy standard.

The extent of the eruption is indefinite; it appears and disappears on different parts of the body irregularly, one day affecting the extremities, and the next the face and neck, or the chest and belly; and indeed, while the fever lasts, it may be excited

by friction or scratching on the parts where it had not previously shown itself. The ordinary duration of the disease is six or seven days, at the conclusion of which period the feverish symptoms have ceased to recur in the evening. It is no uncommon case for the malady to be abruptly terminated about this time by a copious sweat; and we have observed a slight discharge of blood by stool to have apparently the same critical effect. The final disappearance of the eruption is generally succeeded by a slight exfoliation of the cuticle.

Febrile nettlerash may occur at all ages. It most usually affects young persons, especially those of a fine and delicate skin, and those whose occupations are of a sedentary nature. In adults it often occurs amongst those who indulge in the gratifications of the table; and it is observed that moral affections, such as grief and anxiety, render those of a nervous temperament liable to it. Underwood (Diseases of Children,) says that it frequently occurs in children under two years of age. They continue screaming for some time before the cause is discovered, when, upon examining the body and the lower limbs, they are found covered with large wheals: the fever, however, is much less in them than in adults, and the whole affection shorter in its duration. The disease has been occasionally observed to assume an intermittent form, and to be accompanied with severe symptoms. In cases detailed by Bricheteau, (Journal compl. des Sc. Méd. tome xxxvii. p. 266,) the tertian type was so accurately presented, that it appeared doubtful whether the primitive disease was really urticaria, or whether the cutaneous eruption which appeared and departed with the intermittent paroxysm, was not to be considered as a mere epiphenomenon to the latter. The question is not without pathological interest, but it does not add any difficulty to practice, as the treatment which is proper for the affection is precisely that which is most efficacious against ague.

This febrile species of nettlerash appears to have been regarded by authors as the type of the disease. It is it more particularly which Juncker, Sauvages, and Vogel, intended in their description under the names we have before mentioned. It corresponds with the *maculosa* of Frank, and is the same which Sydenham described under the title *febris erysipelatosa*.

The remarkable form of urticaria which is produced by the use of certain articles of food, especially some kinds of fish, is usually described by authors under this species. It agrees with it, indeed, in the existence of fever, and the bare enumeration of symptoms is not much different. They possess, however, a much greater intensity of character than in the common febrile nettlerash, and the general features of the affection are so much modified by the exciting cause, that it demands a distinct notice. We shall, therefore, advert to it in connection with its source, when considering the *causes* of urticaria.

Urticaria Evanida: *evanescent nettlerash.*—The regularity of an exanthem is entirely wanting in this species, and it is unaccompanied by fever. The eruption consists of rounded wheals, which sometimes extend in long streaks, resembling those produced by flagellation. These appear at irregular intervals, sometimes in one situation, sometimes in another; but probably the face and arms are most frequently affected with it. They disappear at the end of a few hours, but are easily reproduced by change of temperature, exercise, or other trivial causes. Their colour scarcely differs from that of the general skin, and they do not rest upon a red base like those of the febrile urticaria. A violent itching attends the eruption, which is most troublesome on undressing. A case is in our memory in which it used to come out in the head of a boy during the night for some time, and caused such excessive irritation by its tingling heat, that the bed-hour was dreaded by the young patient. He used to start out of sleep, violently scratching his head, and rolling his eyes wildly, he would exclaim that "his head was bursting," and that he should "go mad."

This species of nettlerash is usually a chronic affection, but the greatest diversity obtains with respect to its duration. It may be dispersed in two or three days, or last for months and even years. Heberden (Commentarii, p. 132, ed. Frankf. ad. Mæn. 1804,) relates that he has observed it continue with few intermissions for two, in some seven, and in others for ten years. While neither age nor sex is exempt from it, females and young men of a sanguine temperament and soft skin are more liable to it. In itself it can be said to produce no disturbance except what arises from the pruritus, but those affected with it are likewise liable to suffer from headach, languor, and flying pains, which have no more connection with the urticaria than that they are generally all symptoms of a disordered state of the chylopoietic viscera.

Urticaria Perstans: *stationary nettlebrash.*—Except in the unimportant circumstance that the wheals of this species are permanent, while those of the *evanida* depart and return frequently during the course of the disease, there is little difference between them. It is to be remarked, however, that it is much more easily eradicated than the former species, and these characteristics we think sufficiently justify Willan in allotting it a separate position.

Urticaria Conferta: *confluent nettlerash.*—The eruption belonging to this species is similar in form to that of the febrile nettlerash, but the wheals are surrounded by a more inflamed base. As its name implies, moreover, they coalesce in many situations, and form irregular figures. These marks, however, would have been by no means a sufficient reason for their separation, if this were not decidedly afforded by the absence of the exanthematic fever in the *conferta*, which is the peculiar character of the *febrilis*, and by its chronic duration. Bateman affirms that it "chiefly affects persons above forty years of age, who have a dry and swarthy skin, and seems to originate from violent exercise, or from indulgence in rich food and spirituous liquors."

Urticaria Subcutanea: *subcutaneous nettlerash.*—This is a form of the affection which is accompanied by the tingling and stinging of the other species, but it differs from them in this remarkable particular, that no eruption of wheals appears. Although we have adopted Willan's appellation, it does not seem to be warranted, for there is no proof that any rash makes its appear-

ance under the skin more than on its surface. Urticaria *latens* would have more correctly designated this species, if it were indeed necessary to distinguish it from the former on account of the non-appearance of the cutaneous rash. A similar deviation occurs not unfrequently in scarlatina, and probably in the other exanthemata; but in this it is a more striking circumstance, inasmuch as the heat and stinging is not less troublesome (sometimes resembling the pricks of needles) than in the cases which present the most vivid eruption to the eye.

Urticaria Tuberosa: *tumid nettlerash*.—This is a rare form of the disease, but one which, from its severity and peculiar symptoms, was properly distinguished from the others by Frank. It is characterized by the eruption of red swollen patches, of the breadth of the hand, accompanied by a pruritus of such an intolerable severity as sometimes to cause fainting. They rapidly increase, and take the form of tuberosities of considerable size, which extend deeply, and are so tense and hard as to interfere with free motion, for they generally spread to a great extent over the whole surface, commencing often on the face, and affecting more particularly the inferior extremities. The tuberosities come out in the evening, continue during the night, and disappear in the morning, leaving the patient weak and sore, "as if he had been bruised or much fatigued by exercise." They have the same property of being increased by exposure to cold air, and diminished by the heat of bed, as the wheals of the other forms of urticaria.

This species is accompanied by much general disorder. It occurs usually in those addicted to excesses at table, either in eating or drinking, and has been observed to succeed rapidly upon a debauch. During the coming out of the swellings, a smart rigor and much anxiety are generally present. Cases are recorded in which the erethism of the skin proceeded to such a pitch as to threaten rapid suffocation by the tumefaction of the neck and chest, which at once caused compression of the trachea, constriction of the motions of the thorax, and disturbance of the action of the heart and larger vessels. Its duration is not to be defined: in some instances it may be got rid of by proper treatment, in the course of one or two days; but as it occurs commonly in constitutions impaired by excess, it is more frequently a tedious and obstinate affection.

Causes.—As a general fact, it may be stated that urticaria is always secondary to some internal irritation, of which, for the most part, the seat is the stomach and bowels. In children it is often connected with those disorders of the latter which are produced by dentition. The same principle is true with respect to its occurrence in adults, in whom also it can be usually traced to some cause producing temporary irritation in the stomach. We are inclined to doubt that it has ever been, properly speaking, idiopathic, although in some persons of very irritable skin, and in spring and summer, when its functions and sympathies are in increased activity, an amount of internal disorder almost imperceptible may be sufficient to give rise to it. It has been known to occur also as a symptom of cancer of the uterus, and other internal diseases. We should state, however, that Good considered that it sometimes did arise idiopathically, and that Heberden was inclined to believe that the skin itself is often the chief seat of the disorder, and that the stomach and the system only suffer secondarily. (Study of Medicine, vol. iii. p. 36.) It is never contagious.

It is well known that urticaria often originates from the taking into the stomach certain substances to which it has been unaccustomed, or which seem to operate upon some idiosyncrasy of the individual. To this must be referred the occurrence of it from the use of valerian and some other articles of the materia medica, and also after certain articles of aliment, as cucumbers, mushrooms, almonds, honey, &c. The connection between such substances and the nettlerash is not at present ascertainable; it is worth remarking, however, with respect to the subject, that there are individuals of highly excitable temperaments, who are liable to sympathetic affections of a peculiar nature from certain impressions on their nervous system, and that the nettlerash is observed to occur amongst those. Dr. Autenrieth notices this subject, and illustrates it by some cases, and especially by a remarkable one, which has an immediate reference to the matter alluded to. He knew a woman who was possessed of such uncommon irritability that the application of a sinapism threw her into a violent fever, with an eruption of bullæ over the whole body; the sting of a bee produced a terrible cutaneous swelling, with such an affection of the spirits, that she wept the whole day; and finally, on eating crabs, or other fish, or even potatoes, she was attacked with fever, accompanied by general erysipelatous inflammation* and profound languor.

It arises, however, so frequently after some kinds of fish are partaken of, that they must decidedly be reckoned as exciting causes, independent of individual predisposition. A great variety might be mentioned as having been known to produce it, but that which by universal observation stands most in connection with it is the mussel. After this may be enumerated lobsters, crabs, mackarel, salmon, some species of pike, tench, carp, and barbel. Many of the tropical fishes have this property also in a very intense degree, as the kingfish, the yellow-billed sprat, barracuda, porgee, the Otaheite eel, &c. The action of many of these on the economy is so injurious that the urticaria which follows is to be regarded as amongst the less severe symptoms: and with respect to the nature of the deleterious influence which the fish exerts, a little acquaintance with the history of its effects makes us accede to the universal opinion that it is a genuine poison. This, indeed, has been long known; the only question agitated for many years has been, what constitutes the poisonous qualities of such fish. It was referred at one time to a diseased condition of the fish; at another a chemical ex-

* *Autenrieth*, Ueber das Gift der Fische. Tübingen, 1833, p. 116. We give here the words of the author, but that he means *nettlerash* we have no doubt. In other places he uses ambiguous phrases where it is decidedly intended; and again, we find that the word *Rothlaufsentzündung* is often freely employed to signify any efflorescence of the skin with heat, itching, and fever. See *Raimann's Pathologie und Therapie*, v. i. p. 496.

planation was proposed, namely, that it depended on the impregnation of the fish with copper. Some writers believed it a sufficient explanation to refer it to a putrefactive state of the fish, and others considered that the deleterious principle was contained in some of its secretions, or in some particular organ. The most recent investigator of the subject is Autenrieth, and although the composition and origin of fish-poison still remain a mystery, his researches are an approximation to the truth, and tend much to clear away error. We refer to his work for several interesting details, and must be content here to give the conclusion he arrives at. Having traced its analogy with old cheese and rancid sausages in smell, taste, and effects, he concludes that the poisonous property of fish is contained in a bitter principle which is found in combination with a fatty matter in the fish, usually passed into a state of rancidity, and he compares the connection between this bitter and the fatty matter to that which subsists between pyroligneous acid and its bitter principle (kreosote), or between prussic acid and the volatile oil of bitter almonds. This appears to exist in some fish before death, in others only when decomposition has already commenced. It is also established that most of the fish are only poisonous at particular seasons of the year, which is found in some to be the spawning time,—a fact which must have the same explanation as that in many fish only certain organs are poisonous, and those are invariably found to be the parts in which oily matter most richly abounds. We add that it seems probable that the deleterious influence of animal substances in general in a state of putrefaction may be owing to the development of this poisonous fatty principle, as their pathological effects are strikingly similar to that of fish-poison. In considering the operation of fish-poison, Autenrieth divides it into three forms, which may be called the choleric, the eruptive or urticose form, and the paralytic or collapse form. The first two of these consist of those cases in which the impression of the poison is followed by a violent reaction of the general system, and they differ from each other in that the first exhibits its effects mainly in the internal organs, especially the stomach and bowels, while the second manifests itself upon the cutaneous periphery. The third form is named paralytic or collapse, because in it the poison acts with such intensity on the nervous system as to take away all power of reaction, so that the patient sinks under a gradual exhaustion of the vital powers. It is beside our purpose to proceed further; but as we did not describe the peculiar characters of urticaria arising from fish-poisons in the general history, we subjoin here a sketch of its symptoms as constituting the second or eruptive form of Autenrieth:—

"The phenomena commence usually a short time after the repast which causes them, and are ushered in by a sudden and vehement excitation of the vascular system, with a remarkable rushing of blood to the head. Whilst the carotids pulsate and the eyes grow red and turgid with fluid, the patient becomes affected with giddiness and the most violent and rending pain in the head. The eyes roll wildly in their orbits, and the eyelids are held spasmodically open. At the same time the face swells up, as do the buttocks and the limbs, and a scarlet redness or an urticose eruption overlays the whole body, accompanied with severe burning itching. In rare instances large vesicles or bullæ rise upon the skin. The patient perhaps plunges his hands into cold water to mitigate the heat, but each time he does so he experiences a peculiar stinging or prickling in them, and also in the nose. With this eruption at one time is combined fever with hard frequent pulse, tightness of the chest, and general shivering; at another violent pains in the limbs or the back, or on the other hand, with loss of sensation, and even total immobility of the limbs. The inner surface of the body also takes a part in the morbid excitement, although in a much less degree in this the eruptive than in the choleric form of the affection. Pains in the stomach and bowels soon set in, which are followed by griping, purging, and vomiting. For the most part in the milder cases, when these evacuations take place, the erethism of the vessels gradually subsides, the cutaneous swelling sinks, the pulse loses its hardness and becomes smaller, and at length a favourable sweat comes, which puts an end to this short malady. It is frequently followed by exfoliation of the cuticle."

In the cases, however, which occur after the partaking of the poisonous fish of the hot climates, the recovery is not so rapid, and the disease of a much deeper cast. "For besides that the forementioned symptoms are far severer, the heat and itching being intolerable, and the eruption of an erythematous form, and the giddiness increased to a vertiginous reeling, still further phenomena appear. Dreadful cramps in the limbs and in the intestines rack the patient; a peculiar constriction with a prickling heat occurs in the pharynx, and a painful tenesmus, with strangury and retention of urine, supervene. To these in some instances is added an icteroid hue of the skin and urine, and even the sweat is known to stain the linen. But what is perhaps the most oppressive to the patient are the shooting pains in the swollen knee-joints, wrists, and the instep, and in the periosteum of the cylindrical bones. When he has, under these symptoms, for a long time vibrated between life and death, their violence at length diminishes, and when this occurs the skin peels off in several places, the hairs fall out, and even the nails drop. Occasionally abscesses form under the skin, which, although coming at the close of the disease, have not the same critical importance as those which are so favourable a termination to typhus; and they appear to be rather a purulent dissolution of the cellular tissue under the skin than a regular phlegmonous abscess." (*Autenrieth*, Op. cit. p. 131.) Even this laborious recovery, however, sometimes fails, and the patient sinks rapidly under the violence of the symptoms, or else, having made a rally through them, dies exhausted by the weakness succeeding them, which is in some cases aggravated by excessive suppuration of the skin. After death the stomach and pharynx have presented marks of a high state of inflammation.

Diagnosis.—It is not a difficult matter to discriminate between urticaria and other cutaneous eruptions, yet while this is the case, it is necessary to be well versed in the distinguishing marks on

which its diagnosis rests, as instances occur in which it is important. Those are furnished by the characteristic form of wheals which the eruption assumes, by the peculiar stinging heat of its pruritus, and by its fugitive character.

There exists a possibility of confounding it with the other exanthematous diseases, rubeola, scarlatina, and erythema. This, we apprehend, however, could only occur through inattention; therefore it only requires to refer to the wide difference which the characteristics of the latter present in contrast with those we have just laid down as belonging to urticaria, at the same time intimating that error would be prejudicial both to the patient and the physician. Two forms of erythema, the *papulatum* and *nodosum*, have been noted as presenting some characters which might impose on the observer at the first glance. But besides the papular nature of the first, in contrast with the wheals, it is to be remembered that erythema is not fugitive or remittent in its progress, but continuous; and examination of the papulæ discloses the violet tint, which is never present in any variation of urticaria; although, as we have seen, the *febrilis* sometimes presents papulæ instead of wheals. The elevated nodosities of the erythema *nodosum* have nothing in common with any form except the urticaria tuberosa, in which also the skin is raised into tuberosities. The external character of these, however, is entirely different; the erythema presents scattered isolated swellings, while those of this form of nettlerash are aggregated, and rising in the midst of the swollen skin; but a reference to the severe symptoms which accompany the latter will furnish at once a decisive criterion.

A species of lichen, the *urticatus*, has also been contrasted with it for the sake of diagnosis. Its papulæ are round, small, and little elevated; they are also firmer under the finger, and their colour is deeper. Their chief distinction is, however, their persistent character, as it is this which renders it at all desirable to separate this affection from urticaria, with which in other respects, as its name implies, it has much affinity.

With respect to the diagnosis of that more severe variety of the disease which arises from fish poison, the circumstances under which it occurs, and the symptoms to which it gives rise, will sufficiently protect it from being confounded with any other disease. It is of much importance, however, that no obscurity should exist with regard to it, for it happens that the only affections which resemble it are the effects of the mineral poisons, arsenic or copper, or else the disease of which symptoms are not very dissimilar to the latter — cholera. The possibility of confounding it with the former was indeed proved by a legal case, in which a woman was suspected of having administered poison to her husband, who died suddenly after eating mussels. (Bateman's Synopsis, p. 132, note.)

Prognosis and treatment. — In its ordinary forms, urticaria is not attended with danger; but instances occur in which it becomes a very severe affection, and may take a dangerous turn. We are not acquainted with the constitutional conditions which give it an unfavourable impress, but that such idiosyncrasy exists is proved beyond doubt by many observations. It obtains even in that produced by the poisonous fish, as out of a large party who have partaken of the latter, the majority sometimes escape altogether, whilst amongst those in whom it occurs some are severely, others but slightly affected. It seems to be under such circumstances that some chronic nettlerashes are exceedingly intractable, but it is of more practical interest to know that interference by a perverse treatment may render cases so which in themselves had nothing to prevent a favourable course and speedy termination.

The febrile urticaria has a period, as before stated, of about seven days; and it seldom is in the power of medicine to disperse it before that time; and, indeed, it will be the more prudent aim of the physician rather to moderate its symptoms than to attempt by the exhibition of strong measures of any kind to cut it short. His interference in many cases need be very little, and he has occasionally to exercise both judgment and delicacy in withholding it. The remitting nature of the fever, and the itching, is a cause of anxiety and disappointment to the patient, which is best obviated by warning him of its character. In cases where a suspicion is entertained that the stomach retains any offensive matter, it will be proper to commence the treatment by the exhibition of an emetic of ipecacuanha, after which the patient should be placed in bed, where he ought to remain, even during the remission, until the affection subsides. His bowels should be kept moderately free by the use of gentle laxative medicine, but strong cathartics are uncalled for and improper. We have known the use of one, which moved the bowels three times, produce such a weakening effect, that deliquium took place after each evacuation. Small and repeated doses of the acid infusion of roses with sulphate of magnesia, will be found to suit well as an aperient. In lax habits this end may probably be as conveniently answered by a draught composed of equal parts (ten to fifteen grains) of magnesia and rhubarb in an ounce of cinnamon water, with the addition of twenty drops of aromatic spirit of ammonia. In some cases it will be preferable to use enemata with castor oil. Some authors recommend warm bathing; we apprehend that while the fever lasts its use might be better dispensed with; but at its subsidence warm bathing has an excellent effect in restoring the vigour of the skin, and renovating the general health of the patient. The cinchona or sulphate of quina with sulphuric acid in small doses should be administered also at this period as a tonic. In the cases, however, which assume a genuine intermittent type, this remedy must be administered from the time that this can be verified.

No endeavour should be made to repel the eruption in any of the *acute* forms of nettlerash, by the application of cold, nor should the practitioner countenance its use in any way, even for the temporary allaying of the heat and itching. Frank notices (Op. cit. lib. iii. p. 112,) cases that have been recorded, in which fatal metastasis to the brain was the consequence of urticaria repelled by cold. An instance was also known to Dr. Macintosh, (Practice of Physic, vol. i. p. 155,) in which the application of Goulard-water for the

same object was instantly followed by fainting, and the patient narrowly escaped with life through a dangerous fever. The employment of tepid baths for the mitigation of excessive pruritus is recommended by several, and if cautiously used they are unobjectionable, and much more effective than cold.

In children no other treatment is necessary than attention to the state of the teeth and bowels. The employment of common absorbent medicines and alteratives will be found quite sufficient to combat it. Amongst these the pulvis contrayervæ compositus is extolled by Underwood. We have found no powder have so uniformly a favourable action with children, as one composed of from two to five grains of hydrargyrum cum cretâ, with an equal proportion of rhubarb, and a quarter of a grain of ipecacuan.

In the chronic forms of nettlerash the treatment is often a matter of much greater difficulty, as these affections depend frequently upon internal causes, which it is not easy to appreciate. They are sometimes connected with the habitual use of some disagreeing article of diet, and Willan found that the only way of at once detecting their cause and eradicating them was to direct the persons so affected to omit, first one, and then another article of their food and drink. The offending substance was different in different persons: "in some it was malt liquor; in others spirit, or spirit and water; in some white wine; in others vinegar; in some fruit; in others sugar; in some fish; in others unprepared vegetables." He acknowledges, however, that "in some cases a total alteration of diet did not produce the least alleviation of the complaint." (Bateman's Synopsis, p. 136, edit. 1829.) In such cases, instead of having recourse at once to mineral acids or other tonics, as Bateman advises, it will be more prudent to investigate strictly the condition of the internal organs, as it is probable that it depends on some latent irritation of the gastro-intestinal canal or the liver, of a more permanent description than mere disturbance of the digestive function. If on examination such a suspicion be at all warranted, the application of six leeches to the epigastrium once or twice may do more towards its removal than any other means, and when the local abstractions of blood have somewhat reduced the internal congestion, bitter, alkaline, or acid tonics may be advantageously employed, as in the case of gastritic dyspepsia. With respect to bathing, although in the chronic urticaria danger is not to be apprehended from it as in the acute, much benefit is seldom found to accrue from it; the good effects of the vapour-bath entitle it, however, to trial. In these forms also, lotions of cold water with spirit and vinegar, or of water with small quantities of camphorated spirit, are sometimes found grateful applications for allaying the pruritus.

In the severe form produced by fish-poison, the urticaria, although intense, with respect to the treatment must be considered as a secondary matter. The first object to be attempted is the freeing of the stomach and bowels of the exciting cause. In doing this the West Indian physicians prefer the sulphate of zinc to any other emetic, as it operates more rapidly and depresses the strength less than any other; on which account the tartar-emetic is never employed by them. For the same reason the most gentle means are to be used for promoting evacuations from the bowels; castor oil and repeated laxative injections are to be preferred to saline purgatives. The further treatment is to be founded upon the decision which the physician comes to upon the important question, whether the stage in which the patient is brought under his notice be that of sinking of the vital powers by the direct agency of the poison, or, on the other hand, the stage of reaction. It is obvious that in the first case the practice must consist in the exhibition of stimulants to support and revive the powers of life, and that in the latter, the indication is to reduce the erethism of the vascular and nervous systems. The most approved stimulant is madeira wine; carbonate of ammonia is also to be used, and capsicum is much extolled by Dr. Clarke, a physician of Dominica. With respect to the stage of reaction, it is to be kept in mind, that however high the erethism may mount, it is not to be combated by the powerful antiphlogistics which a free inflammation of the same degree would demand. Venesection should not be resorted to except in the case of young plethoric individuals; leeches may be sparingly applied to the organ which appears most oppressed, but we must be contented to rest for the fulfilment of this indication on the exhibition of acid diluents, such as lemon-juice, or lime-juice, vinegar, &c. together with keeping the patient in cool air. A more ample development of this subject belongs, however, to the head of TOXICOLOGY rather than to urticaria.

J. HOUGHTON.

UTERUS AND ITS APPENDAGES, PATHOLOGY OF THE.—The sexual system of the human female consists of the uterus, and of its internal and external appendages. Before the age of maturity, the uterine organs are small, exert but little influence on the constitution of the female, and are not liable to many diseases. From the age of fourteen or fifteen, when menstruation is usually established, until the middle period of life, the functions of the uterus are subject to serious derangements; and at a more advanced period of life, its structures are often destroyed by diseases of a malignant nature. In extreme old age, the uterine system, without any organic disease, undergoes a great diminution of volume, and not unfrequently the canals of the Fallopian tubes and upper part of the cervix uteri become impervious.

Various irregularities in the formation of the human uterus have been described in the works of different authors under the terms bilocular, bicorned, bifid or double uterus, in all of which, without a single exception, the uterine appendages have been simple, or have consisted of one ovarium or one Fallopian tube annexed to each cornu of the uterus, and not of two ovaria and two Fallopian tubes, as the term double uterus would seem to imply. In the examination of a great number of children at the Maternité of Paris, the division of the uterus, as in some of the lower orders of mammalia, was often met with. Professor Chaussier has described the case of a woman who was delivered in the Maternité of her

tenth child, in whom it was found after death that the right side of the uterus only existed, with one ovarium and one Fallopian tube. (Bulletin de la Faculté de Médicine, Paris, 1817.) Littre, in dissecting the body of a little girl, found the vagina divided by a fleshy perpendicular septum, as in most of the ruminant animals. The vagina is sometimes divided by a thin perpendicular membranous partition. Vallisnieri relates the history of a woman who was poisoned with cantharides, in whom two uteri were found to exist, one of which opened into the vagina, the other into the rectum. (Esperienze ed Osservazione Spettanti all' Istoria Naturale, etc. l. iv.)

M. Cassan has referred to numerous other examples of similar malformations of the uterine organs, and to those more particularly the histories of which are contained in the Memoirs of the Royal Academy of Sciences. (Recherches sur les Cas d'Utérus double et de Superfœtation, par M. L. Cassan, Paris, 1828.) In the Museum of the Royal College of Surgeons in London, there is a specimen of bifid unimpregnated uterus, and another was preserved in the collection of Mr. Brookes, in which the fundus, cervix, and os uteri were all divided by a thick septum. Similar cases have been recorded by different writers. Messrs. Lauth and Cruveilhier have reduced all the malformations of the uterus to the four following varieties: 1. where the uterus and vagina are separated into two cavities by a septum running in the direction of the mesial line, while the external configuration presents nothing unusual; 2. where the fundus and body of the uterus are divided into two cornua, the cervix, os uteri, and vagina remaining in the normal state; 3. where the uterus is bifid, as above, while the cervix and vagina are divided by a septum; 4. where the vagina forms a single canal with a double os uteri. These deviations from the natural formation of the uterus do not prevent impregnation. Morand, Bartholin, Purcell, Ollivier, and many other writers have recorded cases of double uterus in which conception had taken place, and the fœtus had been retained till the full period. "Num mulieres," inquires Riolan, "quæ superfœtare solent aut plures fœtus quam duos generant, uterum bipartitum habeant!" (Schola Anatomica, Parisiis, MCVIII. p. 317.) M. Cassan has also recently speculated upon this subject, but there are certain facts which prove that the doctrine of superfœtation, if well founded, cannot be explained on the supposition that the uterus is double or bifid. The author has related a case of impregnated double uterus, in which an organized deciduous membrane, in the form of a shut sac, lined the unimpregnated cornu, and rendered superfœtation and menstruation impossible. (Med. and Chir. Trans. vol. xviii. p. 475.) The uterus has been found wanting in some women; others have had the orifice closed by a membrane or a dense fleshy substance, or the os uteri has opened into the rectum. The vagina is also sometimes malformed. Its orifice has been impervious from unusual strength of the hymen, or a considerable portion of the canal has been closed, within the os externum, by a thick fleshy substance. Cases have been recorded in which the whole vagina has been filled up with a dense solid mass. An extreme narrowness and shortness of the canal has also been repeatedly observed, and in some it has been altogether wanting. In the neck of the bladder, urethra, and parts situated around the orifice of the vagina, many varieties of malformation have occurred.

We ascertain the presence of disease in the uterine system chiefly by the uneasy sensations of the patient, by the disordered functions of the organs, and by the changes in their situation, form, and sensibility. The mammæ, stomach, brain, and nervous system are all sympathetically affected in many of the diseases of the uterus, and in most of the organic affections of the organ and its appendages there is severe burning or lancinating pain experienced in the hypogastrium, or dull gnawing pain in the sacrum, loins, pubis, and upper part of the thighs. There are often sickness and vomiting, loaded tongue, impaired appetite, and other signs of gastric derangement. There are frequently also dull pain, sense of giddiness, confusion of head, and many irregular nervous affections. The mammæ sometimes become enlarged and painful, as in the early months of pregnancy. The functions of the uterus, more particularly of menstruation and conception, are interrupted or disturbed. There is frequently an altered secretion of the lining membrane of the uterus and vagina, and instead of the mucus which lubricates the passages, serum, pus, or blood are poured out in greater or smaller quantity from the parts. When a female after the middle period of life suffers from an habitual discharge of a serous, sanguineous, or purulent nature from the vagina, with pain in the back and irritation within the pelvis, an internal examination should be made to determine the condition of the uterus. If our object is to ascertain the condition of the lower portion of the uterus, the patient should remain in the erect position with the back resting against the wall while the forefinger is carried through the vagina to the os uteri. When the finger reaches the uterus, pressure should be made with the left hand over the hypogastrium, that the sensibility, form, and weight of the organ may be accurately ascertained. It is necessary for the practitioner to recollect that there is great variety in the form of the os uteri in different women, without disease. In some individuals its length is remarkable, and in many women who have had children, in whom labour has been natural, there are irregularities or fissures from laceration, where there is no organic disease. In some women, observes M. Dugès, after repeated labours, the lips of the os uteri do not project, the orifice occupying directly the upper part of the vagina like a funnel. This we have repeatedly found to be the state of the os uteri in aged females, whether they have had children or not. Sometimes the orifice is so large as to admit the point of the finger prolonged backward and to the left by an oblique fissure with round edges. Not only should the smoothness, hardness, and regularity of the lips of the os uteri be examined, but the degree of dilatation of the orifice should be ascertained, if any exists, and whether it is giving passage to a tumour of any description. The size and weight of the uterus should also be determined, and whether the fluid covering the finger be mucous, serous, sanguineous, or

purulent. The condition of the vagina should likewise be accurately explored, for there are few diseases of the uterus of a cancerous or malignant nature, in which some change is not perceptible in the coats of the vagina. It is by an examination per vaginam that we become acquainted not only with the alteration of structure in the os and cervix uteri, but with the numerous displacements to which the organ is liable.

The speculum uteri has been much employed on the continent in the exploration of the diseases of the uterus; and in some cases of inflammation and superficial ulceration of its orifice, important information may be obtained by its use. In many more, however, and particularly in tumours and cancerous affections of the uterus, we are fully persuaded that little information can be obtained from the employment of it; its introduction is painful, and where the vagina is diseased, it has produced most injurious effects. In a case of malignant ulceration of the os uteri and upper part of the vagina, which came under our observation, the introduction of the speculum produced hemorrhage, which proved fatal in the course of twenty-four hours.

We now propose to give a short account of some of the more important diseases.

I. Of the Fallopian tubes.

II. Of the uterus.

III. Of the vagina and organs situated around its orifice.

The structure, functions, and diseases of the ovaria have already been fully described in a preceding part of this work.—See Ovaria, Diseases of the.

I. Diseases of the Fallopian Tubes.

The Fallopian tubes are two slender tortuous canals, about four or five inches in length, which extend between the ovaria and the superior angles of the uterus. They consist, like the uterus, of a peritoneal, muscular, and mucous membrane, and they perform the office of conveying the spermatic fluid from the uterus to the ovaria, and, after impregnation, of carrying back the germ or ovulum to the cavity of the uterus. They are liable to attacks of acute and chronic inflammation, both in the unimpregnated and puerperal states. Their fimbriated extremities are frequently, in consequence of acute or chronic inflammation, firmly united to the ovaria, posterior part of the uterus, omentum, and other contiguous parts. The structure of the fimbriæ is often completely destroyed, and the tubes terminate in a cul-de-sac. The canals of the tubes are also sometimes obstructed, and sterility is the result. The obstruction may be partial or complete. One of the most frequent morbid appearances which the writer has observed in the bodies of young subjects after death, is adhesion of the Fallopian tubes to the ovaria by short, firm, adventitious membranes, or by long, slender, transparent filaments. After parturition, when inflammation attacks the peritoneum, the Fallopian tubes in most cases become red, vascular, and partially or completely imbedded in pus or lymph. Their ovarian extremities not unfrequently become softened, of a deep red colour, and deposits of pus in a diffused or circumscribed form take place within their cavities or in their sub-peritoneal tissues. Their lining membrane also becomes inflamed, and the canals throughout their whole extent filled with pus. A case of abscess of the Fallopian tube communicating with the rectum, has been observed by M. Andral. The woman, after suffering from constipation, had vomiting, pains in the right side of the abdomen, then in the left, and in the right thigh; a tumour gradually formed in the left flank, with fever, emaciation, and purulent diarrhœa. On opening the body, the effects of inflammation of the bowels were observed; the left Fallopian tube, considerably dilated, opened into the rectum by an opening which would admit a writing-quill. A purulent fluid, or a thick viscid matter, like cream, is frequently found in their cavities, where there has been no previous inflammation of their coats. The cavities of the tubes are also found in some cases distended with scrofulous matter, and the same deposition is occasionally observed within the cavity of the uterus. The coats of the tubes are frequently much thickened, and of a red or dark colour, when affected with scrofula. All these affections produce barrenness, but there are no symptoms by which we can positively determine their existence during life. In the article Ovaria, the author has expressed his belief that in many cases of painful menstruation there exists a state of great congestion or inflammation of these organs, and there can be little doubt that the Fallopian tubes often participate in the same disease. In such cases, and in others, where there is reason to suspect the existence of inflammation of the uterine appendages, leeches, warm fomentations and poultices to the sides of the hypogastrium, and other antiphlogistic means, should be had recourse to.

Accumulation of fluid sometimes takes place within the cavities of the Fallopian tubes. Dr. Hooper has termed this affection hygroma, and he observes that the Fallopian tubes are not unfrequently found distended by a serous fluid; "I have never seen," he says, "more than seven fluid ounces in one tube; from one to two ounces is the most usual quantity. When a hygromatous tumour is formed in these tubes, the fimbriæ are generally destroyed, and the abdominal openings obliterated. The sides of the tubes are distended into complete bags, which have a long tortuous or pyriform shape, being always much the largest at the loose extremity. The tube of both sides is mostly in the same state of disease, and there are generally traces of pre-existing inflammation, as thickened portions, here and there, and many adventitious membranes and adhesions to neighbouring parts." (Morbid Anatomy of the Human Uterus.)

Sometimes the Fallopian tube is suddenly enlarged by fluid at the ovarian extremity, when it resembles a horn, or has a pyriform or spherical shape, and it may there acquire enormous dimensions. De Haen relates a case in which the Fallopian tube weighed seven pounds, and the cavity contained twenty-three pounds of fluid. In other cases the quantity has been still greater.

It is difficult or impossible during life to distinguish dropsy of the Fallopian tube from cysts formed in the ovaria, and it would not be of much practical importance if the diagnosis could be drawn. All internal remedies are equally unavailing in both diseases. De Haen states that death has

followed the operation of drawing off the fluid from the Fallopian tube by a trochar, and that the viscid state of the fluid, rendering its escape impossible through the opening, makes the operation unsuccessful. Monro states that hydatids may produce the same effect. Boivin and Dugès relate a remarkable case from Frank, in which a pint of fluid escaped daily by the uterus and vagina till the patient died of consumption. On examining the body, thirty-one pounds of a watery and gelatinous fluid were found in the left Fallopian tube. The disease was referred to a violent blow received upon the hypogastrium. Similar cases have been recorded in which the fluid accumulated in the Fallopian tubes has escaped by the uterus and vagina.

When the catamenia are retained from imperforation of the hymen, vagina, or os uteri, the cavity of the uterus not only becomes much distended, but also the cavities of the Fallopian tubes, which may become ruptured by ulceration. (Traité Pratique des Maladies de l'Utérus, t. ii. p. 587.)

The same authors believe that some cases of leucorrhœa may depend on a chronic catarrh of the lining membrane of the Fallopian tubes. Our repeated examinations of the uterus after death have rendered it certain that in many instances of leucorrhœa, the fluid secreted by the lining membrane of the uterus, and not by that of the Fallopian tubes, or vagina.

Small pedunculated cysts are very often found suspended from the fimbriated extremities of the Fallopian tubes, even in women under the age of twenty.

Rupture of the Fallopian tube in the unimpregnated state is a rare occurrence. Boivin and Dugès have cited a case of this description, in which the accident arose from a violent effort, and death soon followed from effusion of blood into the abdomen. This hemorrhage, they observe, must have been excited by a violent fit of rage into which the woman had been thrown. The tube is sometimes, they add, the seat and the source of a sanguineous exhalation without any apparent rupture of the coats, and this happens most frequently in puerperal women, or in those who have miscarried, and in conjunction with metroperitonitis. Dugès relates the following as an example of this rare occurrence. A woman, who had recently miscarried in the early months, was seized with inflammation of the uterus and peritoneum, of which she died; the ovarian extremity of the left Fallopian tube was as large as a hen's egg, and adhering to the ovarium, which it in a great part enveloped; it was red, very vascular, and contained a bloody fluid; the walls of the sac were half a line in thickness. The right Fallopian tube was obliterated at the loose extremity, as large as the finger, destitute of fimbriæ, and adhering to the ovaria by some cellular filaments. (Op. cit. tom. ii. p. 585.)

Rupture of the Fallopian tube most frequently takes place in the third or fourth month of pregnancy, and the ovum sometimes escapes entirely into the cavity of the abdomen; at other times it continues within the tube. It is probably in consequence of some imperfect action of the tube that the ovum is not transmitted along its canal to the uterus, as in ordinary cases. The Fallopian tubes having a structure similar to the uterus, admit of the development of the ovum within their cavity for a certain period, generally to the third or fourth month; after this, the ovum still continuing to enlarge, they become ruptured in consequence of their incapability of undergoing further distension. A violent pain is then suddenly experienced by the woman in the region of the uterus; this is followed by faintness, coldness of the extremities, and other symptoms of internal hemorrhage, and death usually takes place in a few hours. On opening the body, a quantity of blood is found in the sac of the peritoneum, and the tube which contained the ovum is found lacerated or laid open by inflammation and sloughing. When ruptured, it does not possess a power like the uterus to close the exposed vessels after the separation of the placenta, and the blood is poured out from the laceration until the woman perishes. In cases of Fallopian tube conception, an organized deciduous membrane is often found lining the inner surface of the uterus, the volume of which is much increased. In other cases, one of which came under our own observation, the cavity of the uterus is lined with a soft flocculent albuminous matter, which is not organized. In two cases about the end of the fourth month, which we have recently examined, no deciduous membrane lined the cavity of the uterus; the fundus and body were both considerably enlarged, and their inner surface coated with a layer of soft albumen. In Saxtorph's case of Fallopian tube conception, though the patient went to the end of the ninth month, the uterus was not enlarged, but its cavity was lined with a white tenacious mucus, which closely adhered to the lining membrane. (Acta Societ. Reg. Med. Havnien. tom. v.) Mr. Langstaff examined a case in which there was no deciduous membrane, and Dr. Blundell has seen two in which the decidua was likewise wanting.

The Fallopian tubes are sometimes affected with cancerous or malignant disease. This may commence in the tubes themselves, or it may extend to them from the ovaria or other parts of the uterine system.

Considering the similarity of structure which exists between the uterus and Fallopian tubes, it appears singular that fibrous tumours should be so seldom met with in these organs. In no case have we met with a fibrous tumour in the walls of the Fallopian tubes. "I have seen a hard round tumour," observes Dr. Baillie, "growing from the outer surface of one of the Fallopian tubes. This, when cut into, exhibited precisely the same appearance of structure as the tubercle which grows from the surface of the uterus, consisting of a hard white substance intersected by strong membranous septa. This, however, I believe to be a very rare appearance of disease." (Morbid Anatomy, p. 360.)

"A more uncommon situation for this tumour," says Dr. Hooper, "is the cavity of the Fallopian tube. It is occasionally seen, very small, deposited in the cellular tissue under the peritoneum of the tubes; and I once found it in the cavity or canal itself, about the size of an olive; the fimbriæ were destroyed, and the tube terminated in a culde-sac." (Morbid Anatomy of the Human Uterus,

&c. p. 15. [See, also, Churchill, *On Diseases of Females*, 3d Amer. edit. by Dr. Huston, Phil. 1844.])

II. — Diseases of the Uterus.

The most important diseases of the human uterus, accompanied with sensible alteration of structure, may be divided into three classes :—

1. Those which are produced by inflammation of one or more of the textures which enter into the composition of the uterus.

2. Those which arise from the formation of tumours in the parietes of the organ, or from enlargement of the glands situated in its orifice, and have no tendency to degenerate into a malignant form, and do not contaminate the surrounding structures.

3. Those diseases which result from a specific or malignant action of the uterus, by which its different textures and the adjacent viscera become disorganized.

1.—Of Inflammation of the Unimpregnated Uterus.

In the article Puerperal Fever a full account has been given of the symptoms and treatment of uterine inflammation in puerperal women. In the unimpregnated state the uterus is also liable to attacks of congestion and of acute and chronic inflammation, which, though less dangerous than after parturition, are nevertheless productive of great distress, and are often but little under the control of medicine.

Inflammation of the lining membrane of the uterus. — The lining membrane of the uterus in the healthy state is smooth, and moistened with a tenacious mucous fluid of a yellowish white colour. Not unfrequently it is of a deep red colour and ecchymosed, and a little blood escapes from it on pressure. These appearances we have often observed in women who have died suddenly from affections of the brain and other organs, and in whom there had been no symptom of uterine inflammation except an increased discharge of mucus from the vagina.

Inflammation of the lining membrane of the uterus sometimes produces merely an increase of the natural secretion of the part; in other cases pus is secreted, as in inflammation of the mucous membranes of other organs.

In some women who menstruate with pain, there is a membrane somewhat like the decidua, though essentially different in structure, discharged from the cavity of the uterus at each monthly period. It is sometimes of a triangular shape, the inner surface being smooth and filled with fluid, while the exterior, which had been adherent to the uterus, has a rough flocculent appearance. In other cases this membrane is passed in flakes like coagulable lymph, and does not present any appearance resembling the decidua. Women who are afflicted with this peculiar disease of the uterus suffer more or less from uneasiness in the region of the organ in the intervals of menstruation, and they seldom become pregnant. According to Dr. Denman, the disease does not depend upon any peculiarity of constitution or disposition to any other complaint. The false membrane is probably formed between the monthly periods, by a peculiar and specific inflammation of the mucous coat of the uterus. The symptoms would lead to the inference that the substance of the uterus is also affected.

Morgagni was the first writer who described this disease, and he was aware how little it is under the control of remedies. Denman has recommended for its treatment mercury to salivation, the ammoniated tincture of cinchona, infusion of burnt sponge with bark, myrrh, and the different preparations of iron; the Tonbridge or Spa waters, the liquor potassæ, and all the remedies usually termed tonics. In one case injections of the aqua zinci vitriolata cum camphorâ had a good effect. Denman admits that none of these remedies have been attended invariably with success. Dr. Burns says time in general removes the disease better than medicine, which is only to be advised for the relief of pain, weakness, or any other symptom which may attend or succeed to this state.

Dr. Dewees states that he has seen a portion of membrane discharged from the uterus not much larger than the nail, after severe suffering; at other times he has witnessed as much as would fill a small tumbler. The period employed for the extrusion of the substances is various; sometimes requiring but a few hours, at other times several days. The degree of suffering is not always in proportion to the quantity of substance expelled; indeed, the pain would rather appear to be less when much is discharged. Dewees thinks there are two varieties of the disease; one where the mammæ sympathise with the uterus, and become tumid and extremely painful; the other where there is no such affection induced. In this affection, he says there is almost always a permanent pain in the back, hips, and loins, which indicates the presence of a highly congested, if not an inflamed state of the lining membrane, and probably also of the middle coat of the uterus. For the relief of pain in this affection, which is the first object of treatment, he states that he has found the following combination of remedies more useful than any other.

℞ Gum. camphor. ℈i.
Spirit. vin. rectif. q. s. fiat pulvis: add.
Pulv. G. Arab. ʒi.
Sacchar. alb. q. s.
Aquæ cinnam. simpl. ℥i. M.

One-half of this draught is to be given the instant pain is experienced; and if not relieved in an hour or two, the other is to be given. This quantity, however, is not always sufficient to subdue pain; in this case let the mixture be repeated, or the same quantity of camphor may be finely powdered and given in ten-grain doses every hour, entangled in a little syrup of any kind, until relief is procured. The ergot, as might have been expected, has failed to afford relief. Warm baths, pediluvium, and bleeding, have also been prescribed, but he declares that nothing has succeeded so well as camphor. The injection of tepid narcotic fluids into the vagina would probably be attended with advantage, and the application of leeches to the os uteri in the intervals of the monthly periods, when the membrane is forming within the cavity of the uterus.

As a means of affording permanent relief in this painful disease, Dewees has recommended the use of volatile tincture of guaiacum, in doses of a drachm three times a day. In some cases it has

been useful, in others altogether useless. He supposes the inflammation to be rheumatic, but of this there is no satisfactory evidence.

The pathology and treatment of this affection of the uterus, it must be admitted, are but imperfectly understood. The occasional local abstraction of blood from the region of the pelvis, by cupping or leeching in the intervals of menstruation, when there are symptoms of congestion of the uterus present, the exhibition of calomel, Dover's powder, and camphor, with rest in the horizontal position, and the frequent injection of tepid narcotic fluids into the vagina, are the remedies which have afforded the greatest relief in the cases which have come under our care.

When the lower portion of the uterus is chiefly affected with inflammation, there is an uneasy sensation or pain experienced in the back, hypogastrium, and loins, aggravated by pressure and bodily exertion, and chiefly by riding and walking. In this disease there is usually an increased secretion of mucus from the vagina, or there is a discharge of white opaque mucus, "like a mixture of starch and water made without heat, or thin cream; it is easily washed from the finger after an examination, and it is capable of being diffused through water, rendering it turbid." "A morbid state of the glands of the cervix of the uterus," continues Sir C. Clarke, "probably gives rise to this discharge; at least the cases in which it comes away are those in which the symptoms are referred to this part; and when pressure is made upon it, the woman complains of considerable pain." (Observations on the Diseases of Females which are attended by discharges, part ii. 5.)

When an internal examination is made, the uterus is often found hanging unusually low in the vagina; the os uteri is neither hard nor irregular, but it is swollen and puffy, and is painful on pressure. There is more or less irritation in the bladder and rectum, and the symptoms are usually aggravated before and subsequent to menstruation.

When the substance of the fundus and body of the uterus are inflamed, the pain, which is constant, occurs also in paroxysms, and is aggravated by the erect posture, and by pressure over the hypogastrium. The milky discharge from the vagina, which is often present, when there is no inflammation of the uterus, and which Dr. Clarke considers as a pathognomic symptom of inflammation of the os uteri, is wanting, according to his observation, when the substance of the unimpregnated uterus is inflamed. It is sometimes observed in young females soon after marriage, and is most frequently referable to violence, or to the application of cold during menstruation.

There is often little effect produced upon the constitution in this disease. In other cases, constitutional disturbance, more or less marked, accompanies chronic inflammation of the uterus. The pulse is soft, but easily accelerated, particularly in the evening. The digestive organs are deranged, the appetite becomes impaired, and the bowels are confined. The urine is discharged with pain and difficulty. The anus is sometimes retracted. Menstruation is frequently disturbed, and if the disease continues long, and the powers of the system are much impaired, it is entirely interrupted. In many cases, it is impossible during life to distinguish this affection from incipient malignant disease, and other organic diseases of the uterus, of a totally different nature. Dr. Gooch and M. Genès maintain that all the symptoms of chronic inflammation of the uterus may be present without inflammation, or without any sensible derangement of the uterus. This view does not, however, rest on accurate and extensive pathological research; and the heat, swelling, and exquisite sensibility of the neck and body of the uterus, prove that in the disease or group of diseases described by the former of these writers under the name of irritable uterus, a state of the organ exists closely allied to inflammation or congestion. In more than one case, which had been considered and treated as simple irritability of the uterus without inflammation, organic disease of a malignant nature was subsequently developed. The presence of fibrous tumours in the walls of the uterus has likewise in some individuals given rise to that peculiar series of symptoms which has been described as characteristic of irritability of the uterus, without inflammation or disposition to a morbid alteration of structure.

"What is the nature of the irritable uterus?" inquires Dr. Gooch. "It is not acute inflammation, for that would run a far shorter course, and end in certain known consequences. It is not chronic inflammation, for that is a disorganizing process, and slowly but surely alters the structure of the organ in which it goes on. Both in chronic inflammation, and in the disease which I am describing, there is a morbid state of the nerves, indicated by pain, and sometimes at least a morbid state of the blood-vessels, indicated by their fulness; but the substances effused by chronic inflammation show that in this there is something additional in the actions and consequently in the state of the vessels. The disease which I am describing resembles a state which other organs are subject to, and which in them is denominated irritation. Thus surgeons describe what they call an irritable tumour of the breast. It is exquisitely tender; an ungentle examination of the part leaves pain for hours; it is always in pain, but this is greatly increased every month immediately before the menstrual period. Although apprehensions are entertained of cancer, it never terminates in disease of structure. It is represented as a very common disease. Mr. Brodie describes a similar state in the joints. It occurs chiefly amongst hysterical females; it is attended by pain, at first without any tumefaction, but the pain increases and is attended with a puffy, diffused, but trifling swelling; the part is exceedingly tender; this assemblage of symptoms lasting a long time, and being often little relieved by remedies, occasions great anxiety, but there never arise any ultimate bad consequences. 'The disease,' says Mr. Brodie, 'appears to depend on a morbid condition of the nerves, and may be regarded as a local hysteric affection.' These painful states of the breast and of the joints appear to be similar to that which I have been describing in the uterus; similar in kinds of constitutions which they attack; similar in pain, in exquisite tenderness, in resemblance to the commencement of organic disease, and in proving ultimately to be only dis-

cases of function." (An Account of some of the most important Diseases of Women, by Robert Gooch, M. D., Lond. 1831, p. 306.)

Dr. Dewees, whose attention has been particularly directed to the pathology of this affection, does not consider this view of the subject to be correct, and it is certainly very difficult to discover any analogy between a tumour of the female breast or joints and an affection of the uterus depending solely upon a morbid state of its nerves.

Chronic congestion and inflammation of the uterus appear to arise most frequently from exposure to cold and fatigue during menstruation, and subsequent to abortion or parturition. It is an obstinate disease, and often resists the effects of all remedies for many months, or even years. The patient should remain in the horizontal position if the pain is constant and severe. Blood must be drawn from the arm or from the uterine region by leeches, or by cupping-glasses. When the circulation is undisturbed, as is most frequently the case, local is to be preferred to general blood-letting. Some think that cupping affords decidedly more relief than leeches, and that the glasses should be applied over the sacrum, or to the part to which the pain is referred. Dr. Dewees applies them to the inside of the thighs. The bowels should be regulated by castor oil, infusion and electuary of senna, super-tartrate of potash, and Epsom salts. To subdue the pain the tepid hip-bath, warm fomentations, and narcotics must be had recourse to; and camphor, combined with extract of hyoscyamus, henbane, or poppy, should be administered twice or thrice a-day. A belladonna plaster should be applied over the sacrum. Warm decoction of poppy, or lukewarm linseed tea, or eight or ten grains of opium dissolved in a pint of hot water, or solution of starch, may be thrown up the vagina, and an ounce of warm milk with a drachm of laudanum may be injected into the rectum, after the bowels have been evacuated. An alterative course of mercury has afforded decided relief in some cases. Like all the other chronic phlegmasiæ, when the disease has lasted long, relief sometimes follows a different plan of treatment, viz. the employment of exercise, bitters, tonics, sulphurous and chalybeate waters. Where the stomach has suffered much, the phosphate of iron may be given with advantage.

Chronic inflammation of the uterus does not degenerate into cancer, as many suppose, and it rarely terminates in suppuration of the muscular tissue of the uterus. Cases of abscess of the walls of the unimpregnated uterus have been described by writers, but they are very seldom met with. Mr. Howship has a uterus in his possession, in the muscular coat of which, or in the cellular membrane between its layers, was an abscess which contained about an ounce of pus. The symptoms were not ascertained before death. This is the only example of abscess of the walls of the uterus from simple inflammation that we have seen; those abscesses in the uterus described by Dr. Hooper were connected with malignant disease of the organ. Where a collection of pus has taken place within the cavity of the uterus, there has also in most cases been present a malignant organic affection of the os and cervix uteri. The following case, related by Dr. John Clarke, illustrates this fact. "On the 12th of January, 1812, I visited Mrs. A. B. about sixty-five years of age, who had ceased to menstruate many years. A few weeks before I saw her, she had informed Mr. Brande, who attended her, of her having a small sanguineous discharge from the pudenda. The discharge was not attended by any pain. After this she had a discharge like fluor albus, and small, but which afterwards became of a brownish colour, offensive to the smell, and greater in quantity. A very short time before I saw her, she had experienced a more considerable sanguineous discharge, but without any pain. I found, on examination per vaginam, the os uteri very rigid and much harder than usual. The cervix was of the usual length, but harder to the touch. From the upper part of the cervix a tumour bulged out in all directions, so as to occupy nearly the whole space from the os pubis to the os sacrum. On the 31st January she was suddenly seized with violent pain in the lower part of the abdomen, and a sensation as if something had suddenly given way there, and she was still in great pain. She could not pass her urine; she was now in a state of extreme weakness and faintness, like a person nearly expiring, having a small thready-like pulse, great paleness of the surface of the body, and coldness of the extremities. She died soon after this. On opening the abdomen, seven ounces of a most offensive purulent fluid were found in its cavity. The small intestines were inflamed. On raising the intestines to expose the contents of the pelvis, a tumour appeared in a gangrenous state, with an opening in the upper part of it, through which, on the slightest pressure, a quantity of offensive pus oozed, similar to that which was found in the cavity of the abdomen. The bag containing it appeared to be in contact with the quantity which still remained in it, probably about five ounces. This matter being removed, the bag was discovered to be the uterus in a distended state. Both its external and internal surface were of a dark colour, exhibiting nearly the appearance of a mortified part. On the internal surface there was an appearance like half coagulated lymph, but there was no trace of any cyst, so that the fluid was contained in the cavity of the uterus itself. The internal surface of the uterus had a honeycomb-like appearance. The orifice between the cavity and the cervix was closely contracted, so as not to have allowed the contents of the uterus to be discharged through it." (Trans. of a Society for the Improvement of Med. and Chir. Knowledge, vol. iii. p. 560.)

Inflammation of the follicles of the os uteri. — Granular inflammation of the os uteri is the term employed by Madame Boivin to designate this disease, which she states to be little understood, and only to be detected by using the speculum. The os uteri is swollen, red, ecchymosed, morbidly sensible when touched, and disposed to bleed. There is often present a leucorrhœal discharge from the vagina, and a state of excitement bordering upon nymphomania. In some cases the affection has been misunderstood, from the absence of local symptoms, or because it has been accompanied with more severe lesions. The granulations, when hard, are usually very small, like grains of sand or the seeds of the poppy; if

they are larger, their softness prevents them from being discovered, except by a very experienced practitioner.

These granulations are found in a subacute or chronic state. In the former they are seen on the lips of the os uteri, sometimes in small numbers like peas, firm and white; more frequently in great numbers, like grains of millet-seed, also white and soft, and vesicular, without roots. It is from their interstices that the blood flows which escapes into the vagina when they are touched, or when the bowels are evacuated.

In the chronic state the enlarged follicles or granulations are hard, small, and white, and rest on soft, red, miliary elevations, in one case like varicose veins. The causes of this affection are not the same in all cases; they are often obscure, like the causes of all uterine diseases. In some cases, the affection seems to have been produced by syphilis or some cutaneous disease, or by the presence of a fibrous tumour in the uterus. In the examination of dead bodies we have repeatedly seen the appearances described by Boivin, and we agree with her in thinking that they depend on an enlargement of the mucous follicles of the os uteri. We have seen numbers of these bodies much enlarged, both in the vagina and os uteri, when individuals had died from chronic disease unconnected with any morbid state of the uterus.

Emollients and local bloodletting are the remedies recommended by Boivin in the subacute stage of the disease. The treatment must be stimulating in the chronic stage, and afterwards, in the greater number of cases, derivatives must be had recourse to. The greatest advantages have resulted from their use in many cases. Where the disease is syphilitic, mercury must be employed.

Whether *physometra* and *tympanites* are always the result of inflammation of the uterus is not at present ascertained; but as they may sometimes arise from that cause, we may here notice them. The existence of tympanites and dropsy of the unimpregnated uterus might be called in question, if cases of the disease had not been recorded by some authors of undoubted veracity. As no example of either of these affections has come under our own observation, we shall give a short account of their history and treatment as we find them recorded in the works of different writers. Mr. J. Hunter endeavoured, without success, to elucidate this subject. "I have been informed," he says, (at p. 206 of his work on the Animal Œconomy,) "of persons who have had air in the uterus or vagina without having been sensible of it but by its escaping from them without their being able to prevent it, and who, from this circumstance, have been kept in constant alarm lest it should make a noise in its passage, having no power to retard it, as when it is contained in the rectum. This fact being so extraordinary made me somewhat incredulous, but rendered me more inquisitive, in the hope of being able to ascertain and account for it: and those of whom I have been led to inquire have always made the natural distinction between air passing from the vagina and by the anus: that from the anus they can feel and retain, but that in the vagina they cannot; nor are they aware of it till it passes. A woman whom I attended with the late Sir J. Pringle informed us of this fact, but mentioned it only as a disagreeable thing. I was anxious to determine if there was any communication between the vagina and rectum, and was allowed to examine, but discovered nothing uncommon in the structure of these parts. She died soon after; and being permitted to open the body, I found no disease either in the uterus or vagina. Since that time I have had opportunities of inquiring of a number of women, and by three or four have been informed of the same fact with all the circumstances above mentioned: how far they are to be relied upon, I will not pretend to determine."

Denman never saw a case in which wind was collected in the cavity of the uterus in such a manner as to resemble pregnancy, and to produce its usual symptoms; but many cases occurred to him of temporary explosions of wind from the uterus. "When no injury has been done to the parts in former labours, I presume," he says, "that the complaint happens to women with feeble constitutions, and some particular debility of the uterus." (Introduction to the Practice of Midwifery, vol. i. p. 111, London, 1788.) Dr. Hooper once saw a case of flatulent tumour of the uterus in the living subject, but never post-mortem. "Air is formed in this organ," observes Dr. Gooch, "but instead of being retained, so as to distend the uterus, it is expelled with a noise many times a day. It has been doubted whether it really came from the uterus; but in one of my patients there was a circumstance conclusive on this point: she was subject to this infirmity only when not pregnant; but she was a healthy and breeding woman, and the instant she became pregnant, her troublesome malady ceased. She continued entirely free from it during the whole of her pregnancy; but a few weeks after her delivery, it returned." In all these cases there is no positive proof that the air was not accumulated in the vagina only.

In by far the greater number of cases the disease has arisen from the decomposition of bodies contained within the cavity of the uterus, and not from any disease of the uterus itself. After the extraction of a dead fœtus from the uterus, an offensive gaseous fluid sometimes escapes from its cavity. M. Leduc had scarcely extracted the body of a putrid fœtus with the crotchet, when there escaped with impetuosity from the uterus a gas having a sulphureous smell, which burnt with a violet-coloured flame. (Dictionnaire de Médecine, t. xvii. p. 198.) But it is more particularly after delivery, when some portion of the placenta or of the fœtal membranes has remained within the uterus, and the orifice is closed by a coagulum of blood, that a true uterine tympanites takes place. The uterus then admits of distension by the gaseous fluid, and it may acquire a volume equal to that which it had before delivery. Two cases of this description occurred to M. Deneux, the histories of which have been related by M. Chomel. A woman, whose lochia had been suppressed on the fourth day after delivery, became comatose on the fifth, with turgescence of the face and extreme difficulty of respiration. M. Deneux found the abdomen tense and resonant when struck, as in intestinal tympanites. By an examination per vaginam he discovered that a fibrinous coagulum

occupied the orifice of the uterus. Scarcely was this clot displaced, when an offensive gaseous fluid escaped with an explosion from the vagina. The abdomen immediately diminished in volume. It completely subsided when, by a new effort, the clot had been drawn out, and with it another discharge of gas and a quantity of very fetid blood. In twenty-four hours the patient became conscious, and in a few days she was convalescent. In the second case a portion of the membranes closed the uterine orifice, and the uterus presented the same volume which it usually presents towards the fourth month. The extraction of the foreign body was followed by the expulsion of a large quantity of fetid gas.

M. Chomel states that cases have occurred in which the fœtus has been expelled from the uterus twenty-four hours after the death of its mother, by the extrication of gas. In some cases, without the concurrence of any of those causes now mentioned, there takes place gradually within the uterus an accumulation of gas, which augments the volume gradually, like the product of conception. Delamotte relates a case where pregnancy was suspected; but when the woman reached the end of the ninth month, all the symptoms disappeared after the escape of a gaseous fluid from the vagina. An analogous case has been cited by Boivin and Dugès from the Transactions of the Medico-Chirurgical Society of Bologna. A woman, forty years of age, believed herself pregnant; the menses were suppressed, the belly enlarged, and the uterus at the fifth month was on a level with the umbilicus. On stooping down, air escaped in great quantity from the vagina, and the swelling of the abdomen immediately disappeared. The distension of the uterus by air gives rise, according to Chomel, to peculiar phenomena; the patient feels more or less uneasiness in the hypogastrium; the pains extend into the loins, the groins, and thighs. A tumour is felt in the hypogastrium, reaching to the navel. This tumour is elastic, and sonorous on percussion: by passing the finger into the vagina it can readily be ascertained, while the other is over the hypogastrium, that the tumour is formed by the uterus. Some authors affirm that this tumour can be felt to be light. Sometimes the catamenia continue to flow. When the distension of the uterus is considerable, the neighbouring parts suffer from their pressure, and their functions are deranged; the alvine evacuations become scanty, and are passed with difficulty; there are frequent calls to void the urine; the respiration is confined. The escape of air by the vulva affords relief: a copious discharge removes the disease. The treatment recommended by M. Chomel consists in removing the mechanical obstacle, if any exists, by the finger introduced into the os uteri, by hip-baths, injections, and the abstraction of blood. Boivin and Dugès recommend cleanliness, baths, lotions, injections of warm water, or weak solution of chloruret of lime.

Dropsy of the uterus [*Hydrometra.*] — Accumulation of a serous fluid within the cavity of the uterus has only been found where the os uteri has been closed by adhesions from preceding inflammation, which is a very rare occurrence, or has been obstructed by malignant disease or some morbid growth. Dr. A. T. Thomson has related a case in which the cavity of the unimpregnated uterus contained eight quarts of a fluid of a dark brown colour. The woman appeared as large as if six months gone with child. An indistinct fluctuation was perceptible in the tumour, and the least pressure on it excited pain. She died from dry gangrene of the left lower extremity. The internal surface of the uterus was found, on dissection, to be neither more irregular nor more spongy than in its natural state; but none of the orifices could be found, for even the os uteri was interiorly as completely obliterated, as if it had never existed; and although its situation could be traced in the vagina, yet even there it was very faintly marked. (Med. Chir. Transact. vol. xiii. p. 175.) In cases of this description the only remedy admissible is to open the os uteri with a bougie or trochar.

Hydrometra gravidarum, or dropsy of the amnion, forms one of the most distressing complications of the gravid state, and has not unfrequently given rise to dangerous errors in practice. In the works of the earlier writers on the diseases of pregnancy, and particularly in those of Mauriceau and Lamotte, we find cases recorded of dropsy of the uterus. Similar cases are to be met with in the writings of Baudelocque and Gardien; and these authors are the first who seem to have been acquainted with the fact that the fluid in this affection is contained within the cavity of the amnion. It was not, however, until the publication of M. Mercier's essay on this subject in 1809, that any attempt was made to determine the true pathology of the disease by an accurate examination of the contents of the gravid uterus. (Observatio de acuto amniosis hydrope, aut amniosis inflammatione, quæ evasit, etc.; Journal Général de Médecine, t. xliii. and xlv.) His paper contains the histories of three cases of acute dropsy of the amnion; and from the appearances observed in the fœtal membranes, he has deduced the general inference that the inordinate secretion invariably depends on inflammation of the amnion. We have examined the fœtal membranes in eight examples of this affection, without discovering any appearance of inflammation of the amnion. In a recent case which came under our observation there was an accumulation of fluid in the ventricles of the brain of the child, and it lived only a few hours. When unconnected with a dropsical diathesis in the mother, we are disposed to regard it merely as one of the numerous diseases of the fœtus in utero, which arise independently of any disease of the uterus or any obvious constitutional disorder in the parents, and with the causes of which we are wholly unacquainted.

The diagnosis of hydrometra gravidarum is most difficult in the simple form of the disease, when the effusion has taken place to a great extent, and when complicated with ascites. In both these cases fluctuation, more or less distinct, can be perceived on percussion of the abdomen; but we can obtain from this sign no positive information to enable us to determine whether the fluid be contained in the cavity of the peritoneum or amnion, or in both these membranes. In the simple form of dropsy of the amnion, where the quantity of fluid is not excessively great, the fluctuation is obscure, deep-seated, or wholly imper-

ceptible. The presence or absence of fluctuation is, therefore, no certain test of the existence of the disease; and the only mode of arriving at a correct diagnosis, both in its simple and complicated forms, is by instituting an examination per vaginam. By this proceeding we shall not only be able to ascertain the changes in the uterus consequent on impregnation, but the accumulation of a preternatural quantity of fluid in the membranes of the ovum. This latter circumstance is known by the enlargement of the body of the uterus, by the state of its cervix, which is almost entirely obliterated, by the ballottement of the fœtus, and by the sense of fluctuation in the vagina on percussion of the abdomen.

In ascites complicated with pregnancy, Scarpa has observed that the symptoms are entirely different from those of hydrops amniosis. The regular form of the fundus and body of the pregnant uterus, he states, is not evident to the touch in these cases, from the enormous distension and prominence of the hypochondrium, arising from the great quantity of fluid interposed between the fundus and posterior part of the uterus and abdominal viscera. The urine is scanty and lateritious, and the thirst is constant. The abdomen upon percussion presents a fluctuation obscure in the hypogastric region and in the flanks, but sufficiently sensible and distinct in the hypochondria, and strong and vibratory in the left hypochondrium between the edge of the rectus muscle and the margin of the false ribs. These symptoms, with the previous history of the patient, may afford us in doubtful cases some assistance in the diagnosis; but our principal dependence, as we have before said, must be placed on the information acquired by a careful examination of the state of the cervix and body of the uterus. Having arrived at a correct diagnosis, the treatment of dropsy of the amnion becomes simple. Our only aim is to relieve the urgency of the symptoms occasioned by the over-distension of the abdominal cavity; and the only feasible mode of giving this relief is by puncturing the membranes and evacuating the superabundant liquor amnii. The artificial rupture of the membranes, if the operation be carefully performed, is not more dangerous than the spontaneous rupture; and if the ease and safety of the mother can be insured, we ought not to be induced to delay its performance by apprehension for the life of the child, since, from its diseased state in the greater number of instances, it will be still-born.

The only difficulty that can arise respecting the treatment is in cases of dropsy of the amnion complicated with ascites. Even here we would recommend the evacuation of the liquor amnii as the best remedial measure that can be had recourse to, since it relieves the leading symptoms produced by the pressure of the excess of fluid in the peritoneum and amnion on the neighbouring organs, which are, in fact, the only symptoms we have to counteract, and is followed by the expulsion of the contents of the uterus. After delivery, the effusion into the peritoneal cavity, if it depend on utero-gestation, will spontaneously disappear: if it be the effect of hepatic or other visceral disease, it may be treated by appropriate remedies.

Scarpa recommends paracentesis abdominis in this disease. He not only dreads no evil consequence from this dangerous operation in pregnancy, but supposes the gravid uterus itself may be safely punctured, and supports this opinion by cases related in the writings of Camper, Bonn, Languis, and Reiscard. We cannot, however, under any circumstances, be justified in performing either of these operations, which the experience of others has proved to be so hazardous, if, by the simple means now recommended, relief can be obtained.

From what we have observed in several recent cases of dropsy of the amnion, we are disposed to believe that the administration of diuretics and other remedies has a considerable influence in controlling the disease. In a lady who had suffered repeatedly from dropsy of the amnion, the further effusion of fluid seemed to be prevented by the use of mild cathartics, of squill and supertartrate of potash, and by surrounding the abdomen with a soft flannel roller. When there has been unusual sensibility of the stomach, the repeated application of leeches has not only relieved the pain, but apparently diminished the secretion of liquor amnii.

2.—Of tumours and enlargements of the glands situated in its orifice, which are not of a malignant nature.

In a paper on fibro-calcareous tumours and polypi of the uterus, which will appear in the second part of the eighteenth volume of the Medico-Chirurgical Transactions, we have described four varieties of uterine tumours, none of which are malignant or cancerous in their nature. First, the fibrous; secondly, the follicular, or glandular: thirdly, the cystic, or vesicular; and, fourthly, the mucous tumour of the uterus.

The fibrous tumour is usually of a globular form, and varies greatly in size. It has generally a cartilaginous and fibrous structure, and the fibres are often disposed in a concentric or converging manner. This tumour has sometimes a granular appearance, or seems to consist of a congeries of smaller tumours, of different densities, each having a thin capsule of cellular membrane. When large, the tumour is often unequal, lobulated, or divided by deep fissures, and arteries and veins of considerable magnitude can be traced into its substance. Cavities containing a bloody or dark-coloured gelatinous fluid are sometimes formed in the central parts of the tumour, by a process of softening which its substance undergoes. In other cases the tumour does not manifest a disposition to become softer as it enlarges, but its density gradually increases until the whole mass has become cartilaginous, without arteries or veins containing red blood; or calcareous depositions are gradually formed in the substance of the tumour, until it is partially or completely converted into a concretion of phosphate or carbonate of lime. This is generally of a light yellow colour or nearly white, soft, and porous, like pumice-stone; but instances have occurred where it has become so hard as to admit of being polished like marble or ivory. These deposits usually first take place in the most dense points of the tumour. In a few rare cases, they have been formed on the surface of the tumour, and have inclosed it like the shell of an egg. Gardien states that the smallest tumours most frequently

undergo this transformation. Andral, on the authority of Brugnatelli, states that carbonate and phosphate of lime, with an animal or gelatinous matter, enter into the composition of these bodies. Dr. Turner, professor of chemistry in the London University, had the kindness to analyze, at our request, two years ago, a small concretion, which was passed during life from the uterus of a female above sixty years of age. This was found to consist entirely of carbonate of lime and animal matter. Dr. Bostock has more recently analyzed several specimens of uterine concretions, and he has found them principally to consist of phosphate and carbonate of lime with animal matter. (Med. Chirurg. Transact. vol. xviii, part ii. p. 313.)

In several cases of fibro-calcareous tumour of the uterus which have come under our observation, and of which we have related the histories in the paper referred to, little uneasiness was experienced during life; but in another case there was also malignant ulceration of the uterus, and portions of the calcareous tumour were discharged from the vagina long before the disease proved fatal. Many months previous to her death this patient had attacks of hemorrhage and excruciating pains in the uterus before the concretions were passed. There were also sallowness of the complexion, and great irritability of stomach, as in cases of malignant disease.

A somewhat similar case of malignant ulceration of the uterus with calcareous tumour has been recorded by M. Louis, in the second volume of the Memoirs of the Royal Academy of Surgery. A lady long felt a sense of weight in the uterus, and for three years had suffered acute pain with constant leucorrhœa. Six weeks before death, which happened on the 27th of May, 1744, a foreign body which presented in the vagina was removed with a pair of forceps. This concretion, which was shown to M. Levret, was large, and had the form of a hen's egg. Its consistence was like plaister. On the following day a small body of the same character was removed. The patient had borne several children before she began to experience these pains. During the last months of her life the contents of the bladder and rectum passed through the vagina. On dissection, a gangrenous ulcer was found at the orifice of the uterus, and had destroyed the septum between the rectum and vagina. The fundus uteri was healthy.

"The symptoms and the accidents," observes M. Louis, "which these concretions of the uterus produce, do not affect this organ exclusively. Their situation with respect to the bladder may greatly derange its functions. The following observation will show that difficulty in passing the urine, and even retention of urine may be occasioned by the presence of a concretion in the uterus. A woman, seventy-two years of age, died at Lille in 1688. She had been afflicted for fifteen or sixteen years with difficulty in voiding the urine, insupportable pains in the region of the loins, os pubis, and perineum. The cause of the symptoms was referred to the kidneys or bladder, but accidentally the uterus was examined, and it appeared to be scirrhous. A large hard stone filled its whole cavity, which was considerably dilated by this foreign body. The outer layer of this stone was of a friable matter, which was easily detached. The interior was more solid but very porous, for this stone was very large compared with its weight, which was only four ounces; it would have weighed a pound if the matter had been more condensed, and the volume equal."

M. Louis relates the case of another woman, sixty-two years of age, who died of a disease of the chest in the Salpétrière, on the 16th April, 1744. On opening the body the uterus was found as large as a hen's egg, and low down in the vagina. Its orifice was not dilated, and its cavity was completely filled with a white hard substance which weighed ten drachms and a half, and a month after only six. This woman for some years before death had suffered from a disagreeable sense of weight in the region of the uterus, with pains in the loins and thighs. She had also suffered severely from pruritus pudendi and upper part of the thighs. (Mémoires de l'Académie de la Chirurgie, t. ii.)

Schenkius has collected together, from the works of Hippocrates, Vallesius, Salius, and Marcellus Donatus, the histories of some extraordinary cases of stones discharged from the uterus during life, and discovered in the organ after death. Some of these histories are probably authentic, and if so, they prove that the disease now under consideration has existed from the earliest ages. (De aliis Uteri Affectibus, lib. iv. p. 717.)

Hippocrates relates the history of a woman of Larissa who, when young, suffered pain during intercourse, and never became pregnant. When sixty years of age, she was attacked with pain-like labour, after eating a quantity of onions. "The pain became so intense," he adds, "that she fainted, and during this state of deliquium, another woman, perceiving a rough body protruding from the vagina, removed it with her hand. The patient ever afterwards enjoyed good health. (Lib. v. de Morb. Popular. sect. vii.)

Salius relates the case of a nun sixty years of age, who suffered violent pains in the uterus for several months. The pains, which were alleviated by no remedies, ceased after the escape of a concretion the size of a duck's egg. The patient afterwards died from the exhaustion produced by the putrid suppuration of the uterus. (Salius ad C. 113, Pract. Altom.)

Marcellus Donatus states that Hippolita Gaeta died after having long suffered from uterine pains and fever; and that a stone of an incredible size, having the consistence of gypsum, and floating in a quantity of black fluid, was found in the uterus on dissection. "Cujus rei (he observes) nos multos habemus testes." (Hist. Mirab. lib. iv. c. 30.)

About the year 1070, in a village of the Soissonnais, according to the chronicle of Antonin as quoted by Louis, a pregnant woman, who had been three weeks in labour, was delivered of three stones. One was of the size of a goose's egg, the other was as large as a hen's egg, and the third was like a nut. The child immediately followed, and the woman was freed from her pains.

Ambrose Paré states that persons who have stones in the uterus experience violent pains in it, and that they have bearing-down efforts similar to those of labour.

Michael Morus cites the case of a woman upwards of forty years of age, who died of a pleurisy, and had suffered for a long time severe pains of the hypogastrium, for which all remedies had failed to procure relief. On examination, a hardness was felt in the uterus. There escaped from the vagina an acrid discharge, like the washings of putrid flesh. Thirty-two stones were found in the uterus, the smallest of which was the size of an almond. Different folds of the uterus retained them, and some of them were in the Fallopian tubes. He believed these concretions to be of the same nature as bezoars; and he affirms that he saved the lives of several patients by their use. From his statement, that the stones were in the Fallopian tubes, and that they were retained by different folds of the uterus, we are disposed to think that they were uterine phlebolites which he saw, and not fibro-calcareous concretions of the uterus.

With the origin of calcareous tumours of the uterus, pathologists do not appear to have become acquainted, till a comparatively recent period. Walter has given engravings of these bodies in his Annotationes Academica, published in 1786; and he states that calculi are sometimes present with polypi of the uterus and vagina. It does not appear, however, that he discovered the intimate relation which exists between them; and from a recent examination of some of the preparations in the Hunterian Museum at Glasgow, we are disposed to believe that Dr. William Hunter was the first who was acquainted with the different situations which fibrous tumours occupy in the uterus, and with the various changes which they undergo in the progress of their development.

From an examination of a single specimen of the disease, Dr. Baillie was led to suspect, in 1787, that calcareous concretions of the uterus commence as fibrous tumours. "In the cavity of the uterus," he observes, "a bony mass is sometimes found. When this is the case, I suspect that the hard fleshy tubercle within the cavity of the uterus, such as I have already described, has been converted into bone. This, at least, had taken place in the only instance which I have known of this disease; for a great part of the tubercle still remained unchanged, and I think it very probable that such a change most frequently happens where these bony tumours are found." (Morbid Anatomy, t. ii. p. 331.)

Dr. Baillie refers to the works of Lieutaud for proof of the fact that stones have been found in the cavity of the uterus. "These are described by authors," he adds, "as varying in their appearance, some being of a dark, others of a light colour. They are silent about their nature, and I can say nothing of it from my own knowledge, as it has never occurred to me to see an instance of this disease. Such concretions are probably formed from matter thrown out by the small arteries which open on the internal surface of the uterus, and are in some degree analogous to the concretions formed in some glands of the body." (Morbid Anatomy, p. 332.)

Bayle, Bichat, Roux, Breschet, Andral, and many other pathologists, have long been fully aware of the fact, that fibrous tumours occasionally become calcareous, or, as they have improperly been termed, bony. Whether all the concretions reported to have been found in the cavity of the uterus are formed by deposits in fibrous tumours, and whether the substance of the uterus itself is ever converted into bone, as reported by Verdier, we are not at present in possession of facts which enable us satisfactorily to determine.

When calcareous concretions of the uterus are discovered to exist by an examination per vaginam, and where they are loose, they may be removed artificially with a pair of forceps, or with the fingers. Incisions into the os uteri, as in the case related by M. Louis, do not offer much prospect of relieving the patient. When attacks of inflammation of the uterus are produced by these concretions, the symptoms should be relieved by leeching and other appropriate remedies, and irritation diminished by anodynes.

M. Bayle has described the fibrous tumours of the uterus as fleshy and of a red colour at their commencement, then as becoming cartilaginous, and in the last stage osseous. This may be the fact with a few rare examples of the disease, but we are satisfied it is not uniformly so, and that the greater number of these tumours never exhibit a muscular or fleshy appearance at any period of their existence, but have a fibrous structure equally distinct when not larger than a pea, and when exceeding in magnitude the head of the human adult.

Sometimes we find only one tumour present in the walls of the uterus; at other times several are met with of different sizes, and not unfrequently they are combined with cysts and tumours of the ovaria. They have no disposition to ulcerate, nor to degenerate into a malignant form, though they are not unfrequently observed in individuals who have cancerous affections of the uterus, mammæ, liver, and other organs. They have seldom, if ever, been observed before the age of puberty, and Bayle affirms that they are most frequently met with in the bodies of those women in whom the physical signs of virginity are present, and that in twenty out of one hundred women taken indiscriminately after the middle period of life, the fibrous tumour, more or less developed, is found on dissection imbedded in the walls of the uterus.

Fibrous tumours are developed either in the cellular membrane under the peritoneal coat of the uterus, or they are formed between the layers of its muscular or middle coat, or immediately below its internal or mucous membrane. When under the peritoneum, they often hang by a very slender neck, and the peritoneum covering them is highly vascular, when no blood-vessel can be perceived in their substance. When situated under the peritoneum, while their volume is small, they produce no change in the form of the uterus, and they give rise to no irritation, hemorrhage, or derangement either in the uterine functions or general health, and their existence even can only be guessed at during life. But when they attain a large size, and come to occupy a great part of the abdominal cavity, they produce all the injurious consequences of enlarged ovaria, from which indeed during life they are distinguished with the greatest difficulty, and death ultimately takes place from interrupted circulation and long-continued pressure on the bladder and other contigu-

ous viscera. When situated under the peritoneum of the uterus, fibrous tumours do not prevent impregnation, because they do not interrupt the communication between the vagina and ovaria; but when adherent to the posterior part of the body or neck of the uterus, they sometimes produce fatal consequences both to the mother and child by impeding the progress of the latter through the pelvis, or by giving rise to hemorrhage and inflammation after delivery. (Med. Chir. Transact. vol. xviii. part ii. p. 387.)

"When fibrous tumours are formed between the strata of muscular fibres of the uterus, we have also observed that they attain a large size; the fundus, body, and orifice of the uterus usually become hypertrophied as during pregnancy, and greatly altered in shape. If situated midway between the peritoneal and mucous membranes, they press equally in all directions as they slowly enlarge, and separate the muscular fibres, and cause the uterus to project both on the external and internal surfaces. When a thin stratum of muscular fibres is interposed between the tumour and peritoneum, the projection is observed only on the corresponding peritoneal surface on the uterus, and the cavity of the organ remains unchanged." (Ibid.)

Tumours situated in the muscular structure cannot be recognised until they have attained a large size. The disorders they produce, M. Gardien states, are least after the critical age. Women who have fibrous tumours imbedded in the proper tissue of the uterus are frequently barren, or if they become pregnant, abortion takes place in the early months, in consequence of the uterus being incapable of undergoing the requisite development. Where the ovum is not prematurely expelled, death may take place from uterine hemorrhage soon after delivery. M. Chaussier saw a woman die from flooding soon after giving birth to a full-grown child. There was a fibrous tumour of great size in the posterior walls of the uterus. This body was not situated, however, so as to present an obstacle to the passage of the child through the pelvis, but soon after delivery it was perceived that the uterus had not the power of contraction. Profuse hemorrhage took place from that part of the uterus in which the tumour was lodged, the flow of blood could not be arrested, and the patient died.

On the 12th of February, 1823, a woman, aged forty-two years, residing in Cumberland Street, Middlesex Hospital, was delivered by embryotomy of a still-born hydrocephalic child. The liquor amnii amounted to sixteen pints. Profuse uterine hemorrhage followed the extraction of the placenta, and on the third day after delivery death took place from inflammation of the peritoneal and muscular coats of the uterus. We examined the body, and found a hard fibro-cartilaginous tumour in the muscular coat, where the placenta had adhered to the uterus. We have recorded a similar case which occurred to Dr. Chowne. Another case of the same description has been given by Dr. Outrepont.

Dr. Marshall Hall relates the case of a woman who died after parturition from inflammation and suppuration of fibrous tumours of the uterus. (Principles of Diagnosis, Lond. 1834, p. 307.)

There are no symptoms by which we can positively determine during life the presence of fibrous tumours in this situation; they may, however, be suspected to exist in those individuals who, being advanced beyond the middle period of life, suffer habitually from leucorrhœal discharge, who menstruate profusely, and have attacks of menorrhagia, with irritation in the region of the uterus and adjacent organs. After unusual exertion, chronic inflammation of the uterus is not unfrequently produced by them; and from what we have observed in some cases, we have been led to believe that what is termed irritable uterus, which is supposed to arise from a nervous affection of the uterus without any change of structure, is in some women referable to the presence of fibrous tumours in the walls of the organ.

But the fibrous tumour is sometimes developed immediately beneath the lining membrane of the uterus, or with a layer of muscular tissue interposed. It is in this manner that the greater number of uterine polypi originate. As the tumour of polypus enlarges, the cavity of the uterus becomes distended as by the ovum during gestation, and its walls are excited to contract and expel the tumour, which pushes before it through the orifice of the uterus that portion of the lining membrane of the uterus by which it is covered, in a manner somewhat analogous to what takes place in hernia when the peritoneum is pressed forward by the intestine or omentum through the inguinal or crural canals. By the constant and powerful action of the uterus, the tumour is gradually forced into the vagina, where it undergoes various important changes of structure, both in its covering membrane, peduncle, and deep-seated parts. Its mucous membrane is sometimes pale, and presents little sensible change of structure, but more frequently it becomes highly vascular, hypertrophied, softened, and inflamed, or it ulcerates and sloughs and gives rise to a sanguineous, purulent, and fetid discharge from the vagina, and to all the other symptoms of malignant disease of the uterus. In some cases the diagnosis between a large fibrous tumour in this stage filling the vagina, and a malignant fungous disease of the os uteri, is extremely difficult.

Dupuytren believes that fibrous tumours in the vagina sometimes become cancerous; but this fact has not been satisfactorily established.

We have observed in the same volume of the Medical and Chirurgical Transactions, that if the tumour be covered only by the lining membrane of the uterus, little difficulty is experienced in expelling it from the cavity, and the pedicle is slender, consisting only of thickened lining membrane, a little cellular substance, and some small blood-vessels; but when the tumour is covered also with a layer of muscular tissue of the uterus, the root is thicker, often as large as the wrist in circumference, and consists not only of lining membrane and blood-vessels, but chiefly of muscular coat. A longer continuance of uterine action is here required to force the tumour into the vagina, and not unfrequently the patient expires from the loss of blood before the tumour has descended sufficiently low to admit of the application of a ligature around its root. We are disposed to believe, from preparations in our possession, that it

is not on the primitive state of the tumour or polypus, as Herbiniaux and Dupuytren have supposed, that the consistence and form of the peduncle depend, but on the quantity of muscular fibres carried before the tumour, and that in most cases where the peduncle is thick and short, it will be found to be composed not only of mucous membrane and blood-vessels, but of hypertrophied muscular structure of the uterus. This account of the formation of uterine polypi, which is confirmed by the observations of Dr. Sims, Cruveilhier, and Boivin, will satisfactorily explain why it is unnecessary, as many have supposed, to pass the ligature for the removal of polypi close to the uterus; and it also explains a circumstance pointed out by Clement and Puzos, that the root of the polypus which remains never grows again after the general mass of the tumour has been removed.

The fibrous tumour is developed under the lining membrane of the fundus, body, cervix, or os uteri, and the symptoms are modified according as it is situated in one or other of these situations. Inversion of the unimpregnated uterus is sometimes produced when a large fibrous tumour is formed in the walls of the fundus uteri, near the inner surface. Dr. William Hunter and Dr. Denman have both related cases of this description, which terminated fatally in consequence of the ligature having included a portion of the inverted uterus.

It occasionally happens, when the fibrous tumour is large, and is formed under the lining membrane of the cervix uteri, that it is suddenly expelled from the vagina, and produces appearances which strikingly resemble those observed in cases of chronic inversion of the uterus. The fibrous tumour and inverted uterus being both covered by the same mucous membrane, and being liable to the same changes of structure from pressure, interrupted circulation, and inflammation, without an accurate acquaintance with the previous history of the case, and the progress of the symptoms, the diseases might readily be confounded together. Levret, Herbiniaux, and other writers, infer that most of the cases which have been reported of amputated uterus, have been cases of large polypi or fibrous tumours, which had escaped from the vagina. Two cases have come under our observation in which large fibrous tumours of the cervix uteri, having passed through the ostium vaginæ, gave rise to appearances which could not be distinguished from inversion of the uterus during life. A case has been recorded by Klingberg of a large fibrous tumour of the cervix uteri being treated as a case of prolapsus. A great wax pessary had been passed into the vagina to give it support. (Acta Reg. Societ. Hav. vol. p. 31.)

Dr. Merriman relates the history of a pregnant woman in whom a fibrous tumour of considerable size was connected with the os uteri. A ligature was applied around the peduncle, and in a few days the tumour fell off. The general health of the patient improved after the operation; she went to the full time, but the child was still-born.

Dr. Gooch relates a case which occurred in the practice of Mr. Borrett of Yarmouth, in 1799, which terminated fatally soon after delivery. At the commencement of labour a tumour was discovered in the vagina. After the rupture of the membranes, as the child did not advance, it was delivered by turning, and was born alive. The placenta was spontaneously expelled, but some hours after a soft round tumour was found pressing on the os externum. Violent expulsive pains continued for many hours after delivery. A large fleshy tumour, which presented the appearance of an inverted uterus, had been forced out of the vagina. She continued to suffer during the whole of this day, and died in the evening. The body was examined the following day. The uterus was contracted, but its mouth was dragged down as low as the external orifice by a tumour, which grew from it by a broad base. It was attached to the posterior part of the mouth of the womb, and some way up the neck was of a livid colour, and weighed three pounds fifteen ounces. The patient had borne her last child before easily and naturally, but some time before her present pregnancy, she looked as large as if seven months with child. (Dr. Merriman's Synopsis, &c. Lond. 1820. p. 225.)

M. Deneux gives the history of a case of fibrous tumour of the uterus expelled into the vagina, after an abortion at the fourth month, and mistaken for after-pains. The lady, aged thirty, after the second child observed the abdomen larger than natural; menstruation became irregular, and she had occasional attacks of menorrhagia. She again became pregnant, and miscarried at the fourth month. The after-birth was expelled with difficulty. The uterus remained larger than usual. Fever followed, with pain of abdomen. After some days a soft fleshy body was perceived at the vulva, and this was supposed to be the placenta. The febrile symptoms continued. It was found impossible to remove this body, and it was discovered to be a fibro-cartilaginous tumour. It was removed by a ligature applied round its neck, but the patient died. On examining the tumour, which was of the size of the fist, its form was found to be irregular, and it was composed of two distinct parts: 1st, an exterior covering, in a putrid gangrenous state; 2dly, a central portion, white, fibrous, lamellar, presenting an appearance of little cells, hard and resisting when cut with the knife. Uterine and abdominal inflammation followed. The tumour had sprung from the inner part of the anterior wall of the uterus. The ligature had been applied to the proper tissue of the uterus. A smooth cavity was found in the anterior wall of the uterus, which was lined with a fine membrane, a portion of which was enclosed in the ligature. The uterus was healthy in other respects.

M. Deneux cites cases from Delius, Ruleau, Lamotte, Frank, and Arnaud, in which bodies putrefied within the uterus, and he points out the importance of exploring the vagina and uterus, to determine whether this is so when the lochia are offensive. (Répertoire Général d'Anatomie, &c. tom. vii. 1829.)

Though it has been demonstrated that the greater number of uterine polypi are merely fibrous tumours which have been developed under the lining membrane of the uterus, and a layer of its muscular fibres, we are not entitled to infer, as

some writers have done, that these are the only tumous which pass from the cavity of the uterus into the vagina, and which are not of a malignant nature. We have pointed out other three varieties of tumours of the uterus, to which the term polypus has been applied: first, a tumour with a broad base, and generally of a flattened form, originating in a morbid growth of the lining membrane of the organ, and resembling nasal polypi; secondly, a tumour formed under the mucous coat of the uterus, which is composed of a congeries of small cysts or vesicles filled with a clear or yellow-coloured ropy fluid; thirdly, a tumour of the os and cervix uteri arising from a morbid enlargement of the mucous follicles and glands of the part. (Med. Chir. Trans. vol. xviii. part ii.)

History of fibrous tumours and polypi of the uterus.

Before the middle of the eighteenth century, few facts of any importance had been ascertained respecting the origin and structure of polypus of the uterus. The older writers included under the term polypus all the different tumours of the uterus which have now been described, the greater number of the organic affections of the os and cervix uteri of a malignant nature, and also fleshy moles or ova in a morbid state. The confusion and obscurity in which the pathology of uterine polypi has so long remained, may be attributed in a great measure to the circumstance that few opportunities have been enjoyed of investigating their structure before it has been destroyed by inflammation and sloughing produced by artificial or natural means.

In 1696 Saviard examined the body of a woman who died of uterine hemorrhage in the Hôtel Dieu. He found a fleshy mass as large as the heart of an ox adhering to the fundus uteri and filling its cavity. This tumour, which had a slender neck or root, was covered with a membrane which appeared to be an expansion of the internal membrane of the uterus. Four branches of arteries and veins were distributed to the tumour. The arteries were small, but the veins were as large as the crural veins; and when the tumour was laid open, a considerable cavity was formed in its centre, extending from the apex to the base. The lower end of the tumour had a contused and gangrenous appearance, and Saviard believed that the hemorrhage which had destroyed the woman proceeded from the veins. (*Levret*, Observ. sur les Polypes Utérines. Paris, 1749. 8vo. p. 31.)

A woman died at Orleans in the year 1746, who had a tumour hanging from the vagina, which was supposed to be cancerous. M. Levret examined this tumour after death, and found it similar in structure to the tumour described by Saviard. It contained arteries and veins, and was covered on the outer surface by an expansion of the membrane which lines the inner surface of the uterus. A great number of varicose veins were observed on its surface. On laying open the tumour, no other cavities were perceived in it except those of some blood-vessels, the largest of which did not exceed the fourth of a line in diameter. In colour and consistence the tumour resembled boiled cow's udder.

M. Levret divides all polypi peculiar to females into those which arise from the uterus, and those which grow from the walls of the vagina. He subdivides uterine polypi into three species, according as they are attached to the fundus, the cervix, or the margin of the os uteri. He considered hemorrhage an invariable symptom, after the tumour had passed the orifice of the uterus. M. Levret observed that nature had the power in some cases to rid herself of the disease by detaching and expelling the tumour, and he attributed this result to the orifice of the uterus binding and strangling it, like a ligature applied around its neck. When polypi are attached to the os uteri, it sometimes happens, he observes, that the body of the polypus, which is in the vagina, is not every where isolated and surrounded by the os uteri. The finger cannot be carried completely round the tumour, and the point where the resistance is met with is situated a little higher than the remaining portion of the circumference of the orifice of the uterus. He was aware that prolapsus and inversion of the uterus were liable to be confounded with polypus, and suspected that in several of the cases in which the uterus was said to have been amputated, a large polypous tumour had only been removed. The diagnosis and the treatment of uterine polypi were both much improved by Levret, but he did not contribute any fact to elucidate their anatomical structure which had not previously been pointed out by Saviard.

The treatise of Herbiniaux contains a much more complete account of the symptoms, diagnosis, and treatment of polypus of the uterus, than is to be found in Levret's work, and the distinction is accurately drawn by him between the malignant excrescences of the os uteri, and those tumours which have no tendency to become cancerous. He has also described, with greater minuteness, the varieties of form which uterine polypi assume. He says they are not all of a pyriform shape; some are round, others flat, smooth, rugous or in bumps, and the same variety is seen in their roots, some being long and slender, some thick and short. The difficulty of distinguishing polypus uteri from inversion and prolapsus of the organ, and certain organic affections to which it is liable, is illustrated in a striking manner by Herbiniaux's cases, and he has pointed out the importance of the maxim of Levret, "de ne jamais traiter les femmes ni les filles affligées d'hémorrhagies habituelles sans les faire visiter, surtout si ces hémorrhagies sont accompagnées d'écoulemens putrides ou sereux, n'importe de quelle couleur." (Traité, &c. Bruxelles, 1782, tom. ii. p. 6.)

Walter had a very imperfect acquaintance with the structure and origin of uterine polypi. They are produced, he says, by an irritation in the orifices of the vessels which are distributed to some point of the surface of a mucous membrane. "Polypi uteri tunc semper nascentur, si in extremitatibus vasculorum membranæ internæ uteri, per aliquod ibi habitans irritamentum, succus quidam luxurians secernitur coagulabilis, qui in dies singulos magis tenax evadit, et spissus tandemque in veram telam cellulosam commutatur. Hac progenita nunc tela cellulosa, quam firmissime vascula illa conjungens cum illis arctissime cohæret. Vasa membranæ internæ uteri eodem modo elongantur quo vasa pleuræ et peritonei, quæ in-

terdum ita prolongantur, ut cum vasis exhalantibus pulmonum et viscerum abdominalium sese conjungunt. Tali modo uteri polypi vasa accipiant nutrientia, quorum ope de die in diem magis magisve adcrescunt, ita ut talis cellulosa qualis fungus appareat, et prægrandem nonnunquam adipiscetur magnitudinem." (Annotationes Academ. Berolin. 1786, p. 6.)

Dr. Baillie was the first pathologist who had a precise knowledge of the fact that fibrous tumours of the uterus have no relation to cancerous tumours. Dr. Baillie was also the first who discovered that the most common kind of polypus is hard, and consists of a substance divided by thick membranous septa, like the fleshy tubercle of the uterus. "When cut into," he says, "it shows precisely the same structure as the tubercle of the uterus just described, so that a person looking on a section of the one and the other out of the body could not distinguish between them. This sort of polypus varies very much in its size, some not being larger than a walnut, and others being larger than a child's head. It adheres by a narrow portion or neck, which varies a great deal in its size and in its proportion to the body of the polypus. The largest polypus I ever saw was suspended by a neck hardly thicker than the thumb; and I have seen a polypus less than the fist adhering by a neck fully as thick as the wrist.

"The place of adhesion also differs considerably. It is most commonly at the fundus uteri, but it may take place in any other part; and I have seen a small polypus adhering just on the inner lip of the os uteri. When a polypus is of any considerable size, there is generally one only; but I have occasionally seen on the inside of the uterus two or three small polypi, and in some instances several polypi have been known to grow from the uterus in succession.

"Another sort of polypus forms in the uterus, which consists of an irregular bloody substance with a number of tattered processes hanging from it. This, when cut into, exhibits two different appearances of structure; the one appearance is that of a spongy mass, consisting of laminæ with small interstitial cavities between them; the other is that of a very loose texture, consisting of large irregular cavities." (Morbid Anatomy, vol. ii. 1828, p. 327.)

In 1802, M. Bayle published a memoir on fibrous bodies of the uterus, in which he pointed out their structure, situation, and symptoms more accurately than had previously been done, and clearly distinguished them from scirrhous tumours of the uterus. He was perfectly acquainted with the fact that the fibrous polypus and fibrous tumour of the uterus are the same disease. (Journal de Médecine, t. v. p. 62, and Dict. des. Sc. Méd., *art.* Corps fibreux de la Matrice, t. vii. p. 59.) Bichat and Roux published, in 1809, an essay on the organization of uterine polypi, and their surgical treatment. "Until the present time, they observe, all practitioners have confounded under a common denomination many affections essentially distinct. The word polypus has served to designate the various excrescences of the pituitary membrane and the pediculated tumours which are developed in the interior of the womb and of the vagina. Further, all have not distinguished among these latter the true polypi from the fungosities of the mucous membrane. Though Levret has crowned himself with lasting glory in devising means for the application of ligatures around polypi, yet he has left every thing to desire as to the results of his observations from the examination of dead bodies, and of the anatomical details which he might have collected from women who had perished by the disease. Those who followed him are to be reproached with like indifference in not availing themselves of opportunities which they must have enjoyed to interrogate nature, and supply the deficiencies of our information respecting the pathology of polypus of the uterus." Bichat and Roux compare the structure of fibrous tumours of the uterus to intervertebral cartilage in old men, and to prove the fibrous structure of polypi they adduce the fact that they frequently become cartilaginous. "Whatever," they observe, "be the external disposition which these tumours present, of which we now treat, they have all a similar organization. We cannot, however, irrevocably pronounce that there cannot be formed in the walls of the uterus, tumours, or rather diseased productions, differing from those of which we here speak. Perhaps further observations may make these known to us, but at least at the present time, the great number of specimens procured from dead bodies enable authors to establish a perfect identity in the nature of all uterine polypi." (Œuvres Chirurg. de T. I. Desault, t. iii. p. 370, 8vo. Paris, 1809.)

"A polypus does not appear to be regularly organized like a natural part of the body: it most probably arises in this way: a blood-vessel is ruptured, the blood from it coagulates, and into this various vessels shoot, and there, as living matter, it may grow by powers of its own." This is understood to have been the opinion entertained by Dr. J. Clarke respecting the origin of uterine polypi. (London Practice of Midwifery, p. 42, 5th ed. 1823.) Sir C. Clarke defines a polypus of the uterus to be "an insensible tumour attached to the internal part of the viscus by a small neck, forming a disease of a very important character." (Observ. on the Diseases of Females, 1821, p. 243.) Its insensibility, he says, distinguishes it from inverted uterus, and the regularity of its surface from cauliflower excrescence of the os uteri. On the structure of uterine polypi he has offered no remark. Dr. Cusack distinguishes uterine polypi into soft and hard. In a case of soft polypus, Dr. Cusack states that it was exquisitely sensible to the touch, a circumstance which, he says, had previously been pointed out by Dr. Johnson, in the Dublin Hospital Reports, who shows the fallacy of founding a diagnosis between polypus and inversion of the uterus upon the tenderness of the uterus in the case of inversion.

"The most frequent kind of polypus is of a firm semicartilaginous structure," according to Dr. Burns, "and is covered with a production of the inner membrane of the womb, and indeed it seems to proceed chiefly from a *morbid change of that membrane and usually subsequent enlargement of the diseased portion*; for the substance of the uterus is not necessarily affected. The enlargement is generally greatest at the furthest extremity of the tumour, and least near the womb; so that

there is a sort of pedicle formed, which sometimes contains a pretty large blood-vessel, and the tumour is pyriform. But if the membrane of the uterus be affected to a considerable extent, and especially if the substance of the uterus be diseased, then the base or the attachment of the polypus is broad. The vessels are considerable, especially the veins, which sometimes burst; in every instance, I believe, if the patient live long, the tumour is disposed to ulcerate."

Dr. Gooch defines "a polypus of the uterus, when discovered, to be a tumour in the vagina attached to some part of the uterus. It is round, smooth, firm, and insensible." "The internal structure of polypus, in most cases, exactly resembles the internal structure of the large white tubercle of the uterus, commonly called the fleshy tubercle." "They are the same disease, differing only in the seat and mode of their attachment, and consequently in the symptoms which they produce." "On cutting into them, we see a hard white substance, intersected by numerous partitions. This, however, is not always its structure; it is sometimes of a much softer and looser consistence, and sometimes has considerable cavities."

Dr. Craigie thinks there is nothing satisfactory known respecting the nature and mode of development of uterine polypus. "It appears," he says, "to consist in a deposition of matter entirely new, either in the mucous chorion or submucous filamentous tissue. The tumour is almost invariably covered by a thin pellicle, similar to mucous membrane, but much more vascular. It appears on the whole to be much of the nature of vascular sarcoma occurring in other textures. It is generally vascular, often traversed by varicose veins, is liable to frequent hemorrhage, and occasionally degenerates into destructive ulceration. It ought not, however, to be confounded with cancer."

Dr. Hooper observes, that "uterine polypi are organized fleshy fungous substances found attached to the surface of the cavity of the uterus, or that of its cervix, or the surface of the vagina." "Some of them," he says, "are a subcartilaginous, hard, elastic substance, of a dirty brownish colour, which presents, when cut through, an appearance that approaches very much to that of the subcartilaginous or fibrous tumour. In this, which often acquires a great size, there are several small irregular cavities filled with a serous fluid. There is another polypus, which, when cut, presents a smooth compact surface, and a more obviously gristly structure. It also has cavities, but not the cords which the former has. Other polypi Dr. Hooper describes as having a different structure, being soft, spongy, very little elastic, the cut surface smooth and vascular, and its colour fleshy." Dr. Hooper likewise includes, under the term polypus, hematoid and brain-like tumours of the uterus.

Dr. Davis states, that "polypi are adventitious structures, which have been known from time immemorial. Without regard to any precise definition of polypi, modern writers have distributed tumours of this class into several principal varieties, founded for the most part upon these more obvious physical and structural properties, as soft, hard, vascular, fibrous, fleshy," &c. Dr. Davis refers all uterine polypi to the four following varieties:—soft, fibrous, muco-lymphatic or cellulo-fibrous, and spongy-granular. (Principles and Practice of Obstetrical Medicine, p. 599. Lond. 1834.)

"When the polypi of the uterus," observes M. Dupuytren, "are divided immediately after their excision, they present a dead white appearance; they resemble exceedingly interstitial substance, being eminently fibrous; but they also contain another tissue—I mean cellular membrane—generally, however, more dense than elsewhere; sometimes these two are in about equal proportions, but occasionally one preponderates over the other, and it is on this preponderance that the subsequent changes depend. If the fibrous element abounds, the polypus does not degenerate; or if at length it does so, it passes into an ossific state. If, again, the cellular tissue abounds most, the polypus degenerates into carcinoma." (Leçons Orales, reported in the Lond. Med. Gazette, p. 190.)

Treatment of fibrous and other Tumours of the Uterus, which are not malignant in their nature.—When formed under the peritoneum and between the muscular fibres of the uterus, fibrous tumours are but little under the influence either of external or internal remedies. Iodine and mercury have little effect either in arresting their growth or promoting their absorption. The increased determination of blood which often takes place to the uterus when these bodies are formed in its walls, should be relieved by local blood-letting, anodynes, and rest in the recumbent position; and when profuse hemorrhage occurs, it should be controlled by rest in the recumbent position, cold applications to the hypogastrium, the tampon, and the superacetate of lead. The uneasy sensations from pressure on the blood-vessels and nerves of the lower extremities may sometimes be slightly relieved by certain changes of posture; and if the tumour be movable and occupies the hollow of the sacrum, and compresses the bladder and rectum, it may be removed from this situation by pressing it above the brim of the pelvis. In most cases, fibrous tumours cannot be removed by art while they remain within the cavity of the uterus. When the hemorrhage endangers life, some authors recommend us to dilate the os uteri artificially, and to remove the tumour. Lisfranc has recorded a case, in which incisions were made through the os uteri, and the tumour removed.

When fibrous tumours are formed under the lining membrane of the uterus, and have passed through its orifice into the vagina, constituting polypi, they may be removed by a ligature, or their root may be divided with a knife, or they may be twisted off. Since the invention of the double canula by Levret, various instruments have been employed for passing ligatures around the stems of uterine polypi. For polypi of ordinary dimensions, the instruments of Goerz, improved by Niessen and Dr. Gooch, are the best that can be employed. When the tumour is of large dimensions, a curved rod or tube is preferable. When the two silver canulæ are made use of, a strong ligature must be introduced through both tubes, so that its two ends may hang out of their lower apertures, while the middle portion forms a noose between the two upper apertures. Thus armed, the canula must be passed over the globular part of the

tumour, the fore-finger of the left hand having previously been introduced as a guide to the instrument. One of the tubes is then to be kept fixed, while the other tube is to be carried slowly round the circumference of the root of the tumour until it reaches the opposite side of the tube, which has been kept in the same place. The ligature must be tightened until the neck of the tumour is completely cut across. When the tumour becomes putrid, and many days elapse before its root is divided by the ligature, the tumour should be drawn down, and the peduncle should be divided with the knife or scissors. The greatest attention should be paid to cleanliness, and the offensive discharge should be washed away by injection of tepid water and solutions of the chlorurets. This operation is not without danger. In a case which occurred in St. George's Hospital, under the care of Mr. Babington, the patient died of uterine phlebitis. M. Blandin saw a case terminate fatally from the same disease. Cases have repeatedly terminated unfavourably from ulceration being excited in that part of the uterus to which the tumour had adhered. Dupuytren states that he has met with eight or ten cases where patients were destroyed after the application of a ligature around the root of a polypus of the uterus, and where the symptoms were those produced by the absorption of pus into the system. M. Dupuytren has removed two hundred uterine polypi by excision, in the course of the last twenty years. In this large number, hemorrhage has only taken place twice, and in both these instances it was permanently arrested by plugging. In eight cases, M. Velpeau has never met with hemorrhage. Many other distinguished continental surgeons prefer the excision of uterine polypi to their removal by the ligature; and our experience inclines us to prefer the former method. Where the root of the tumour is largely supplied with blood-vessels, as in a recent case which came under our observation, to obviate the danger of hemorrhage after its division, a ligature should previously be firmly applied around it, at a short distance from the uterus. Dubois affirms that even this does not secure the patient from hemorrhage. Dupuytren seizes the tumour with the forceps of Museux, and draws it down till the os uteri can be seen at the entrance of the vagina: a pair of curved scissors is then conducted along the finger to the root of the tumour, and it is divided. It is only in cases where the neck of the polypus is slender and of soft consistence, that it can be safely twisted off.

3. Of the Malignant or Cancerous Diseases of the Uterus.

Scirrhus, carcinoma, hæmatoma, cephaloma, fungus hæmatodes, cauliflower excrescences of the os uteri, *excrescences vivaces*, corroding or phagedenic ulcer of the os and cervix uteri, are some of the terms which have been employed by different authors to designate the varieties of malignant or cancerous disease of the uterus. That there is no essential difference between these affections is proved by the fact, that the morbid alterations of structure by which they are characterized are sometimes found blended together in the same uterus, and they have all this common tendency, that they invariably proceed after a longer or shorter period to destroy the different textures of the uterus and the adjacent viscera.

When the os uteri is affected with that form of malignant disease termed carcinoma, it generally becomes thick, hard, irregular, and the lips are everted and painful on pressure. One or both lips of the os uteri become projecting, or they are changed into hard irregular knobs or tumours, which frequently bleed when touched. In the greater number of cases of malignant disease, the os and cervix uteri are the parts first affected, but the opinion is incorrect that the cervix uteri is invariably the part first attacked, and that the disease commences in the glands of the part. In some cases the lining membrane of the fundus or body of the uterus is extensively disorganized by malignant disease before any change has taken place in the lower portion of the uterus. The cavity of the uterus may be distended with a large, hard, carcinomatous tumour, adhering to the fundus, or with a soft fungous mass growing from the lining membrane of the body of the uterus, while the os and cervix have undergone no sensible alteration of structure. The preparations in our collection illustrate these facts in a striking manner, and they demonstrate also that it is not in the glandular structure of the os and cervix uteri that carcinoma generally commences. Dr. Montgomery observes that "the disease, instead of first showing itself in the cervix or os uteri, very frequently commences in some of the appendages of the uterus, involving the surrounding tissues, or in the upper part of the organ, and thence spreading downwards, manifests itself last in the cervix." (Dublin Hospital Reports, vol. v. p. 457.) Breschet and Ferrus have likewise stated that they have observed cases of extensive malignant disease of the uterus in which the os and cervix were the last to become disorganized. It also follows from these facts that we cannot, in all cases of cancer of the uterus, detect the disease by an examination per vaginam, nor does it admit of relief by excision of the os and cervix uteri.

In carcinoma of the uterus, ulceration of the os and cervix takes place as the disease advances, and all the textures of the part are completely destroyed. The fundus and body of the uterus, which are often much enlarged, also lose the natural appearance, become hard like cartilage, and intersected by a dull white or pale yellow-coloured fibrous or cellular tissue. In other cases, when cut, the uterus resembles a slice of raw or boiled pork: this has been called the lardaceous degeneration of the organ; when it presents, as it sometimes does when cut, the appearance of firm jelly, it forms the *matière colloide* of the French pathologists. In other cases, as the softening and ulceration proceed, the appearance termed hæmatoma, fungus hæmatodes, or encephaloid cancer, is observed to take place. The diseased mass has a soft consistence, like brain, a spongy texture, a lobulated irregular form, and bloody appearance. When cut into, it resembles coagulated blood, with an admixture of albumen, and a soft pulpy substance, which adheres to the knife. Some parts are vascular and fibrous, but the lighter-coloured parts are more firm and fleshy. (Hooper's Morbid Anatomy of the Uterus.)

In other specimens of malignant disease of the

uterus, brain-like masses, as large as an orange, are formed around it, and in these a substance like milk or cream is occasionally found. In various parts of the diseased mass, or around it, portions of a dark-brown or black colour, constituting melanosis, are occasionally observed.

As the disease proceeds to a fatal termination, irregular-shaped fungous growths of harder or softer consistence, and sometimes as large as a moderate-sized apple, and which bleed profusely when touched, spring from the ulcerated surface and fill up the vagina. Occasionally these malignant fungous growths seem to be produced before ulceration has taken place; and as they increase, they sometimes fall off by sloughing or ulceration, and are speedily reproduced, or leave a deep excavated ulcer, with hard irregular edges. Copious fetid discharges of thin serum, pus, and blood take place from the vagina. The fetor is so great in some individuals that we recognise the existence of malignant disease of the uterus before examining per vaginam.

There is a variety of malignant diseases of the uterus which some have considered as essentially different from the preceding, but which is a mere modification of the varieties already described. It has been called the phagedenic or corroding ulcer of the os uteri. Sometimes the ulcer, which is of a deep violet colour, is quite superficial, without much thickening, induration, or enlargement of the part. The ulcer begins like any other malignant ulcer on the surface of the body, and it gradually proceeds until the greater portion of the cervix has been destroyed, or removed by ulcerative absorption, and openings are formed into the bladder and rectum. The portion of uterus which remains after death is sometimes not much altered in appearance: more frequently, however, it becomes softened in texture, and assumes a yellow or reddish-brown colour. Soft fungous excrescences of a cauliflower shape also sometimes grow from the ulcer, and undergo changes similar to those observed in other varieties of malignant disease of the uterus. It is now, we believe, admitted by all pathologists that the cauliflower excrescence of the os uteri, as it was termed by Dr. J. Clarke, and the *excrescences vivaces* of Levret and Herbiniaux, are merely varieties of malignant disease of the uterus, and have nothing in their structure resembling the vascular structure of the placenta, as many have supposed.

But frequently the ravages of these destructive diseases are not confined to the mucous and muscular coats of the uterus; the peritoneal coat is affected, and great changes are produced in all the contiguous viscera. When the cancerous ulceration reaches the peritoneum, inflammation of this membrane is excited, and the patient perishes from an attack of acute peritonitis. This is one of the most common terminations of the disease, and the appearances observed after death do not differ from those observed in cases of fatal puerperal peritonitis. Death sometimes also takes place by perforation of the peritoneal coat of the uterus, as in cancer of the stomach and other hollow viscera. A case occurred several years ago to Mr. Jones of Carlisle-street, in which the peritoneum of the fundus uteri had been perforated by gangrene. Destructive peritonitis was the consequence. In a case which we saw with Mr. Prout, the cancerous ulceration of the peritoneum of the fundus uteri had been closed by a portion of ileum becoming united to it by lymph. The malignant affection did not then cease to extend, but it perforated the ileum, and for many months before death the fæces did not pass along the colon, but into the vagina through the opening in the ileum.

The uterus, when affected with malignant disease, frequently becomes fixed to the surrounding parts in the pelvis, and hangs low down, near the outlet. The vagina most frequently becomes early involved in the disease; its coats become indurated and contracted, and affected with malignant ulceration. When the finger is introduced, it passes into a hard contracted ring in the vagina, beyond which there is often a great ulcerated excavation, communicating with the cavities of the bladder and rectum. From the thickening and induration of the coats of the rectum, constipation is often experienced to a distressing degree. Important changes are likewise produced in the coats of the bladder, which are often perforated, and the urine passing by the opening, the urethra becomes impervious. The cancerous thickening of the coats of the bladder closes the openings of the ureters, and complete suppression of urine sometimes takes place. The ureters frequently become distended to a great degree, so as to resemble a piece of intestine, and the structure of the kidney is greatly changed. In one case which we examined after death, there was a large soft fungous tumour in the posterior part of the bladder, the disease having extended from the neck of the uterus to the bladder. Around this fungous growth the mucous membrane of the bladder was raised into white, hard, irregular knobs. The iliac and lumbar glands become hard, or of a cheesy consistence; or large and soft, like brain or lard. The surrounding blood-vessels and nerves are involved in the cancerous disease, and not unfrequently the iliac and femoral veins become inflamed, and all the phenomena of puerperal crural phlebitis or phlegmasia dolens are produced.

Malignant diseases of the uterus seldom commence till after the middle period of life, but there are exceptions to this observation; and Breschet and Ferrus relate a case of cancer uteri which proved fatal at the age of twenty-two. The author saw a woman twenty-eight years of age, who had the os and cervix uteri destroyed by malignant ulceration, and an opening established between the bladder and vagina. He saw a case of fatal carcinomatous ulceration of the os and cervix uteri in a woman aged twenty-four, who was under the care of Mr. Stodart of Golden-square. Though most frequently observed about the period when menstruation ceases, cancerous disease of the uterus may occur at the most advanced old age as well as in early life: we have observed it in one individual above eighty. It is stated to be nearly as frequent as cancer of the mammæ, and to be about one-half less frequent from thirty to forty, and from fifty to sixty, than from forty to fifty. It appears to occur with nearly equal frequency in chaste women, and in those of an opposite character; in those who have had children, and in those who have never been pregnant." (Dict. des Sciences Méd. tom. iii. p. 387.)

The duration of malignant affections of the uterus varies in different cases; their progress is accelerated by violence. Some women die from a superficial ulceration of the os uteri, while others survive for a considerable time the destruction of the greater part of the organ. The disease may run its course in a few months, or the sufferings of the patient may be protracted for several years. They have in some cases made great progress before they have been suspected to exist. "In women who live temperately," observes Dr. C. Clarke, "the disease may continue for a long time without producing many symptoms, if any judgment can be formed from the cases of patients who apply for medical aid on account of symptoms under which they have not long laboured. On examination there is often found in such women a considerable alteration in the structure of the parts, which most probably could not have happened in a short time. The examinations made from time to time of patients labouring under this disease who will consent to follow a proper regimen, frequently prove the very trifling change which will take place in the complaint even in the course of many years." (On the Diseases of Females, vol. i. p. 212.)

In women who still menstruate, cancer uteri is usually announced by some irregularity of the menstrual discharge. The secretion becomes more copious, returns at shorter intervals, and continues longer than usual. In those who have ceased to menstruate, there is sometimes a profuse discharge of blood from the vagina, or there is an oozing of blood from the uterus, which continues for several days and then ceases, but reappears at longer or shorter intervals, and in so regular a manner as to lead the patient to believe that it is a recurrence of menstruation. At other times the discharge of blood takes place at irregular intervals, after any unusual mental or bodily exertion. In most cases, from the very commencement of the attack there is pain more or less acute, sometimes of a burning or lancinating kind, experienced in the uterus, back, inside of the thighs and groins, with serous, mucous, puriform, or sanguineous discharge from the vagina. One of the first symptoms of the disease is pain experienced during intercourse, followed by a slight sanious discharge. As the disease advances, the sense of burning or lancinating pain in the uterus increases, great irritation is experienced in the rectum and bladder and external parts, the mammæ not unfrequently become hard and painful, and there is constant nausea or vomiting.

Sooner or later the symptoms appear, to which the term cancerous cachexia has been applied, and of which Bayle and Cayol have given the following description: "The colour is pale and yellow; emaciation makes rapid progress; certain bluish patches are observed in the face; the flesh is soft, the tone and energy of all the organs are diminished, and the principal functions are seriously disturbed. Constipation or excessive diarrhœa takes place, with febrile attacks. The pains of the sacrum, loins, and haunches become excruciating, so that the patient cannot stand up without fainting. Some perish at this period from hemorrhage or peritonitis, others of fever or convulsions. If life is not cut short by some of these accidents, a general puffiness or true œdema of the inferior extremities takes place. The discharge becomes putrid, and coagula of blood, with a fetid putrilage, flow from the parts. The urine and fæces pass out from the vagina, mixed with the ichorous suppuration of the ulcer, which extends its ravages to the bladder and rectum and all the surrounding parts. In this deplorable state gangrenous eschars take place on the sacrum and genitals, which accelerate the fate of the patient. Aphthæ at last occur in the mouth." (Article *Cancer Uteri*, Dict. des Sciences Médicales.)

This is not, however, the invariable course of the disease; for cases have repeatedly come under our observation, where, with little local or general disturbance, there has existed extensive malignant disease of the uterus. A fatal case of true carcinomatous ulceration of the os and cervix uteri, with great induration, recently came under the notice of the writer, in which there was copious fetid, puriform, and bloody discharge from the vagina; yet the patient made no complaint of uneasiness in the region of the uterus, and continued to take food to a short period before death. Dr. Montgomery has also related cases where the sufferings of the patient were inconsiderable, even after the disease had made great progress in disorganizing the uterus. In most cases there is a peculiar lurid or sallow hue of the face, observed very early in the disease, but in others there is little or no perceptible change in the countenance; and death takes place before there is any considerable degree of emaciation.

There are various diseases which are distinguished with difficulty from cancer uteri. Fibrous tumours which have passed through the os uteri, when their surface ulcerates and sloughs, give rise to the same fetid, purulent, and bloody discharges from the vagina which are observed in malignant diseases of the uterus. It is only by a careful examination of the tumour and os uteri that the diagnosis can be accurately drawn. Fetid leucorrhœa, the unnatural lengthening of the neck of the os uteri in some women, its subsequent swelling, and chronic inflammation of the os uteri, may all be mistaken for malignant disease of the uterus; and it is only by a careful examination per vaginam, by time, and watching the effects of remedies, as Bayle and Cayol have observed, that we can arrive at the knowledge of the true nature of the complaint. Scrofulous and venereal ulcerations of the os uteri are also distinguished with difficulty from the cancerous.

Causes.—It is often an hereditary disease. It is not produced by inflammation, but inflammation is often excited in its progress, and when produced, hastens the fatal termination of the affection. Mechanical injury has been enumerated among the causes of malignant disease of the uterus; but we have never met with a case where it could be distinctly referred to violence of any kind.

Treatment of malignant diseases of the uterus.—There are no means by which we can prevent or remove these diseases. They do not depend upon common inflammation, but on a specific action of the parts which proceeds invariably, sooner or later, to the destruction of the patient. Considerable relief to the sufferings of the patient

may be procured against those attacks of plethora and inflammation which occur in the progress of carcinomatous degeneration of the uterus; and perhaps the progress of the disease may be sometimes rendered more slow by certain modes of treatment. To remove plethora, leeches should be applied to the vulva or anus, or blood in sufficient quantity should be drawn from the loins or sacrum by cupping-glasses. If there should be acute pain with inflammatory symptoms about the pelvis, venesection should be performed. Great relief for a time followed a profuse hemorrhage from the uterus in a case of malignant fungus of the orifice, produced by an unsuccessful attempt to enclose the growth in a ligature. Spontaneous hemorrhages, though they tend to weaken the patient, often procure temporary relief; and it is better to allow the blood to flow till a decided effect is produced upon the pulse. The application of leeches to the os uteri by a speculum has also, according to some writers, been had recourse to with decided benefit. To alleviate the agonizing sufferings of those afflicted with these diseases, narcotics must be employed, and the most important of these are opium, conium, belladonna, &c. which should be administered in doses proportioned to the severity of the sufferings of the patient. One of the best modes of employing the opium is in the form of suppository, or starch and laudanum glyster, or laudanum in warm milk. The doses of the opium must be gradually increased. Frictions and embrocations should also be employed, and a belladonna plaister laid over the sacrum. In some cases morphia procures rest when all other remedies fail. But there are cases in which every narcotic fails to procure relief for the sufferings of the unhappy patient. When hemorrhage occurs, we must suspend the use of opiates, and have recourse to mucilaginous and astringent remedies. To allay the irritability of the stomach, hydrocyanic acid has been recommended. An injection of the chloride of soda is often of great use in relieving the fœtor of the discharge. The tepid hip-bath and warm injections of decoction of poppy should also be employed.

No permanent benefit can be expected to result from the application of a ligature around the root of a malignant fungus of the os uteri.

From what has been stated in the course of these observations, it must appear unnecessary to pass a sentence of condemnation upon the practice of removing the uterus, either wholly or partially, when affected with malignant disease. The operation appears to us equally cruel and unscientific.

III. Diseases of the Vagina and Vulva.

Vagina.—The mucous membrane of the vagina is liable to attacks of common and specific inflammation. When inflamed it is red, swollen, and painful; and the patient experiences uneasiness in the part when the urine is voided and when she moves. When the inflammation is severe, pus is secreted from the affected membrane, or abscesses are formed in the walls of the vagina. In other cases its structure is rapidly destroyed by gangrene, sloughing, or ulceration; and fistulous communications are formed between it and the bladder and rectum. In several cases which have come under our observation, where there had been a white discharge like pus from the vagina during life, we found on dissection a thin, pale, false membrane coating the lips of the os uteri and a considerable portion of the upper part of the vagina. The mucous membrane under this layer of lymph was red, rough, and granular, and clusters of enlarged mucous follicles were perceptible.

The application of cold, mechanical violence, and specific poisons appear to be the most common causes of inflammation of the vagina. Where the affection is of a mild form, it admits of relief from the occasional employment of the tepid hip-bath, fomentation, or emollient and anodyne injections, mild cathartics, and low diet. After the acute symptoms have been removed, a solution of nitrate of silver, or some astringent substance, thrown up the vagina, often produces beneficial effects. If the inflammation be intense, warm cataplasms to the external parts and local and general bloodletting may be required in addition to the remedies now specified. When suppuration takes place in the parietes of the vagina, or in the surrounding cellular membrane, the matter should be early evacuated. If a contraction of the canal of the vagina, preventing sexual intercourse, follows sloughing and ulceration, it can generally be overcome by the use of metallic bougies. The dilatation should, however, in this as in cases of natural contraction of the part, be very gradually performed, lest fatal peritoneal inflammation should be excited.

The vagina is also sometimes closed by the presence of an impervious hymen, or from a membrane stretching across the vagina at a greater or less distance from its orifice. No inconvenience results from imperforate vagina before the age of puberty, when the menstrual fluid, being unable to escape, accumulates, and distends not only the cavity of the vagina, but in some cases the uterus and Fallopian tubes. This distension produces pain in the loins and region of the uterus, difficulty in evacuating the bladder and rectum, and other signs of mechanical irritation of the parts within the pelvis: no discharge is observed at the expected time. The symptoms are aggravated at each monthly period; and if the disease is not recognised, and the membrane divided, the abdomen becomes swollen, and violent contractions of the uterus, like those experienced in labour, are set up. In some cases the symptoms have been referred to pregnancy or chlorosis; and if an examination is not permitted, it will be difficult to discover the actual condition of the patient. When the nature of the disease is ascertained, the inconvenience is removed by making a crucial incision through the hymen.

Scrofulous, syphilitic, and cancerous ulcerations are met with in the mucous membrane and follicles of the vagina. In several individuals who have been cut off by tuberculous phthisis, we have found numerous scrofulous ulcers in the vagina. In one case the purulent discharge had not proceeded from the surface of the vagina, as was suspected before death, but from the lining membrane of the uterus, which was red, greatly thickened, and much softer than natural. Dr.

Carswell has given a representation of scrofulous ulcers of the vagina; and he has informed us that it is not a disease of frequent occurrence. Dr. Hooper observes that "this assumes the character of scrofula in other parts. The sides of the ulcerations are tumid: solid puriform depositions are found about them between the membranes in the cellular structure; and there are perhaps fistulous communications with the urinary bladder, rectum, or psoas muscle." (Morbid Anatomy of the Human Uterus.) The different excrescences of the vagina which appear near its orifice are supposed by M. Murat to be of a syphilitic origin, whilst he considers those to be of a cancerous nature which spring from the walls of its cavity. He admits this diagnosis to be extremely difficult, and in many cases impossible.

In the mucous membrane of the vagina there are orifices leading to simple or compound lacunæ and glands, which differ in size. In the natural state they are small, but they become enlarged by disease. These lacunæ and glandular bodies are more numerous at the orifice and at the interior part of the vagina than in the remainder of its surface. The milky discharge in many cases of leucorrhœa proceeds from these mucous follicles when affected with inflammation of a chronic character. It has also been demonstrated that many tumours of the vagina, and probably the greater number of polypi, originate in a morbid enlargement of its mucous follicles. Portal states that the vagina is sometimes very narrow, and even obliterated; and then not only intercourse cannot take place, but sometimes the flow of the menses is prevented. This may either be the effect of acute inflammation, or of such an increase of the volume of the glands of the vagina that they may fill the cavity, as has been observed in some venereal and cancerous affections. Portal likewise observes that the canal of the vagina may be narrowed, or even obstructed, by hydatids.

We saw a case, with Mr. Lawrence, about a year ago, where there was a tumour at the orifice of the vagina like a prolapsus vesicæ, and which had been treated as such by the introduction of a large pessary. A viscid dark-coloured gelatinous fluid escaped from the opening which we made into the most prominent part of the tumour with a lancet: the fluid never collected again, and the patient recovered in a short period. Mr. Lawrence pointed out to us the following description of an analogous case which occurred to Mr. Hunter:—"From an obliteration of the ducts of Cowper's glands, I have seen a very large tumour formed at the entrance of the vagina. I once saw one very large, which had been mistaken for a rupture: both in this and the former case an opening should be made as nearly as possible to the former opening of the duct; this should be either a crucial incision or a round opening made with caustic, which may serve in future for an artificial duct." (Hunterian Reminiscences, by Mr. James Parkinson, p. 142.)

The following interesting case of this disease has been related by M. Pelletan. "Une femme, agée de vingt-quatre ans, se présenta, en 1807, à l'Hôtel Dieu, pour y être traitée d'une tumeur qui l'incommodait par sa saillie dans le vagin et dans le rectum, l'obligeait à marcher les cuisses écartées, et la génait dans des travaux habituels. La tumeur occupait la partie gauche et postérieure du vagin, et était couverte par sa membrane muqueuse: elle était ronde, et de la grosseur d'un œuf de poule. La toux semblait augmenter son volume, et la poussait vers l'orifice du vagin, où elle se présentait également quand la malade restrait long-temps debout: alors on la repoussait aisément à l'intérieur, on la sentait aussi avec le doigt introduit dans le rectum. Cette tumeur était sans douleur; elle génait la sortie de l'urine et des matières stercorales. Plusieurs personnes pensaient que cette tumeur était une hernie; elles s'en laissaient imposer par la mollesse de son tissu et la facilité avec laquelle on la repoussait, sans, cependant, la faire disparaître. M. Pelletan en jugea autrement: il parvint à parcourir toute sa circonférence, et à l'amener à l'entrée du vagin, en portant deux doigts derrière elle: il fut convaincu par là qu'elle n'avait aucune continuité avec les parties circonvoisines. Il reconnut sa mollesse pour une fluctuation: et sa mobilité lui persuada que le fluide était renfermé dans un kyste recouvert du vagin, et entouré d'un tissu cellulaire assez lache. Une incision de deux pouces de longueur, faite aux parois de cette tumeur, donna issue à un demiverre d'une matière puriforme, blancheverdâtre, et la tumeur fut evacuée. L'écoulement fut assez abondant pendant quelques jours. Le pansement ne consista que dans des injections détersives dirigées dans le vagin. La malade fut parfaitement guérie vingt-six jours après l'opération." (Clinique Chirurg. tom. i. p. 250.)

Sir A. Cooper has described a similar case, in which the tumour originated in a morbid enlargement of a mucous follicle just before the meatus urinarius. Mr. Hemming states that he examined the bodies of two women, in whom he found tumours projecting into the vagina. In one there were two of these follicular tumours; in the other there was a single one as large as an egg. On a minute examination of their internal structure, it was evident that they consisted of obstructive lacunæ, which had thereby become dilated into a cyst and distended with a gelatinous fluid. Mr. Hemming infers that the greater number of tumours which obstruct parturition are of this description. (Edin. Med. and Surg. Journal, v. xxxv. p. 82.) We have previously shown that fibrous tumours of the uterus and ovarian cysts and tumours often impede the progress of the fœtal head through the pelvis. Fibrous tumours, according to certain authors, are also sometimes developed in the walls of the vagina, and when they have attained a considerable size, clear the vulva. M. Baudies has given the description of a tumour, ten pounds and a half in weight, which grew from the vagina. M. Dupuytren relates two cases in which fibrous tumours of enormous size were developed in the vagina. Varicose and aneurismal tumours sometimes form around the vagina, and give rise, when injured, to profuse hemorrhage. M. Murat observes "that tumours of different kinds are met with in the vagina; some being fatty, others fibrous or encysted, and not a few of a carcinomatous or malignant nature. I have found tumours in the vagina which contained pus, water, air, calculi, &c. Some of these

tumours are developed in the thickness of the walls of the canal, or on its surface; others are in some degree foreign to it, though they come to project into its cavity." (Dict. des Sciences Méd. tom. lvi. p. 468.) No case of fibrous tumour or fibrous polypus of the vagina has come under our observation, and the rarity of the disease probably depends on the absence of a muscular coat in this canal similar to that in the uterus. Between the rectum and vagina fibrous tumours similar to those in the uterus are sometimes formed. M. Pelletan has related two cases of this description, where an incision was made through the walls of the vagina, and the tumours, which were of large size, were removed with success.

The *caruncule myrtiformes* sometimes become inflamed from violence. At the orifice of the vagina, tubercles of a conical form and of a deep brown, rose, or pale colour, are sometimes met with. Boivin and Dugès state that these sometimes become excessively inflamed, and interrupt intercourse. The usual local means for subduing inflammation should be employed. The caruncule are also susceptible of becoming elongated and hypertrophied. M. Dubois has seen cases of this description where they were mistaken for venereal excrescences. The *clitoris* and *nymphæ* are also liable to attacks of inflammation from common and specific causes. They sometimes become much enlarged by hypertrophy and malignant disease, and require extirpation. In some cases hypertrophy of the nymphæ seems to be produced by syphilis.

Urethra and Meatus Urinarius.—Around the orifice of the female urethra, several excretory canals of mucous glands open, and within the urethra there are also ducts which lead to mucous follicles. Portal believed that some varieties of gonorrhœa and leucorrhœa depended upon inflammation and an increased secretion from these glandular bodies. (Anatomie Médicale, t. v. p. 475.) Some of the vascular excrescences connected with the female urethra probably also originate in a morbid state of these bodies. The female urethra has certain longitudinal folds which facilitate its dilatation, and render it much more extensible than the urethra of the male. Its shortness and dilatability in the female render the introduction of foreign bodies into the bladder, and their removal, much more easy than in men. Large calculi have been extracted from the female bladder by gradual dilatation of the urethra with sponge tents and other appropriate means. (Med. Chir. Trans. v. i. p. 123.)

Irritation of the female urethra is sometimes connected with disease of the kidneys; in other cases it is symptomatic of some affection about the neck of the bladder, or of calculi in that viscus. Mr. Howship has seen cases depending on the presence of uric acid calculi in the kidneys. Dr. Bateman states that prurigo urethralis sometimes occurs in women without any manifest cause, and is removable by the use of bougies. (Practical Synopsis of Cutaneous Diseases, 8vo. 1813, p. 22.) In hysteria and other severe affections of the nervous system, the urethra and neck of the bladder are sometimes spasmodically contracted. The pressure of the head of the fœtus during labour may give rise to severe irritation and inflammation of the urethra; it can then be felt like a hard cord running along the upper part of the vagina, and is painful on pressure, or when the urine flows. Local bleeding, anodynes, gentle cathartics, and tepid fomentations are the remedies which afford the greatest relief in cases of irritation and inflammation of the lining membrane of the urethra.

In some cases of malformation of the parts, the orifice of the urethra opens into the vagina. In other cases a communication is formed between the vagina and urethra by sloughing, from injurious pressure during parturition. The direction of the canal of the urethra is sometimes altered by displacements of the uterine organs, and by the pressure of ovarian tumours.

Stricture of the female urethra is a rare disease. Dr. Cusack mentions a case where a contracted state of the urethra gave rise to all the symptoms of diseased bladder, which were relieved by the frequent introduction of the bougie. (Dublin Hospital Reports, vol. v. p. 506.) Sir Benjamin Brodie has a preparation in his collection of morbid parts where stricture of the female urethra existed, and the following is the account of the case: "The patient was admitted into St. George's Hospital, labouring under an exceeding difficulty of making water. The urine was voided almost in drops with much effort and straining. The internal orifice of the urethra was so much contracted that it could scarcely admit a small probe. It was, however, dilated by means of bougies, and the patient voided her urine in a moderate stream. Some time after she was seized with an attack of fever, which proved to be dependent on inflammation of the peritoneum covering the liver, unconnected with the stricture, and of this she died. The stricture is quite at the extremity of the urethra, occupying about half an inch of the canal."

A small, florid, vascular tumour or excrescence sometimes grows from the lining membrane of the female urethra, or from the edge of the meatus urinarius, which gives rise to severe irritation in the part. At first the tumour resembles a prolapsus of the inner membrane of the urethra, and it may be returned wholly or partially within the canal. It soon, however, enlarges, becomes of a bright red colour, extremely painful when irritated by any foreign body, or the passage of the urine, and bleeds when touched. The tumour often assumes a flattened oval form, with a thick broad root, or it has a slender pedicle. Its sensibility is not increased in proportion to the increase of its size, though its scarlet hue becomes more and more vivid as it enlarges. It may attain the size of a horse-bean or cherry, when the movements of the body and the voiding of the urine occasion intolerable pain. It is seldom of a firm consistence, and the surface is sometimes smooth, at other times irregular or granulated.

All the excrescences which grow from the female urethra have not the same florid red colour. We have recently seen a young married female, with Dr. Forbes, who had two painful excrescences growing from the ostium vaginæ on the left side, and another from the lower part of the margin of the urethra and a portion of the mucous membrane of the urethra. They were smooth, were

not of a florid colour, had thick bases, and were exquisitely painful when touched. The root of the tumour, which grew from the meatus urinarius, bled profusely after being removed with the scissors.

There is sometimes with this affection an increased secretion of mucus from the parts, but this does not take place in all cases, and the symptom is not characteristic of the affection.

Morgagni was the first who described this disease. "In urethræ osculo," he observes, "corpusculum prominebat rubellum: quod ipsa secundum longitudinem incisa, nihil aliud esse vidi nisi intimam ejus tunicam, quæ cum supra a subjectis vasculis sanguine distentis tota nigricaret, ima parte se extrorsum invertens exstabat; quod et in alia a claudicatione scribam nemini vidisse. Utramque autem cum de urinæ difficultate agerem commemorasse, et parvi illius vitii causam quæivisse." (De Causis et Sed. Morb. Epist. 1. No 51.) Sir C. Clarke was the first author who gave a full account of the symptoms and treatment of the affection.

Sir C. Clarke, Dubois, Cullerier, and Lachapelle, have all seen many cases of this disease, both in single and married women, and in those who had never been affected with syphilis. Mr. Wardrop has informed the writer that he saw a case of vascular tumour of the meatus urinarius in a girl previous to the age of puberty. The excrescence was removed with the scissors, but was soon reproduced. Morgagni saw it in a girl fifteen years of age. We have seen examples of this affection in two married ladies, who were under twenty-two years of age, and who were in consequence unable to cohabit with their husbands. We have likewise observed the disease in individuals beyond the age of sixty. A woman aged sixty-two was supposed to be afflicted with prolapsus uteri, and a pessary had been introduced into the vagina, and retained there for several months, which greatly aggravated all the symptoms. The patient had for a long period never enjoyed undisturbed sleep, and had become greatly emaciated from her sufferings. There was constant sense of pain in the urethra, and the incessant desire to pass the urine, with sense of burning heat in the passage, prevented her from enjoying undisturbed sleep. She could not taste either warm food or drink, or swallow even a small quantity of any stimulating fluid without experiencing great aggravation of all her symptoms. These were all immediately relieved by excision of the tumour, and it never returned. In a case of vascular tumour of the urethra which we saw with Dr. Burder, the symptoms were similar to those usually witnessed in cases of malignant disease of the uterus, and without a careful inspection the true nature of the affection could not have been detected.

The tumour should be seized with a pair of forceps, and drawn out, and its root divided by a pair of probe-pointed scissors. When the bleeding has ceased, the cut surface should be touched with nitrate of silver or potassa fusa. Like growths and excrescences from other mucous surfaces, this tumour is sometimes reproduced, and a second or third operation is required. Where the disease has been connected with a considerable portion of the mucous membrane of the urethra, bougies should be introduced and retained in the urethra until the tumour has been destroyed. A case has been related by Dr. D. Davis, in which the whole lining membrane of the urethra was affected, and the disease was completely relieved by the use of bougies of gradually increasing size. Madame Boivin (vol. ii. p. 668), has also related an instance of fungous tumour of the meatus urinarius, in which there was a painful sensation experienced after the passage of the urine, and a sero-sanguinous discharge from the vulva. The symptoms, as in Dr. Burder's case, led to the supposition that there was a malignant disease of the uterus. Mad. Boivin advised the patient to use an elastic catheter three inches long, of a conical shape, the extremity of which was two lines in diameter, and the base eight lines. This part, which had several small apertures, was fixed to a piece of sponge two inches thick. This apparatus was retained in its situation by a T bandage. The presence of this sound in the urethra at first produced very acute pain. Every time the sound was withdrawn, it was covered with a cerate containing opium before being re-introduced. The pain became gradually more supportable, and in fifteen days the tumour had lost a part of its solidity, so that a larger sound could be introduced. The portion of the tumour which remained was removed by excision on the twenty-second day, and the sound, surrounded by a portion of agaric and sponge, was introduced, and the affection was relieved in fifteen days. It is difficult in this case to discover why the fungus in the first instance was not removed with the scissors, and afterwards treated with a common bougie.

It is requisite in all cases, after this operation has been performed, to recommend the patient to remain for a week or ten days in a state of rest, and to live on spare diet. This we do from having observed death take place from obscure abdominal inflammation twelve or fourteen days after the excision of a vascular tumour from the margin of the meatus urinarius. Indeed, after all operations upon the external uterine appendages there is some danger of inflammation being excited in the peritoneum.

In some women there is a thickening of the cellular membrane surrounding the urethra with a varicose state of the vessels of the part. It is accompanied with a sense of dull pain, increased by pressure, in the situation of the urethra, and frequent desire to pass the urine, and difficulty in voiding it. If the finger be introduced into the vagina and carried along the urethra, it is felt tender, hard, and swollen; and if the patient presses down, the swollen and vascular condition of the urethra becomes apparent.

In this affection Sir C. Clarke recommends us first to unload the vessels by leeches or by puncturing them with a lancet, and to do this repeatedly until the symptoms are relieved. Solutions of lead, or of muriate of ammonia, or sulphate of zinc, are afterwards to be applied to the parts. Pressure should afterwards be made by introducing a piece of wax-candle, or a small roll of linen, which has previously been dipped in the lotion.

Labia. — The inner surfaces of the labia are liable to become excoriated and ulcerated. Phleg-

monous inflammation of the labia, which is most frequently produced by mechanical violence or the application of cold, is accompanied with pain, heat, swelling, and sometimes with pyrexia.—Where it is not subdued by the early application of leeches and other appropriate means, warm fomentations and poultices should be employed to promote suppuration. The labia are also sometimes affected with erysipelatous inflammation, which requires appropriate treatment.

Dr. Percival, Mr. Ward, and Mr. Kinderwood have described a fatal disease of the labia pudendi and other external parts in children, which is preceded by pyrexia for several days. The patients then complain of pain in voiding the urine, and the genital organs are found to be enlarged and inflamed. The inflammation is of a dark colour, and soon extends over the clitoris, nymphæ, and hymen. Ulceration succeeds, and the parts are progressively destroyed. M. Ollivier, of Anger, has traced an analogy between this affection in children and gangrene of the mouth and cheeks.

Great enlargement of the labia is occasionally produced by blows and falls, and by extravasation of blood into their cellular substance during labour. One of them becomes suddenly distended with blood, either during the progress of labour or soon after the birth of the child. It is generally confined to one labium, and in the practice of Dr. Dewees it has always occurred after the birth of the child.

The source of the hemorrhage in this affection has not been positively ascertained. Encysted and solid tumours are sometimes formed in the labia, and the labia are liable, like all the other external parts, to become affected with malignant induration and ulceration.

Warts and excrescences are often seen about the labia and orifice of the vagina. They are referable to gonorrhœa or syphilis in many cases, and they are accompanied with much uneasiness and an offensive discharge. Their removal with the knife, scissors, or escharotics is often necessary.

Some women suffer severely from irritation of the labia and mons veneris. Dr. Bateman states, (Synopsis, p. 24,) "that prurigo pudendi muliebris is sometimes connected with ascarides in the rectum, and sometimes with leucorrhœa, but is most violent when it occurs soon after the cessation of the catamenia. The itching about the labia and os vaginæ is constant and almost intolerable, demanding incessantly the relief of friction and cooling applications, so as to compel the patients to shun society, and even sometimes to excite at the same time a degree of nymphomania."

"This condition," Dr. Bateman adds, "is generally accompanied by some fulness and redness of the parts; sometimes by inflamed papulæ, and sometimes by aphthæ. Saturnine and saline lotions, lime-water, with calomel, vinegar, and oily liniments prepared with soda or potass, are beneficial, especially in the milder cases; but the most active remedy is a solution of the oxymuriate of mercury in lime-water, in the proportion of two grains, or a little more, to the ounce. As in the cases before mentioned, however, the presence of rhagades or excoriations will require palliation before it can be employed."

In some cases of this affection the mucous membrane of the vulva and vagina is likewise inflamed, and there is a copious leucorrhœal discharge. Lorry has given a vivid description of the intolerable sufferings of women afflicted with this disease. It frequently indicates, as has already been stated, the existence of carcinomatous disease of the uterus, and this intolerable itching of the pudendum is sometimes the first and most distressing symptom of which women complain who are labouring under malignant organic disease of the cervix uteri. The irritation of the external parts being merely symptomatic, our attention should be chiefly directed to the affection of the uterus.

Prurigo of the pudendum is one of the most distressing symptoms experienced by some women during gestation; and most benefit is derived from the employment of bloodletting, and the administration of calomel and opium with cathartics. Temporary relief is obtained by saturnine lotions, solutions of the chlorurets of lime or soda, cold water, or ice and water to the parts. But the disease sometimes continues to harass the patient in spite of all the remedies we can employ until she is delivered. The diet should be light, and in all cases of this description the utmost attention should be paid to regular ablution of the parts. Wine and fermented liquors of all kinds should be disused, and where there is leucorrhœal discharge, the tepid hip-bath, and tepid lotion of Goulard, and decoction of poppies, should be applied occasionally to the parts.

The uterus is liable to several important displacements, as inversion, retroversion, and prolapsus; but the consideration of these diseases properly belongs to surgery.

[It may be well to remark, that Dr. Simpson (*Lond. and Edinb. Monthly Journ. of Med. Science*, June, August, and November, 1843,) has recommended the employment of a *uterine sound* or *bougie*, by means of which, when introduced into the uterine cavity, it is possible, he says, "to ascertain the exact position and direction of the body and fundus of the organ; to bring the higher parts of the uterus in most instances within the reach of tactile examination, and to ascertain various important circumstances regarding the os, cavity, lining membrane, and walls of the viscus." The instrument resembles a common male sound, but is rather smaller: it has a bulb on the extremity, to prevent its injuring the uterus, but tapers gradually from the handle to the bulb, being one-fifth of an inch in diameter at the former,—one-tenth of an inch at the latter situation. The bulb is one-eighth of an inch in diameter; the stem nine inches long, and it is graduated in order to measure the dimensions of the uterus. A small knob exists on the stem, two inches and a half from the bulb, that being the ordinary length of the uterus; and the further graduation of the instrument is effected by a series of shallow double grooves, half an inch or an inch from each other.

The introduction of the instrument is said to be usually attended with but slight uneasiness, and in a few cases only with a feeling of sickness. The occurrence of actual pain indicates that the lining membrane of the uterus is not in a healthy state.]

ROBERT LEE.

VACCINATION.—Towards the close of the eighteenth century, small-pox continued, notwith-

standing every effort, to be the source general terror to mankind. The progress of intelligence, and the great improvements which had been effected in the art of inoculation, combined indeed to extend prodigiously that practice, to the great benefit of individuals, but unhappily without any corresponding diminution of the general mortality. The prudent were preserved by it, but the careless and the improvident, who will always form the bulk of mankind, had their dangers increased. The sources of infection were multiplied, and small-pox, which formerly used to visit country districts only at long and uncertain intervals, was now to be met with in all parts at all times. In London the evil effects of inoculation were felt in their fullest force. Inoculation was there widely diffused among the lower ranks of society, but without the precaution of seclusion; in consequence of which the contagion of small-pox was daily encountered in the open streets.

The deaths by small-pox in the metropolis at this period, according to the bills of mortality, averaged 2000 annually, or about one-tenth of the total mortality. In 1796 small-pox prevailed epidemically in London with such extraordinary severity, that 3549 lives are recorded as having fallen victims to it. The total deaths by small-pox throughout England were estimated at about 45,000 annually. Inoculation was practised almost universally among the higher ranks of society; and the general impression upon the minds of men was, that every individual born must expect at some period of his life to become the subject of this loathsome and too often fatal disorder.

Such was the state of public opinion, when, in the summer of 1798, Dr. Jenner, a provincial physician of established reputation, favourably known to the scientific world by his investigations in natural history, announced his discovery of a means whereby all this mass of evil might be effectually removed, and mankind relieved from the painful necessity of undergoing small-pox. It is not to be wondered at that the public should have hailed with avidity so gratifying a prospect, held out to them, not by a youthful and too confident aspirant to fame, whose proposal was the impulse of a moment, but by one whose character was at stake, and who announced his discovery as the result of much thought, and of deliberation matured through the long period of twenty years. The eagerness with which vaccination was adopted formed a singular contrast to the events which eighty years before marked the introduction of variolous inoculation into England. A comparison of the spirit in which that proposal was received, with the encouragement which vaccination experienced from all classes of persons within twelve months after the announcement of the discovery, will redound greatly to the credit of the present age. While it shows how much education has opened the minds of the people at large, it exhibits at the same time, on the part of medical practitioners, a praiseworthy promptness to acknowledge the merits of one whose name was almost unknown to them; a benevolence which could sacrifice without a murmur a large share of most profitable practice, and a candour which could renounce at once the prejudices of early education.

The circumstances which led to the original discovery of vaccination, and which attended its introduction into general use, are deserving of particular inquiry, not merely as matters of historical interest, but because they contributed to influence, in a very remarkable manner, public opinion as to the merits of the new discovery. We shall enter, therefore, with some degree of minuteness into the details connected with the early history of vaccination, and trace the causes of that singularly rapid hold which it took of public opinion.

History of Vaccination. — Edward Jenner, third son of the Rev. Stephen Jenner, was born at the vicarage of Berkeley in Gloucestershire, on the 17th May, 1749. Very early in life he evidenced a strong taste for the study of natural history, which probably had an influence in determining the choice of his profession. He was instructed in the elements of surgery and pharmacy by Mr. Ludlow, an eminent surgeon practising at Sudbury near Bristol. While engaged as his apprentice, Jenner had his attention frequently called to a popular notion current in the dairy districts of Gloucestershire, that cows were subject to a disorder called the cow-pox, which was sometimes communicated to the milkers, who became thereby protected from the small-pox. One such occasion is particularly recorded. A young countrywoman came into the shop to seek advice. The subject of small-pox was mentioned in her presence: she immediately observed, "I cannot take that disease, for I have had cow-pox." (Baron's Life of Jenner, p. 121.) This little incident riveted the attention of Jenner. Young as he then was, he dwelt with deep interest on a communication thus casually made to him by an uninstructed peasant, and foresaw in some degree the vast consequences which might result from so extraordinary a fact. In the year 1770, being then twenty-one years of age, Jenner went to London to prosecute his medical studies at the school, and under the immediate eye, of John Hunter. To that enlightened man he repeatedly mentioned the popular rumours concerning cow-pox, but it does not appear that he received from his master much encouragement to prosecute the inquiry. In 1775, being then established in practice in Gloucestershire, he gave more attention to it, but found many difficulties besetting his path, such as would probably have deterred most men from persevering in the task. Among the country people whom he was called upon in the course of his practice to inoculate for the small-pox, some resisted every effort to give them the disease. (Jenner's Origin of the Vaccine Inoculation, page 5.) They were milkers, who had undergone cow-pox. But some of those who appeared to have undergone cow-pox, and whose security might have been anticipated, received small-pox in the usual way. These occurrences led him to make inquiries among the medical men of the district, all of whom knew of the cow-pox and its reputed powers, but they agreed in opinion that it was not to be relied on as a certain preventive of small-pox. They imagined that the phenomenon depended upon some peculiarity in the constitution of the individual who escaped rather than upon any efficacy in the disorder received from the cow. They attached

no value to the facts adduced by Jenner, and thought that a farther prosecution of the subject would only terminate in doubt and disappointment. These obstacles damped for a while, but did not extinguish, Jenner's ardour in his favourite pursuit. He now ascertained that the cow was subject to a variety of eruptions on the teats, all of which received indiscriminately the name of cow-pox. He learned to distinguish the one of these from the others, and was led to entertain the belief that one only was possessed of specific power over the human body. This he called the *true* cow-pox; the others the *spurious*.

The next step of the inquiry convinced him that the true cow-pox itself was liable to undergo progressive changes, and that it was only at one period of its course, in its acmé of intensity, when it was endowed with specific and preventive, or anti-variolous properties. During the investigation of this branch of the subject, Jenner was struck with the idea that it might be practicable to propagate the disease, by inoculating, first from the cow, and finally from one human being to another. At what precise period of his career this brilliant thought first occurred to him is not accurately known, but it was probably early in 1780; for in the month of May of that year we find him speaking of it to an intimate friend, and this was probably the first glimpse of that reputation which he ultimately attained. (Baron's Life of Jenner, p. 128.) In 1788 Jenner visited London, and carried with him a drawing of the casual cow-pox, as seen on the hands of the milkers, which he showed to Sir Everard Home and others; but the physiologists and physicians of London saw in this nothing but a curious and barren fact.

Hitherto Dr. Jenner had taken no decisive step to ascertain the practicability of inoculating for the cow-pox, upon the success of which his whole scheme mainly rested. It is worthy of mention in proof of the slowness with which the philosophic mind of Jenner ripened into conviction, that in November, 1789, he inoculated his eldest son with the small-pox. Soon after this period, however, his confidence in the preservative powers of cow-pox rapidly strengthened. He spoke and wrote about it to many friends, and nothing was wanting but an opportunity of putting his ideas to the test of experiment. This at length presented itself. Cow-pock matter in an active state was found, and parents were met with possessing sufficient confidence in Jenner to submit their children to the important trial. On the 14th of May, 1796, the decisive experiment was made. James Phipps, eight years of age, was vaccinated with matter taken from the hands of Sarah Nelmes. He passed through the disorder in a manner perfectly satisfactory, and was tested with variolous matter on the 1st of July following. The small-pox inoculation, though carefully conducted, took no effect.

Jenner now prepared to communicate to the world the result of his long and anxious investigations concerning cow-pox. His work was ready in June, 1797, but he delayed the publication of it for a twelvemonth, partly that he might profit by the advice of his friends, and partly in the hope of strengthening his argument by additional experiments. This he was happily enabled to do in April, 1798; and the new trials having been equally successful with the first, he felt justified in announcing to the world the discovery of vaccine inoculation. His original essay, published in London in June, 1798, is entitled, "An Enquiry into the causes and effects of the Variolæ Vaccinæ, a disease discovered in some of the western counties of England, particularly Gloucestershire, and known by the name of the cow-pox." In this work twenty-three cases are detailed, viz. sixteen of the casual, and seven of the inoculated disease, with coloured drawings of the appearances in both.

Dr. Jenner, in this work, first treats of the causes of cow-pox. He announces his belief that this disorder does not originate with the cow, but is in all cases communicated to that animal from the horse, where it appears on the heels, and is known to farmers by the name of *the grease*; the hands of the milkers and farm servants being the medium of communication. He next throws out the suggestion, that the small-pox itself may have been originally morbid matter of the same mild kind, which accidental circumstances had changed, and aggravated into that contagious and malignant form, under which we now commonly see it. He then states his conviction that the cow-pox, when it has once passed through the human body, leaves the constitution for ever after secure from the infection of small-pox. The essay concludes by describing four classes of persons, to whom the discovery of cow-pox inoculation holds out the prospect of great benefit. First, those who from family predisposition may be presumed likely to take small-pox unfavourably: secondly, those whose constitutions are predisposed to scrofula: thirdly, those who from some peculiarity of habit resist small-pox inoculation in early life: fourthly, those who are labouring under forms of chronic disease, in which counter-irritation is desirable. An unassuming tone and philosophic spirit pervades this first essay on vaccination, which is very striking, and which, no doubt, contributed essentially to promote the great cause in which the author had embarked.

Dr. Jenner's first publication excited in a remarkable degree public attention. It may be mentioned, however, as a singularly strong proof of the distrust with which any new invention is received, that during a period of nearly three months that Dr. Jenner remained in London superintending the publication of his book, he could not procure one person on whom to exhibit the disease. In the end of July, Mr. Cline made the first experiment with cow-pox in London, which succeeded perfectly; soon after which trials were multiplied in every quarter, and a general rush in favour of vaccination succeeded, which contrasted strongly with the apathy displayed by the medical profession during the infancy of Dr. Jenner's investigations.

The early career of vaccination, however, was not without its drawbacks. A few, but happily a very few, opposed the new practice with a degree of rancorous malignity which carried with it its own cure. Professional jealousy, too, was excited, and a systematic attempt was made to wrest from Jenner's brow the laurels which he had so fairly

won. It was proved, indeed, that rumours of the preservative efficacy of cow-pox were general, and that the attention of Sir George Baker had been specially called to the subject, about the year 1782, by the Rev. Herman Drew, of Abbots in Devonshire, and Mr. Bragge, a surgeon of Axminster. The investigation, however, was never followed up, nor was Dr. Jenner ever made acquainted with the circumstance. Sir George Baker had been, not long before, engaged in a very troublesome inquiry respecting the endemical colic of Devonshire, and was probably unwilling to come forward again as a controversial writer. There were other physicians, well disposed to the cause of vaccination, and who ultimately became its strenuous and most efficient supporters, who yet brought it at first into much discredit by their rashness and carelessness. A series of experiments on the cow-pox was undertaken at the Small-Pox Hospital, in the spring and summer of 1799, by Dr. Woodville, with the praiseworthy object of establishing the Jennerian discovery. In the course of these experiments, the variolous and vaccine poisons became mixed, and much confusion ensued. But in December of the same year, the difficulty was explained and obviated; and the nineteenth century opened most honourably for science and for this country. An antidote against a dreadful pestilence had unexpectedly been brought to light by the scientific researches of an English physician.

It would have been well for the cause of vaccination, if its early supporters had satisfied themselves with a general statement of its acknowledged advantages, and left the rest to time and to future opportunities of observation. Unfortunately, they announced at once that henceforth small-pox was disarmed of all its terrors, and that its complete extermination might not unreasonably be contemplated. The brilliant prospect thus held out added at the moment prodigiously to the splendour of Jenner's fame, but it ultimately did harm. It raised unreasonable expectations, and occasioned disputes in after-times, which brought on one party the charge of prejudice and obstinacy, and on the other that of disaffection to the cause of humanity. The friends of vaccination, however, were certainly justified, by the whole tenor of Dr. Jenner's writings, in encouraging this belief in the adequacy of vaccination to exterminate small-pox. Yet it was a notion which facts at the time little warranted, and which subsequent experience has proved to be fallacious. In his second publication, indeed, dated April 1799, Dr. Jenner judiciously recommended "that the investigation should be conducted with that calmness and moderation which should for ever accompany a philosophic research." But in his third (dated 1800), he expresses his confidence that "the cow-pox is capable of extirpating small-pox from the earth;" and his fourth work, printed in May 1801, concludes with the statement, "that it is now too manifest to admit of controversy, that the annihilation of small-pox, the most dreadful scourge of the human species, must be the final result of this practice." (Origin of Vaccine Inoculation, p. 12.) Whatever allowances we may make for Dr. Jenner's zeal, (and great allowances ought undoubtedly to be made for him), still it must ever be a matter of regret, that such sanguine anticipations should have been indulged at a time when the cow-pox had been known to the world scarcely three years, and had been the subject of general observation not more than two.

Vaccination advanced with extraordinary rapidity. Dr. Jenner states, (Continuation of Facts and Observations, 3d edition, p. 146,) "that in 1801 upwards of six thousand persons had been vaccinated, by far the greater part of whom had been tested with small-pox and exposed to its infection, in every rational way that could be devised, without effect." In 1799, the practice of vaccination was introduced into America, through the agency of Dr. Waterhouse. In the same year, a strong testimonial of confidence in the virtues of the cow-pox was signed by thirty-three of the most eminent physicians, and by forty distinguished surgeons of London. In 1800, vaccination was introduced into France. The earliest supporter of vaccination on the continent of Europe was Dr. De Carro, of Vienna, whose exertions in the cause were beyond all praise. Dr. Sacco, of Milan, distinguished himself, not merely as an active propagator of the new practice in Italy, but by his pathological investigations into the origin of cow-pox. Great difficulties were experienced in transmitting vaccine matter to India; but this object, so ardently desired by Dr. Jenner, was at length effected through the ingenuity and zeal of Dr. De Carro. In June 1802, vaccine lymph, in an active state, reached Bombay from the Persian Gulf, and was thence rapidly disseminated over the continent of India.

In 1802, a committee of the House of Commons investigated and reported upon the utility of vaccination, and upon Dr. Jenner's claims to the discovery; and upon the 2d June in that year, Parliament voted him £10,000. In 1807, this matter was re-considered, and an additional sum of £20,000 awarded to him. In 1808, vaccination was taken under the direct protection of the government. The National Vaccine establishment was then formed, which continued for many years to superintend with much success the practice of vaccination in this country. Dr. Jenner died, in 1823, at Berkeley, in Gloucestershire, the scene of his early labours, for ever rendered memorable as the birth-place of vaccination. During the latter years of his life, he continued to devote much of his time and attention to this subject, but he did not publish any thing of much importance concerning it subsequent to the year 1803. In 1833, a committee of the House of Commons, appointed to inquire into the constitution of this establishment, extended their investigations into the effects of vaccination generally, and the volume of evidence published by them (Report and Evidence of the Select Committee on the Vaccine Board, 1833, folio,) contains the latest information to be met with on this interesting subject.

Phenomena of Vaccination.

We now proceed to a detail of the phenomena of vaccination, which we shall treat of in the following order:—cow-pox in the cow, casual cow-pox in man; and the inoculated cow-pox.

1. **Of Cow-Pox in the Cow.**—This disease is not of frequent occurrence: it is epizootic, and rarely, if ever, shows itself except where cattle

are collected together in herds. It then breaks out at irregular periods, and from causes not at all known. Dr. Jenner's early experiments concerning it were frequently interrupted by its complete cessation among the herds. During the year 1828 the National Vaccine Board made numerous inquiries through their extensive correspondence with practitioners in the dairy counties of England; but no tidings could be learned of the disease in the cow. (Marshall on Vaccination, 1830, p. 7.) The latest observations on it were made in India in 1832. (See Macpherson's "Experiments relative to Vaccination," in Calcutta Medical and Physical Transactions, vol. iv. p. 175.) Some Italian physicians, in the year 1830, observed the disease among the cattle of the Piedmontese Alps. (Griva sull' Epidemia Vaiuolosa del Torino, p. 102; also London Medical Gazette, vol. ii. p. 323.)

Dr. Jenner's earliest statements (Inquiry, p. 3,) led to the belief that cow-pox in the cow was generally a local disorder, confined to the udder. More recent observations, however, have shown that it is really a constitutional febrile disease, accompanied with eruption, and sometimes extremely severe, and even fatal. According to Dr. Jenner, (Inquiry, p. 4,) the true cow-pox shows itself on the nipples of the cow in the form of irregular pustules. At their first appearance they are commonly of a palish blue colour, or rather of a colour approaching to livid, and surrounded by an erysipelatous inflammation. They frequently degenerate into phagedenic ulcers. The animal appears indisposed, and the secretion of milk is much lessened. The cow is subject to other pustulous sores on the nipples, which are of the nature of common inflammation, and possess no specific quality. These are free from all bluish or livid tint. No erysipelatous redness accompanies them. They desiccate quickly, and create no apparent disorder in the animal. Such a complaint is frequent among cows in the spring season, and when the calf is suckling. This disease was called by Dr. Jenner the spurious cow-pox.

The following description of the cow-pox in the cow, as observed at Moorshedabad in August 1832, is given by Mr. Macpherson. (Calcutta Medical and Physical Transactions, vol. iv. page 175, 1833; also, London Medical Gazette, vol. x. p. 510.) The animals for a day or two appeared dull and stupid. They were then seized with distressing cough, accumulation of phlegm in the mouth and fauces, and loss of appetite. On the fifth or sixth day pustules made their appearance all over the body, especially on the abdomen, accompanied with fever and much general distress. These went on to ulceration, the hair falling off wherever a pustule ran its course. The mouth and fauces appeared to be the principal seat of the disease, being, in bad cases, one mass of ulceration, which impeded mastication, and proved fatal apparently from inanition. The mortality in this severe epizootic was calculated at from fifteen to twenty per cent.

2. **Casual Cow-pox in Man.** — This affection, caught by the milkers from the affected cow, appears on the hands and wrists in the form of inflamed spots, which run on to suppuration. The pustules assume a circular form, having edges elevated above their centre, and are of a colour inclining to blue. (Jenner's Inquiry, p. 5.) After a time absorption takes place, and swellings appear in the axilla. Fever succeeds, accompanied with headach, vomiting, and sometimes delirium. The constitutional symptoms decline in three or four days; but the sores on the hands often remain, very painful, and difficult to heal. No eruption of the skin follows the decline of the feverish symptoms.

3. **Phenomena of the Inoculated Cow-pox.** — When vaccination has been successfully performed on a healthy child, the incision may be felt elevated on the second day, and on the third, if examined with a magnifying-glass, appears surrounded by a slight efflorescence. On the fifth day a distinct vesicle is formed, having an elevated edge and depressed centre. On the eighth day it appears distended with a clear lymph. The vesicle, on this, its day of greatest perfection, is circular, and either pearl-coloured or slightly yellow. In its form and structure it resembles the pustule of small-pox. Its margin is turgid, firm, shining, and wheel-shaped. It is composed of a number of cells, by the walls and floor of which the specific matter of the disease is secreted. On the evening of the eighth day an inflamed ring, or areola, begins to form around the base of the vesicle, which continues to increase during the two following days. This areola is of a circular form, and its diameter extends from one to three inches. When at its height on the tenth day, there is considerable hardness and swelling of the subjacent cellular membrane. On the eleventh day the areola begins to subside, leaving, as it fades, two or three concentric circles of a bluish tinge. The vesicle before this has burst, and its surface acquired a brown colour. The lymph which remains becomes opaque, and gradually concretes; so that about the end of the second week the vesicle is converted into a hard round scab of a reddish brown colour. This scab contracts, dries, blackens, and about the twenty-first day falls off, leaving a cicatrix, which is permanent in after-life, circular, somewhat depressed, striated, and indented with six or eight minute pits, corresponding to the number of cells of which the vesicle had been composed.

The constitution generally sympathizes about the seventh or eighth day. The child is restless and hot, and the bowels are more or less disordered. This commonly subsides in two or three days. A few children pass through the disorder without the slightest indication of constitutional disturbance, which is not to be looked upon as by any means essential to the success of the vaccine process. About the tenth day a papulous eruption of a lichenous character frequently shows itself on the extremities, and sometimes extends to the trunk of the body. It continues for a week, and occasionally lasts after the scab has fallen off. This vaccine lichen is chiefly met with in children of full habit, where numerous vesicles had been raised on the arm, which discharge freely. It is an accidental occurrence, which, like the constitutional irritation, indicates a full effect upon the system, but is not deemed requisite to ensure it.

Cow-pox in the adult exhibits the same succes-

sion of phenomena. The vesicles, however, are thinner and more easily ruptured. The lymph is usually of a yellowish tinge, and the areola is more extensive. The glands of the axilla, too, frequently swell, which is rarely observed in children. Constitutional irritation commonly runs higher. The secondary lichen is less observable. Some observations, recently made by Dr. Heim, of Ludwigsburg, (London Medical Gazette, vol. xiv. p. 513,) tend to show that adult lymph is more energetic than infantile lymph; but the facts require further investigation.

Of the irregular Vaccine Vesicle.—The regular or normal progress of the vaccine vesicle now described is liable to be disturbed by various causes and in various ways. Imperfect vaccination is not characterized by any uniform sign or criterion, but exhibits in different cases different appearances, such as pustules, ulcerations, scales, and irregular vesicles. The most common form of irregular vesicle is marked at its commencement by very troublesome itching, so great as to provoke scratching or rubbing, to which the subsequent appearances are generally, but most unfairly, attributed. The vesicle throws out a premature efflorescence, and advances too rapidly; so that on the fifth day it has attained its height, when it will be found raised on a hard inflamed base. It is acuminated or conoidal, and gives the appearance of a common festering sore produced by a thorn. It is generally of a straw colour, and contains, instead of a clear transparent lymph, some opaque matter or pus. The succeeding scab is small, and of an amber colour, and drops off by the tenth day.

The causes of this irregular vesicle are various. It is sometimes dependent on the state of the atmosphere. We infer this from the fact, that many cases are observed about the same time, and more frequently on the approach of winter than either in the spring or summer months. Sometimes it may be traced very distinctly to a bad quality of the lymph employed; that is to say, three or four children vaccinated from the same source shall exhibit these irregular appearances: yet the vesicle itself from which the lymph is taken shall show no apparent deviation from the healthy state. (See London Medical Gazette, vol. xiii. p. 441.) Many practitioners have been of opinion that such an irregularity of the vaccine vesicle as we have just described arises from the employment of lymph taken at too late a period of the disease, that is, on or after the tenth day. (See Willan on Vaccine Inoculation, p. 32.) To this doctrine, however, we cannot yield an unqualified assent. The facts we believe to be as follows: After the tenth or eleventh days, the virus becomes so diluted with the common serum of the blood as to reproduce the disease with great difficulty. But of a dozen incisions made with such a thin lymph, not more than one perhaps will prove effective; but that one is just as good, and just as effectual in preserving from the small-pox, as a vesicle raised from lymph of an earlier age and greater intensity. The unanswerable argument in favour of this position is, that the scabs of cow-pox, moistened with a little lukewarm water to the consistence of mucilage, will often produce the disease in all its purity; but out of twenty or thirty incisions made with such a virus, not more than one or two will be found to take effect.

Lastly, irregularity of the vaccine vesicle is sometimes attributable to a bad habit of body,—to what the old authors would have called a foul state of the blood and humours. The proof is, that one child only out of many vaccinated with the same lymph shall show the anomalous form of cow-pox. It is a singular but very important fact, that an imperfect vesicle, the offspring of a perfect one, degenerated by some peculiarity of habit in the individual vaccinated, shall sometimes reappear in all its original purity and perfection, when transplanted into a healthy well-predisposed subject.

Other anomalous Appearances.—Cow-pox occasionally presents some other anomalies. In some instances the specific inflammation or areola is very violent, extends from the shoulders to the elbow, invades the trunk of the body, and requires to be assuaged by cold lotions and active purgatives. The vesicle, instead of hardening into its proper black scab, is, under these circumstances of local irritation, converted into an ulcer, discharging profusely. The inconvenience thence resulting is, however, only temporary. Such extensive inflammation, provided it has begun at its proper period, does not appear to lessen, or in any degree interfere with, the protective virtue of the cow-pox. Occasionally, the vesicle about the fifth or sixth day becomes scaly. A species of psoriasis takes place of areola. In some few cases true erysipelas supervenes. Such anomalies as these, it is needless to say, deprive the cow-pox of all claim to specific properties. A much more frequent but less important variety is the retarded cow-pox. The advance of the vaccine vesicle is without any apparent cause suspended. The areola does not form before the tenth or twelfth day, but ultimately the process is completed. In these cases the success of the vaccination is in no degree prejudiced.

Complications of Cow-pox.—It sometimes happens that a child is vaccinated after imbibing the germ of measles or scarlatina. Under these circumstances the cow-pox is generally retarded. (Jenner's "Facts and Observations," pp. 137 and 170.) In a case which we have recorded in the London Medical Gazette, (vol. x. p. 440,) cow-pox was retarded sixteen days, while the measly germ was making the circuit of the constitution. The genuine chicken-pox (varicella lymphatica) will run its course along with cow-pox, and not interfere with any of its phenomena. (London Medical Gazette, vol. ii. p. 633.) The modifications which cow-pox undergoes when small-pox invades the constitution at the same time are very curious and interesting, and have excited much attention. They are subject to considerable variety, but the following are the phenomena most commonly observed.

Cow-pox occurring along with Small-pox.—When cow-pox is inserted during the incubative stage of the casual small-pox, while the small-pox is still latent, the vaccine vesicle for the most part does not advance, or advances tardily and imperfectly. There are exceptions, however, to this rule, and cow-pox and casual small-pox

may sometimes be seen running their full course in the same person at the same time. In no case, however, does the cow-pox so inserted alter or modify the course of the small-pox. When the variolous and vaccine fluids are inserted into the arms on the same day, each disease occasionally proceeds, preserving its original character. At other times, however, they mutually restrain and modify each other. The vaccine vesicle is smaller than usual, and irregular in its progress, while the variolous pustules which follow are of the kind denominated *variolæ verrucosæ*, vulgarly swine-pock, stone-pock, or horn-pock (Willan on Vaccine Inoculation, p. 5); that is to say, they are hard and shining, surrounded with little inflammation, and they suppurate imperfectly. The small quantity of matter they contain is absorbed, leaving the cuticle horny and elevated for many days afterwards. Upon the extremities the eruption does not pustulate at all, but is minute and papulous, and terminates by desquamation. It will be found in most cases that even though the eruption be modified in its character, there is nevertheless considerable disturbance of the general system under the joint influence of the variolous and vaccine poisons.

When the insertion of the vaccine lymph *precedes* that of the variolous by a period not exceeding four days, both diseases advance locally. Sometimes an eruption of small-pox papulæ follows. At other times the variolous fever is slight and unaccompanied by eruption. Under these circumstances, matter taken from the primary vesicles shall sometimes communicate cow-pock and small-pox respectively, but more commonly the variolous poison predominates, and contaminates the lymph of the vaccine vesicle. It was ignorance of this phenomenon in the mutual action of the vaccine and variolous poisons, which occasioned Dr. Woodville's mistakes at the Small-Pox Hospital in 1799, and not the variolated atmosphere of the hospital, as he himself at first supposed, and as some persons still persist in believing. (See Report of "the Select Committee on the Vaccine Board," pp. 119 and 124.) Variolous matter inserted into the arm at any period not exceeding a week from the date of vaccination will take effect and be followed by a pustule. After that time no effect is produced. Mr. Dunning entertained the idea that a hybrid disease might be formed by the simultaneous inoculation of small-pox and cow-pox, but there is no foundation whatever for this notion. Dr. Woodville on several occasions inoculated with a mixture of the variolous and vaccine poisons. The result was not to be depended upon, but in general pure small-pox succeeded.

When small-pox inoculation precedes by three or four days the insertion of vaccine lymph, the vaccination advances, but after the tenth day the fluid in the vaccine vesicle becomes purulent; and in that state will communicate small-pox. (Willan on Vaccine Inoculation, p. 8.)

Those who have in early life undergone small-pox inoculation are for the most part unsusceptible of cow-pox. Under such circumstances, however, vaccination sometimes produces a certain degree of effect. The disorder manifests itself, but in an imperfect or modified form. The fluid in the resulting vesicle cannot be trusted to for reproducing the genuine cow-pox.

Recurrent and modified cow-pox.—When cow-pox has once completed its regular course, the constitution is always left, for a considerable time at least, unsusceptible of the same disorder. But this law does not hold good when the renewed application of the virus takes place at very short or at very distant intervals. If vaccine virus be re-inserted on the fourth, fifth, or sixth day after a regular primary vaccination, the vesicles of the second vaccination are hurried forward in their course, so as to overtake the first crop, and the whole maturate and scab together. The second crop of vesicles, however, are not more than one-fourth of their normal size, and the areola surrounding them is equally contracted. Mr. Bryce, in 1802, very ingeniously proposed to avail himself of this circumstance, and by testing with vaccine matter on the fifth day, to give a security that the system was under the full influence of the vaccine disorder. This plan has since been extensively pursued, and is known by the name of *Bryce's test*. Mr. Bryce considered that this test afforded as clear and well-defined a mark of constitutional affection in cow-pox, as the variolous eruption does of successful inoculation. (Bryce on Cow-pox. Edinburgh, 1802.) To obtain this criterion in the greatest perfection, he advises that the second application of the virus should take place between thirty-six and forty-eight hours before the primary areola begins to appear (end of the fifth or beginning of the sixth day). If no acceleration of the second crop of vesicles be observed, it is to be concluded that no constitutional action has resulted from the first insertion of the virus. The second is then to be regarded as the primary affection, which in its turn is to be tested with a third, and so on until we are satisfied that the full measure of constitutional effect has been produced. Some persons have claimed for this suggestion the highest honour, and have even considered Dr. Jenner's discovery as incomplete without it. (See Monro's "Observations on Small-pox." Edinburgh, 1818. p. 113.) Dr. Jenner, however, never laid much stress upon it. In doubtful cases it is undoubtedly a prudent practice, but in our opinion it has been extolled far beyond its real merits. It shows whether or not constitutional influence has been exerted by the primary vesicle, but it does not determine what has been the degree of such influence:—in other words, it does not show whether the constitutional effect has been *complete* or otherwise. As a test, therefore, of the stability of the vaccine protection in after life, (in which light alone it can be valuable,) Bryce's test is absolutely nugatory.

Re-vaccination.—The effects of re-vaccinating at distant intervals from the date of the primary vaccination are deserving of attention. Dr. Jenner, in his original essay, (Jenner's Inquiry, p. 21), announced that the human body after a time had the susceptibility of cow-pox renewed. We have noticed four different effects resulting from the operation of re-vaccination. (London Medical Gazette, vol. i. p. 590.) In many cases, especially where the interval from the primary to the secondary vaccination has not ex

ceeded five years, the skin appears completely insensible to the vaccine poison. The inoculated point takes on no inflammatory action, and no greater effect is produced than if the lancet had been dipped in the serum of the blood. More commonly, however, especially at intervals exceeding ten years, the virus irritates locally. In three, or at furthest four days from insertion, an areola of irregular shape appears, surrounding a minute, itching, acuminated, and angry vesicle. Frequently the glands in the axilla swell, and in particular habits of body, especially in adult females, irritative fever to a considerable extent is superinduced. A scab forms on the eighth day, which soon falls off, leaving no permanent cicatrix. In a third set of cases, a vesicle forms more gradually, without either local or constitutional irritation. A slight areola succeeds, and the vesicle yields, on the seventh day, a considerable quantity of thin lymph; but this lymph will be found, on trial, incapable of propagating the disease. In a fourth set of cases, the second vaccination runs a perfectly regular course. A true circular areola forms on the eighth day, and the lymph will be found to propagate a good and genuine cow-pox. It is difficult to avoid entertaining the notion, that those who exhibit the first set of appearances now described would have effectually resisted the infection of small-pox; that those under the circumstances last mentioned might have undergone small-pox in some of its ordinary forms; and that the remainder would, under circumstances favourable to the development of small-pox, have undergone it in the form which we have elsewhere in this volume designated and described as the *varicella variolodes*.

Surgery of Vaccination.—In the performance of this simple operation many circumstances require attention. Failure in the operation is always harassing to the parent, and is frequently urged as a pretext for dangerous delays. Of the sources of failure some have reference to the mode of operating, some to the selection of lymph, and others to the system of the individual operated upon.

Wherever it is possible, vaccine lymph should be inserted in a recent state. It should be perfectly clear and limpid, and the earlier it is taken the better, for effective lymph must always be in a certain state of intensity. A fifth-day vesicle will often afford a minute drop of lymph of great energy. Lymph may be taken, however, with every prospect of success, up to the eighth and ninth days. On the tenth day the virus is often so much diluted with the serum of the blood as to be unfit for reproduction. The same thing, too, frequently happens to vesicles of the seventh or eighth days, when the lancet of the operator is applied to them too often, or with an undue degree of roughness. A vesicle should always be handled very gently. After the tenth day the virus is scarcely fluid, and never can be relied on.

It is of the utmost consequence to the success of the operation that the lancet be clean and perfectly sharp. Failure often arises from a peculiar toughness of the child's skin, which a blunt lancet penetrates with difficulty. The lymph is consequently thrown back upon the shoulder of the lancet, and not a particle of it enters the wound. A good vaccinating lancet should have a broad shoulder as well as fine point, for an instrument of this shape best retains an adequate portion of virus. The skin should be kept perfectly tense during the performance of the operation by grasping the arm firmly. Six or eight punctures may be made at convenient distances and to a moderate depth. Much importance has been attached to the quantity of blood drawn, it being held that the escape of blood must necessarily wash away the virus. This, however, is a mistake. Provided that a genuine lymph of due intensity has once come in contact with the absorbing surface of the cutis vera, it is a matter of perfect indifference whether little or much blood flows from the wound. The quantity of blood that escapes depends more upon the child's habit than upon the operator. A child full of blood always bleeds freely when vaccinated; but such children exhibit subsequently the most perfect appearances.

Care should be taken, as far as possible, that the child to be operated upon should be in perfect health. During the presence of any disease,—at the period of dentition,—when the bowels from any cause are disordered,—or the skin preoccupied by some eruption, whether herpetic or scaly, vaccination should be delayed, unless from the pressure of some extreme necessity. The best age for vaccinating is between the third and fifth month after birth, when the child has acquired plumpness, and before dentition has commenced.

Preservation of Vaccine Lymph. — The importance of using fresh lymph need not be insisted on; but occasionally no other resource presents itself than preserved lymph. Being a fluid of extreme delicacy, and very liable to spontaneous decomposition, as well as to other changes which impair its efficacy, great difficulty has always been experienced in preserving it, and more especially in transmitting it in an active state to tropical climates. The following are the modes of preserving lymph which are now adopted.

1. It may be preserved fluid for several days, between two pieces of glass, about an inch square, which fit each other accurately. Lymph thus preserved, even when dry, will often, if carefully moistened with the breath, propagate the disease. 2. Vaccine lymph may be preserved on ivory points shapen like the teeth of a comb. These should be twice dipped in the fluid of the vesicle, and allowed to dry slowly. When used, they should be retained in the wound made by a sharp lancet for about half a minute. They are very effectual. Some vaccinators give the preference to platina points. 3. Vaccine lymph may be kept fluid in small capillary tubes, having a bulb at one end, (in shape like a thermometer). They admit of being hermetically sealed. To prevent spontaneous decomposition, the lymph should be collected only in minute quantities. 4. Mr. Bryce announced, in 1802, that vaccine scabs may be made use of to communicate the disease; and it has since been ascertained that this is the most certain mode of transmitting the cow-pox to hot countries. They are prepared for use by rubbing to powder, and moistening with a little lukewarm water to the consistence of a thin mucilage. Punctures made with this artificial lymph ought to be very numerous. 5. Dr. Jenner occasionally em-

ployed dossils of lint saturated with the fluid of an eighth-day vesicle. These he placed between glasses, one surface of which has a small central cavity. The glasses should be tied together, their edges sealed and the whole covered with sheet-lead. Preserved in this manner, vaccine lymph will retain its fluidity and efficiency for a considerable length of time.

THEORY OF VACCINATION.

Identity of the Vaccine and Variolous Poisons. — The confidence with which Dr. Jenner originally announced vaccination as an antidote to the small-pox, was mainly founded on the speculations in which he had so long indulged concerning the common origin of human and epizootic maladies. Into the details of this curious but uninviting branch of medical theory we do not propose to enter; but we may mention that, according to Dr. Jenner, the most remarkable malady which affects equally man and the brute creation, is that which in its most malignant form we call small-pox, and in its milder forms swine-pox, chicken-pox, and cow-pox. It is a matter of curiosity at least, if not of more serious reflection, that the vulgar, in their nomenclature of diseases, should have acknowledged the doctrine of a common origin to the disorders of man and beast. Jenner not only believed that the small-pox and cow-pox were essentially the same disease, but that the former was a malignant variety of the latter, the parental disorder being the cow-pox. This theory was pointedly marked by the phrase *variolæ vaccinæ*, under which cow-pox was first introduced to the notice of the scientific world. As it has found both supporters and opponents in later times, a few observations upon it may not be misapplied.

Diseases that mutually produce each other are clearly referable to the same source: the identity of swine-pox and small-pox, therefore, is universally admitted. The cow-pox, however, is differently circumstanced. In man, cow-pox never produces small-pox; nor does small-pox, however mild, approach to the character of cow-pox. It remains, therefore, a very questionable point, whether these disorders can be essentially the same,— in other words, whether cow-pox can be considered a permanent, as swine-pox is a temporary modification of variola. It has been argued, in favour of this hypothesis, first, that the cow-pox in the cow is a constitutional and sometimes malignant disorder, approaching in its characters to variola, and in various countries called and considered as variolous: 2dly, that cow-pox contaminated by small-pox sometimes loses its virulence, ceases to produce eruptions, and at length takes on the true vaccine character. (Baron's Life of Jenner, p. 245.) Dr. Jenner never brought forward any direct experiment in favour of this opinion; but attempts have recently been made to support it by proving that small-pox can be communicated from man to the cow. Experiments, it is said, have been instituted by Dr. Sonderland, at Bremen, (London Medical Gazette, vol. ix. p. 162,) showing that cows may be *infected* by inhaling the effluvia of blankets saturated with small-pox matter. Other experiments are stated to have been made in Egypt by medical men, showing that a cow may be *inoculated* with small-pox matter, and that the result is a fine active vaccine virus. (Ibid. vol. i. p. 673.) From the loose way in which these experiments are detailed, (Ibid. vol. ix. p. 500,) and from the fact of their having been repeated carefully under our own observation at the Small-Pox Hospital, (Ibid. vol. i. p. 781;) at Utrecht, by M. Numann, (Johnson's Medico-Chirurgical Review for January, 1834, p. 209;) and by Mr. Macpherson, (London Medical Gazette, vol. xiii. p. 511,) in India; we may fairly presume that they are incorrect, if not altogether fabulous. It is a singular circumstance, that hitherto, so far as our observation extends, no distinct experiments have proved that cow-pox can be communicated from man back to the cow. (London Medical Gazette, vol. i. p. 781; also Calcutta Medical and Physical Transactions, vol. vi. p. 174.) The theory, therefore, which would explain the preservative power of cow-pox on the principle of its being small-pox, which, in passing through the body of the cow, had become modified, is still unsupported by direct experiment. It is presuming too far to say that these experiments have been carried to their furthest reasonable limit; but enough has been done to show that the communication of small-pox from man to the cow is most uncertain, and that the hope entertained by some sanguine physiologists, that in the possible loss of the present stock of cow-pox, small-pox might be made to furnish its own antidote, is altogether illusory.

[More recent experiments, however, by Messrs Ceely, Thiele, and others, seem to show convincingly, that the cow may be inoculated with the matter of small-pox, and that in passing through the body of the animal, the matter is converted from small-pox into vaccine.]

Identity of the Cow-pox with the grease in horses. — In Dr. Jenner's original essay on vaccination, not only was the connection between cow-pox and the grease in horses prominently put forward, but it was confidently stated that cow-pox never occurs in dairy countries except where there is access to horses. (Inquiry, p. 47.) In other words, Jenner denied the spontaneous origin of the disease in the cow. We cannot help thinking that the stress thus laid upon the *equine* origin of cow-pox was injudicious. The facts bearing upon the question were then very imperfectly known; and the opinion itself was, as Dr. Jenner himself confessed, unsubstantiated by any direct experiment. (Ibid. p. 46.) Even if most satisfactorily proved, it could not have tended in any degree to strengthen public confidence in the virtues of cow-pox; and being a doubtful point, it gave a handle to the opponents of vaccination of which they were not slow to avail themselves. For several years this question was the source of controversy. Dr. Baron acknowledges that in 1803 all the principal medical men in London were adverse to the opinion. (Life of Jenner, p. 584.) Later observations, indeed, have established the identity of the two affections, cow-pox and grease; but they have shown at the same time the incorrectness of some of Jenner's original views. It has been satisfactorily established, for instance, first, that cow-pox does originate in the cow without access to horses, (*Griva*, "Epidemia Vaiuolosa del Torino," p. 102); and, secondly,

that cow-pox is communicable to man from the horse without the intervention of the cow, and with nearly equal facility as from the cow itself. Dr. Jenner held that the direct communication of the disorder from the horse to man was undetermined and uncertain, and that the active quality of the greasy virus is greatly increased after it has acted on the nipples of the cow. (Inquiry, p. 52.)

This branch of the theory of vaccination has been investigated with great diligence by Dr. Loy of Whitby, (Observations on the Origin of Cow-pox, 1801,) Dr. De Sacco of Milan, (Baron's Life of Jenner, p. 250,) and Dr. Carro of Vienna. The last-named author (see Monro "On the Prevalence of Small-pox," in Edinburgh Journal of Medical Science, vol. i.) states "that the matter in use at Vienna from 1799 to 1825 was partly British vaccine, and partly originated from the grease of a horse at Milan without the intervention of a cow. The effect was so similar in every respect, that they were soon mixed; that is to say, after several generations, and in the hands of innumerable practitioners, it was impossible to distinguish what was vaccine and what was equine." "The whole British settlements in India," he adds, "were *equinated;* for the first liquid drop sent thither was the second generation of Milanese equine, or greasy matter, transplanted at Vienna."

Protective influence of Cow-pox.—After an experience of thirty-four years in the efficacy of vaccination, and with the knowledge that that practice has extended over every quarter of the globe, and is still almost universally adopted, it would be a waste of time to enlarge upon the extraordinary power which it possesses of preserving the human body from the assaults of small-pox. Sir Gilbert Blane (On the true Value and present State of Vaccination, p. 14,) most truly and eloquently observes, "that, viewed as a mere phenomenon in the natural history of the animal kingdom, it is highly interesting. The physiologist finds himself lost in astonishment when he contemplates the singular fact, that a mild virus taken from a domestic animal should shield the body from one of the most fatal and cruel maladies to which it is subject; while the philanthropist sees in it benefits to mankind which in his most sanguine moments he could never have dreamed of." How great, then, how unrequitable are the obligations of mankind to the individual who first drew the secret from the dark recesses of rural tradition, and rendered it available to the whole human race!

Time, which has fully corroborated the general truth of the important law of the animal economy first promulgated by Jenner, has shown also that it is subject to several modifications. These we next proceed to investigate, seeking to determine, so far as observations have hitherto gone, their number and extent.

Constitutional inaptitude to Cow-pox.—One of the most important principles bearing upon the great question of vaccine influence is to be found in the fact that the predisposition to receive cow-pox is not equally great in all persons, nor at all times; and that in some individuals there exists, either through life or for a limited period, an utter unsusceptibility to the vaccine virus. This position opens a wide field of curious investigation, as we have elsewhere attempted to explain. (See London Medical and Physical Journal, Nov. 1827, p. 381.) In a certain number of children subjected to careful vaccination, the vesicles will be found small, their progress slow, the areola faint, and the constitutional disturbance trifling. In such habits the absorbents of the arm are inactive, and not more than one out of eight or ten punctures advances. In other words, the disposition in the constitution to *receive* the vaccine virus and to bring it to perfection are identical. From hence it follows that the mode of vaccinating and the supply of lymph being the same, the proportion of successful to unsuccessful incisions affords a fair criterion of the degree to which the constitution is predisposed to nourish and profit by the vaccine virus. Some of the children who receive vaccination with difficulty are obviously sickly, and labouring under some disease weakening the body generally. In others, this atony of the absorbent system is displayed in conjunction with slowness of dentition, an imperfectly ossified head, and an emaciated aspect of body. On the other hand, it will frequently be found that a constitutional inaptitude to cow-pox coexists with the most healthy aspect. We may assume, therefore, that it is sometimes dependent on idiosyncrasy. In the former case, the indisposition to receive cow-pox is only temporary; in the latter, so far as we have had opportunities of observing, it continues, and probably through life. Mr. Cross calculates that about one in fifty of mankind are unsusceptible of the vaccine virus. (On the Variolous Epidemic of Norwich, p. 32.)

An interesting question here presents itself. Does the constitutional inaptitude to cow-pox denote a like inaptitude to small-pox? It would require a very extended sphere of observation to give a decided answer to this question; but experience seems to show that the predisposition to the two complaints is the same, and that a child who has altogether resisted the vaccine virus will be found equally unsusceptible of small-pox. (Gregory on the Recurrence of Exanthematous Fevers, in London Medical Gazette, vol. viii. p. 494.)

The difficulty of giving cow-pox in a perfect form may be traced in some instances to the state of the atmosphere. At Turin, in August 1829, the number of cases in which vaccination failed was so great, that it was proposed to intermit vaccination altogether. (*Griva*, Op. cit. pp. 63 and 100.) The phenomena appeared to depend upon the state of the weather, which caused a hot, dry, and furfuraceous state of the skin, that impeded both absorption and exhalation. Dr. Jenner was well aware that the condition of the skin frequently offered an insurmountable obstacle to successful vaccination (On the Varieties and Modifications of the Vaccine Pustule, 1806); but he does not appear to have connected this with any atmospheric changes. The difficulty of keeping up a supply of genuine lymph in tropical countries has long been known, (See Ferguson on "Vaccination as practised at Sierra Leone," in London Medical and Physical Journal, vol. lix. p. 195,) and admits of an easy explanation on this principle.

Occurrence of Small-pox after Cow-pox.—The number of persons who have taken small-pox after undergoing cow-pox [varioloid] in a satisfactory manner is now so great, that it becomes necessary, with a view to forming an impartial estimate of the value of vaccination, to investigate the subject very carefully. Previously, however, we must revert for a short time to the views originally entertained by Dr. Jenner concerning the complete efficiency of vaccine protection. Popular rumour, we have seen, attributed to cow-pox a certain degree of protecting power over small-pox, but it was only in a certain degree; and the reason why Jenner, prior to 1798, failed in convincing his medical friends of the justness of his views, was, that in their judgment the quantum of protection afforded by the cow-pox was insufficient. "We have all heard," they would say, "what you speak of, and we have seen examples which certainly do give countenance to your opinions; but we have also known cases of a perfectly different kind. We have seen persons reported to have had cow-pox who have subsequently caught small-pox. The evidence in favour of the protective power of cow-pox, therefore, appears to us both inconclusive and unsatisfactory." (Baron's Life of Jenner, p. 125.) Jenner, we have seen, took a different view of the nature of vaccine influence, and confidently announced the complete and permanent security afforded by it, provided the disease was received in its perfect form. His petition to Parliament in 1802 stated, "that he had discovered a disease attended with the singularly beneficial effect of rendering, *through life*, the person inoculated with it *perfectly* secure from the infection of small-pox." It is certainly curious that Dr. Jenner should thus have acknowledged the full value of the popular opinion regarding the security afforded by cow-pox, but should have rejected or treated lightly the qualifying clauses. Experience has now shown that common observation was not less deserving of attention in the one case than in the other; and it is probable that in the outset a more moderate estimate of the prospective advantages of vaccination would have obviated much of the difficulty which has lately been experienced, without materially lessening the public zeal in its favour. It is well worthy of remark, that in Dr. Jenner's original essay no mention is made of any cases in which cow-pox failed to afford protection in after life; nor should it be forgotten that the confident announcement then made of the permanency of vaccine protection was founded *exclusively* upon cases of the *casual* disorder. It was not until his third publication, in 1800, that Jenner alluded to the chances of failure, which he did in the following words (Continuation of Facts and Observations, 1800, p. 32):—"Some there are who suppose that the security from the small-pox obtained through the cow-pox will be of a temporary nature only. This supposition is refuted, not only by analogy with the habits of diseases of a similar nature, but by incontrovertible facts, which appear in great numbers against it."

Proportion of the Vaccinated who take Small-pox.—Various attempts have been made to ascertain the actual proportion of those who are effectually and permanently secured by vaccination, to those who subsequently receive small-pox; but on this point there is great difficulty in attaining even an approximation to the truth. The loose statements frequently made in reference to this question would lead to great errors. Thus we read in one of the reports of the National Vaccine Establishment, (Report of the National Vaccine Establishment, dated May 18, 1820,) "that of more than sixty thousand persons vaccinated in London and its vicinity in the course of twelve years by that establishment, five only are reported to have been subsequently affected with small-pox." But it must be obvious that twelve years would serve to scatter a large portion of such persons over the face of the globe; and if one-tenth or one-twentieth of them took small-pox in after life, there is little probability that the news of it should reach the ears of the members of the board. Mr. Cross, of Norwich, calculates (Variolous Epidemic of Norwich, p. 192,) "that of the vaccinated, not more than one in twenty will be in any way affected by the most intimate exposure to small-pox contagion; and less than one in fifty will have the disease in a form answering to the generally received descriptions of modified small-pox." These calculations, however, are grounded on very imperfect data.

[The following tables by Dr. George Gregory, (Tweedie's *Library of Medicine*, 2d Amer. edit., i. 325, Philad. 1842,) taken from the records of the Small-pox Hospital, London, exhibit the comparative mortality in the varieties of regular small-pox, at different ages, during the epidemic of 1838. They further show the degree of protection and the diminished mortality after vaccination.

NORMAL SMALL-POX.	UNPROTECTED. Admitted.	Died.	VACCINATED. Admitted.	Died.
Confluent	295	149	56	21
Semi-confluent	78	8	42	4
Distinct	19	0	20	0
	392	157*	118	25

ABNORMOUS SMALL-POX.	UNPROTECTED. Admitted.	Died.	VACCINATED. Admitted.	Died.
Confluent modified	2	0	38	4
Semi-confluent do.	1	0	28	1
Varicelloid	1	0	114	1
Total abnormous	4	0	180	6
Grand total	396	157	298	31†

AGES.	UNVACCINATED. Admitted.	Died.	VACCINATED. Admitted.	Died.
Under 5 years	42	20	0	0
From 5 to 9, inclusive	37	11	5	0
10 to 14, "	30	8	25	0
15 to 19, "	104	32	90	6
20 to 24, "	115	50	106	16
25 to 30, "	45	23	55	8
31 to 35, "	12	7	13	1
Above 35 years of age,	11	6	4	0
Total	396	157	298	31

The ratio of mortality of small-pox after vaccination, according to Drs. Geo. Gregory and Heim, (*Brit. and For. Med. Rev.* Jan. 1839,) is the same in London and in Germany, namely, 7 per

* Of these there died of fever and superadded erysipelas, 14.

† Of these there died of fever and superadded disease, 10.

cent.; but in France, it would appear to be much less than this: thus, according to the report of M. Villeneuve, of 365 cases of confirmed small-pox, occurring in persons who had been successfully vaccinated at some previous period, there were only 8 that proved fatal, giving a proportion of about 1 in 45 or 46; and more recently, M. Gaulthier de Claubry infers, that varioloid destroys 1 in 100; whilst the mortality from small-pox is 1 in 8.5. The writer—as elsewhere remarked, (*Practice of Medicine*, 2d edit. ii. 567, Philad. 1844), has never met with an unfortunate case; but he has seen numbers in which the face was scarred.

The tables, above given, show the effect of time in diminishing the amount of protection afforded by vaccination. Of the 298 previously vaccinated cases that presented themselves at the Small-pox Hospital in London, during the epidemic of 1838, none were under 5 years of age: 5 were between 5 and 9, inclusive; 25 were between 10 and 14; 90 between 15 and 19; 106 between 20 and 24; 55 between 25 and 30; 13 between 31 and 35; and 4 above 35 years of age; and, more recently, Dr. Gregory has stated it to be worthy of record, that among 120 cases of varioloid, occurring subsequent to vaccination, at the Small-pox Hospital in 1840, 11 only were under 16 years of age. The youngest person admitted under such circumstances was aged 7; and the first occasion on which he had ever known a child under five years of age admitted with small-pox after vaccination, occurred the week before he wrote:—facts which would seem to encourage the view that after a certain time the protective power of vaccination is greatly diminished; yet it will be observed, that after 35 again, the subsequent occurrence of variola is extremely uncommon.]

Characters of Small-pox after Vaccination.—This subject has been already adverted to. (See Small-pox.) We have now only to remark concerning it, that ample experience has demonstrated that small-pox, as it occurs subsequent to vaccination, is for the most part a mild and tractable disorder. The pustules are generally small, hard, and tuberculated. Few of them maturate perfectly; but at the same time the small quantity of matter which they do contain will give, both casually and by inoculation, small-pox to others. It is neither followed by pits and scars, nor by injury to the general health. Severer cases unquestionably do occur, and fatal cases are on record; but this ought not to surprise us. When small-pox and its accompanying fever once take possession of a weak, delicate, and scrofulous frame,—when it attacks persons advanced in life and of plethoric habit, or those who are recovering from other disorders,—when its inroads are synchronous with some other affection, as pneumonia, enteritis, or phthisis,—it would be difficult to set bounds to its injurious tendencies. The eye of the practised physician, indeed, may distinguish between the *specific* and the *accidental* modes of death in small-pox; but this nicety can never be made intelligible to the public mind, which, in the event of the patient dying within thirty days from the invasion of small-pox, will always be inclined, and not without some justice, to attribute death to that cause.

Within a very few years after the discovery of vaccinations, physicians began to record cases of succeeding small-pox; but in almost all these instances there was either some doubt as to the correctness of the vaccine process, or the disease was so mild as to suggest doubts of its being really variola. In process of time these cases became both more numerous and less equivocal, and now they are familiar to every one engaged in practice. The experience of the Small-Pox Hospital during the last twenty years furnishes many useful facts which bear upon this question. It has shown, for instance, how much more frequent small-pox after vaccination is among adults than children. Very few children have been received into the hospital under such circumstances; and those few have invariably had a mild disease, more allied to chicken-pox than to small-pox: whereas *all* the severe cases, and the greater proportion of the mild ones have occurred in adults, in whom an interval varying from ten to thirty years (the average eighteen) had elapsed since the date of vaccination.

[It has been affirmed by M. Levret, from observation of between 1700 and 1800 cases of small-pox in his private practice and in the hospitals, that cases of a second attack of small-pox were as numerous in proportion as attacks of small-pox after vaccination.]

Causes of Small-pox after Vaccination.—The attention of Dr. Jenner was early directed to investigate the circumstances which interfered with the protective power of cow-pox. We have already had occasion to remark, that in his earliest publications he adopted the notion of a true and a *spurious* cow-pox, the produce of the cow, one of which afforded protection, and the other none. When he afterwards ascertained that the true cow-pox itself could not always be depended upon, he took up the theory of *local action*, and contended that cow-pox virus originally good might become, from a variety of causes, so deteriorated in quality as to produce a local disease but no such constitutional influence as is necessary to ensure protection against small-pox. Towards the close of his life Dr. Jenner enlarged the theory of imperfect vaccination, and considered that the grand impediment to successful vaccination was *pre-occupation of the skin* by herpetic or other eruptions during the development of the vaccine vesicle. In the course of years, when some of those took small-pox, who had been declared by competent judges, even by himself, most perfectly vaccinated, a third explanatory principle was adopted, which we may designate as the doctrine of *variolous diathesis*. Other pathologists had early suggested a fourth explanatory principle,—the decay of vaccine influence in the lapse of years; but this was resolutely opposed by Jenner even to the last. This general sketch of the supposed sources of vaccine failure may serve as an introduction to that more detailed inquiry which the frequency of the occurrence in recent times appears to demand.

1. *Deterioration of the vaccine virus.*—It has been repeatedly urged as one mode of accounting for the occasional occurrence of small-pox after vaccination, that the vaccine virus deteriorates by passing through a succession of human bodies.

This idea was never countenanced by Dr. Jenner, and is not generally received by medical men, at least in this country, but it is a favourite doctrine with the public. We see no grounds whatever for adopting such a notion. It has neither reason nor analogy in its favour. Those who take cow-pox naturally, or by direct inoculation from the cow, are as open as others to the chance of subsequent small-pox. Persons vaccinated by Dr. Jenner himself in the very infancy of the practice, before such deterioration could possibly have commenced, have yet been attacked by small-pox in after life. It is contrary to the analogy of small-pox virus, which has undergone no such change, but remains as virulent as in the days of Rhazes and Avicenna. If appearances can be trusted, they are all against such a notion. The elevation and pearl-like aspect of the vesicles of the present day, the extent and shape of the areola, the colour and form of the resulting scab, — all correspond precisely with the earliest delineation and descriptions of Dr. Jenner. So far from believing in any deterioration of virus from successive inoculations, there is reason to believe that by a careful selection of well predisposed children, the pock may even be restored from an imperfect to a perfect state, and by proper care, therefore, may be retained indefinitely in that condition. If children are successively vaccinated from each other, all of whom are from various causes ill-disposed to take on the perfect disease, the virus may unquestionably degenerate, and at length wear out altogether. In tropical countries, and in confined localities, such an occurrence certainly takes place, but this is very different from the notion of a virus deteriorated by the mere influence of *time*.

2. *Imperfect vaccination.* — This was the favourite theory of Dr. Jenner, and as such alone it would deserve attention. But it has other and more legitimate claims to our consideration. Vaccination is said to be imperfect, when any considerable deviation from the ordinary course of the vaccine vesicles takes place. The impediments to perfect vaccination, according to the supporters of this theory, are principally the following :—1. Spurious matter, by which is understood, not a spurious virus as originally taken from the cow, but matter taken from the arm at an improper period of the process. 2. An insufficient number of vesicles. 3. Preoccupation of the skin by some disease in which a fluid is poured out capable of conversion into a scab, such as tetter, ringworm, scaldhead, erysipelas, or even a whitlow on the finger. 4. Robbing the vesicle incautiously of its contents, particularly where one only has come to maturity. 5. External violence done to the vesicle, (such as rubbing or scratching it,) more especially during its early stages. That these circumstances may, and do in some cases, materially interfere with the success of the vaccine process, cannot be questioned; but many strong arguments have been adduced to prove that the influence attributed to them has been overrated (See Edin. Med. and Surg. Journ. vol. xvi. p. 235); and that the theory itself is neither so well founded in general reasoning, nor so far justified by experience, as to afford a satisfactory explanation of the phenomena. It has been shown, for example, by numerous and well-marked instances, that vaccination, which according to all rule should have been called perfect, has given only imperfect security; while, on the other hand, cases in which the process was interrupted, have notwithstanding afforded perfect security. The instances in which single vesicles have preserved from small-pox both casually and by inoculation, are so numerous, that no reliance whatever can be placed on the notion which would connect the security of the individual with the number of maturating vesicles. It has been remarked that a case of small-pox after vaccination will seldom be seen without observing that several persons under precisely the same circumstances, that is to say, belonging to the same family, vaccinated by the same practitioner, in the same manner, having similar marks on the arm, and equally exposed to contagion, escaped entirely. It has been proved, too, that persons have taken small-pox after being subjected to Bryce's test, the only mode hitherto invented to ascertain that a perfect constitutional affection had resulted from the original vaccination.

3. *Variolous diathesis.*—At various times, and by persons high in authority, (See Report of the National Vaccine Board for 1821,) the opinion has been put forward, that small-pox occurring after vaccination may be ascribed to some peculiarity of constitution identical with that which renders some persons liable to second attacks of small-pox. This theory is still upheld by some, and great importance has even been attached to it, as an explanation of vaccine failure. Its validity depends upon the assumption that small-pox and cow-pox are essentially the same disease, a position which we have already shown to be objectionable, even if at all tenable. The great, and as it appears to us, unanswerable argument against it is this; — small-pox occurring a second time was so rare, that its occurrence was actually denied by three of the oldest and most experienced physicians of the last century; viz. Van Swieten, Dr. Heberden, and Dr. Monro, (See Thomson on Varioloid Diseases; Appendix, p. 8,) while small-pox after cow-pox is an event of daily occurrence. One-third of the total admissions into the Small-Pox Hospital for several years past has consisted of persons who in early life have undergone vaccination. During the twelve years ending December 31, 1833, one thousand and six patients have been received into the hospital having small-pox after reputed vaccination, while in the same period the total number of cases of secondary small-pox has amounted only to fourteen. This statement, however, is not intended to convey any comparison between the preservative effects of inoculation and vaccination. The two processes are in their nature and objects so essentially different, that no fair comparison can really be made between them. The former is calculated, by ensuring one attack of small-pox, to prevent a second. The object of the latter is to prevent any attack of small-pox whatever. A person is not inoculated to prevent a second attack of small-pox, but to give a first. A comparison between the two processes, therefore, is like instituting a comparison between the relative frequency of first and second attacks of small-pox. It may with propriety be undertaken by those who

believe that cow-pox is only small-pox in a milder form; but those who believe, with us, that cow-pox and small-pox are as essentially distinct as small-pox and measles, may be excused from prosecuting such an inquiry. It has been observed that, as a measure of prevention, inoculation is the most severe, but the most certain; — vaccination the most mild, but the least certain. This probably expresses the exact state of the question as to the relative value of vaccination and inoculation in the fewest words, and in the clearest manner consistently with our present knowledge.

4. *Decadence of vaccine influence.*—There was no doctrine to which Dr. Jenner was so resolutely opposed as that of a gradual decay in vaccine influence in proportion as life advanced. His great argument against it was that it was contrary to the analogy of small-pox inoculation, which was universally allowed to sustain no diminution of energy by the lapse of time. But here again the force of the argument depends on the presumed identity of the vaccine and variolous poisons. If this principle be not conceded, there is as much reason in supposing that the influence of vaccination may gradually subside, as that it may continue permanent through life. In such a case, experience alone, not analogy, can determine the fact.

Should we even be inclined to admit the truth of the Jennerian doctrine so often quoted, "that when once the human frame has felt the full force of genuine and perfect cow-pox, it was never afterwards assailable by small-pox," the question still recurs, what is the law which regulates the subsequent liability to small-pox, when the vaccine process has been *imperfectly* gone through, and when, from some peculiarity of habit, the system receives only a *portion* of that salutary influence which cow-pox is capable of imparting. Dr. Jenner held that, under such circumstances, "small-pox would recur, and that the degree in which its phenomena were modified was proportioned to the degree of perfection which the vaccine vesicle assumed during its development." (Willan on Vaccine Inoculation; Appendix, p. v.) The results of our own observation lead to the belief that, even under these unfavourable circumstances, the susceptibility of small-pox does not recur immediately, but that imperfect cow-pox gives temporary security.

Dr. Willan adopted without change the notions of Dr. Jenner concerning the permanency of vaccine influence when the process was complete (Ibid. p. 72); and many of the more recent writers on cow-pox have expressed the same opinions. The public, however, have become familiarized with the notion that the influence of cow-pox wears out in the course of years. Some have even attempted to define accurately the period during which vaccination gives this "charmed" life; and seven, ten, and fourteen years have been respectively announced as the limit of its protective power. We see no grounds for upholding the doctrine as thus propounded, but we are strongly disposed to believe that the susceptibility of small-pox does return in many cases, more especially when favoured by certain concurrent circumstances. Of these the most energetic hitherto ascertained, are change of climate and the period of puberty. It is not an unreasonable supposition that the changes effected by each of these means in the constitution, loosen to a certain degree the hold which vaccination has upon the system, and thus pave the way for the inroad of small-pox. The late experiments of Dr. Heim would tend to connect the subsequent susceptibility of small-pox simply with the development of the *adult* constitution. (London Medical Gazette, vol. xiv. p. 517.)

Such a doctrine will probably be conceded even by the staunchest advocates of Dr. Jenner, when it is applied only to cases of doubtful vaccination; but the question, to be met fairly, should be further extended and put thus: Does the doctrine of a limitation in the period of vaccine security apply at all (and if it does, in what proportion), to those cases in which the primary process is complete in all its stages,—when every insertion takes effect,—when the vesicles are large, pearly, and elevated,—when the areola reaches its acmé on the tenth day,—when the constitution at that period gives evidence of internal derangement,—when the scabs remain adherent to the twenty-first day,—and, lastly, when the resulting cicatrix is well defined and permanent in after life? Years must elapse before this question can be answered beyond the possibility of doubt or cavil. In the meantime, however, we are warranted in saying that, if such limitation does apply to such cases, it is only to a small proportion of them,—in other words, that in the present state of our knowledge permanent security is the *law* of the animal economy and temporary security the *exception*.

Remedies for the Imperfection of Vaccination.—Whatever difficulty there may be in determining the exact proportion in which vaccination fails to impart that perfect and permanent security against small-pox which was its early attribute, it is clear that the cases of vaccine failure are very numerous, for they have forcibly attracted public attention, and several plans have been suggested, some of them emanating from the public rather than the profession, having for their object to obviate the real or supposed imperfections of vaccination. Four different proposals have been made with this view, viz:—Recurrence to the cow; re-vaccination; inoculation at *short* intervals from the date of vaccination; and inoculation at *distant* intervals from the date of vaccination. Each of these is occasionally practised. Each becomes in its turn the favourite of the day. They will, therefore, require separate investigation.

1. *Recurrence to the Cow.*—For many years past it has constantly been urged upon the profession in this country, as well as abroad, to revert more frequently to the cow for supplies of lymph. The proposal is certainly specious, but in our opinion by no means to be recommended. The following arguments appear to us to be conclusive against its general adoption. It is by no means easy to find the true cow-pox, even in a large dairy. Years often elapse before it is met with. There must always be a doubt as to the purity and genuineness of the new stock, until the experiment of variolous inoculation has been subsequently made, which parents are very seldom disposed to allow. Further, the true vaccine lymph, as first taken from the cow, is frequently very

acrid, producing glandular swellings and local inflammation, and thus occasions distrust rather than increased confidence. Lastly, it is not found that cases of small-pox are more frequent in those recently vaccinated, than in those vaccinated in the infancy of the practice.

The experiment was tried in Italy upon a large scale in 1829. (*Griva*, Op. cit. p. 104.) The result was, that there was no perceptible difference between the course of the old and the new, the primitive and the *humanized* lymph. More recent experiments in India tend to show that the measure may on some great occasions be adopted with advantage, (Calcutta Medical and Physical Transactions, vol. vi. p. 177), but it is clear even from these statements, that recurrence to the cow is not lightly to be recommended, nor adopted without great and multiplied cautions.

2. *Re-vaccination.*—The practice of re-vaccinating at distant intervals from the date of the primary process is one from which no harm and much benefit may be expected. The operation is simple and free from risk. If no effect follows, the security of the individual is rendered doubly sure. If vesicles arise, and the disease goes through all or some part of its usual course, that security may reasonably be considered as *renewed.* The only objection that can be urged against it is the difficulty of applying it on a large scale and the fear lest the general adoption of such a remedy should serve to unhinge and disturb the public mind on the subject of vaccine security. To its application in individual cases no reasonable objections can be offered. The practice has been carried to a very great extent in Germany since the year 1829. (Lond. Med. Gazette, vol. xiv. p. 515.)

[At the time when the re-vaccinations published by Dr. Heim, (*British and Foreign Med. Rev., Jan.* 1839, p. 186,) were practised, the population of Würtemberg was 1,363,298; and it appears, that during the period of five years, 208,322 children were vaccinated, leaving only the insignificant number of 271, above three years of age, still unvaccinated. The total number of cases of small-pox that occurred during the same period, was 1677, of which 354 were cases of genuine small-pox, and 1043 modified or rendered milder by previous vaccination,—being about one case of failure in every 217 persons. The total number of persons vaccinated a second time, after the lapse of a certain number of years, was 44,009; of this number, upwards of 20,000 took the disease perfectly; 9,006 imperfectly, and 15,000 not at all. It might be inferred from this, that little more than one-third of those vaccinated in infancy could be regarded as protected from small-pox; but although probable, it is not proved, that a susceptibility for cow-pox is the same thing as a susceptibility for small-pox; for, if this be admitted, it would seem to follow, that the proportion of persons liable to a second attack of small-pox must be greater than is commonly believed. Thus it appears, that of 297 persons who had previously had small-pox and were pitted, 95 received the cow-pox in a perfect form, and 76 in a modified form, whilst 126 resisted it altogether. The results of re-vaccination in the Hanoverian army, in the years 1837–8–9, according to Mühry, were similar. Of 112 pitted with small-pox, 16 received complete re-vaccination, 21 incomplete, and 75 none at all; in other words, the susceptibility of re-vaccination existed in no less a degree than in those who had been vaccinated. On the other hand, it appeared, that after varioloid scarcely any were susceptible of revaccination; for of 34 who were subjected to the operation, one only showed any result, and that was imperfect.

It resulted from the Würtemberg experiments, that the proportion of persons who took the cow-pox well, on the second vaccination, progressively increased with the distance of time from the first vaccination. Thus, in some of the departments of the kingdom, where the re-vaccinated were chiefly children, the proportion of cases in which the operation succeeded was comparatively small: among the military, 14,344 in number, where the subjects were nearly all about the age of twenty-one, a much greater number received the disease; whilst in a whole department, in which the persons re-vaccinated were thirty years old or upwards, a still larger proportion was affected. All these results bear strongly on the expediency of a second vaccination: they have been urged, indeed, as rendering re-vaccination absolutely necessary for the protection of the public, and it must be admitted, that all the experience we yet have tends decidedly to countenance this view; besides a strong argument in its favour is, that it may be productive of benefit, whilst no harm can possibly result from it.

One very important fact would seem to be fully established,—that the existence of a cicatrix or mark of the primary vaccination in the arm is no test whatever of the immunity of the individual from small-pox,—it having been found in Würtemberg and Hanover (Heim and Mühry) that those with, and those without, the mark, were equally susceptible of cow-pox on the second trial. Thus, of the 14,334 re-vaccinations among the military in Würtemberg, 8,845, or more than half, showed what are usually considered good marks of previous vaccination; and, of this number, the success of re-vaccination was complete in 31 per cent.; modified in 29 per cent.; and it failed altogether in 40 per cent.; whilst of those of imperfect marks, the re-vaccination was complete in 28 per cent.; modified in 26 per cent.; and total failure occurred in 46 per cent.

In the year 1840, there were vaccinated in all the regiments of the Prussian army, 43,522 persons. On these, the cicatrices from previous vaccinations were distinct in 34,573; indistinct in 6177; not discernible in 2772. The pustules produced by the vaccinations were regular in their course in 20,952; irregular in 8820; and no effect was perceptible in 13,750. The unsuccessful vaccinations were repeated successfully in 2831 cases; unsuccessfully in 8958; and the number of genuine pustules produced was from 1 to 5 in 10,021 cases; 6 to 10 in 5875; 11 to 20 in 4171; and 21 to 30 in 885. Of all the re-vaccinations, 48 per cent. were successful—the proportions varying between 40 per cent. and 60 per cent. in different regiments. (Lohmeyer, *Berl. Medicinisch. Zeitung*, April 22, 1840, and *Brit. & For. Med. Rev.*, July, 1840, p. 276.) In 1841 the proportion was 52 per cent. It is difficult to account for this difference, as well as for

that observed in different countries. In the Hanoverian army, the proportion of perfectly successful cases is stated to have amounted to upwards of $\frac{1}{16}$; in the Prussian army, as just remarked, to nearly $\frac{1}{2}$; in Würtemberg, in the army, to about $\frac{1}{3}$; and among civilians to nearly $\frac{1}{2}$. The proportion of imperfectly successful cases was, on the contrary, greatest in the Hanoverian army: in it, it was more than $\frac{1}{9}$; in the Prussian army, $\frac{1}{9}$; in the Würtemberg army, less than $\frac{1}{4}$; and in the people, $\frac{1}{3}$; but taking the successful and imperfectly successful cases together, the results were nearly the same in all. (Mühry, *loc. cit.*)

Results, similar to the above, have been obtained elsewhere. Small-pox and varioloid having been unusually prevalent in Philadelphia during the spring of 1840, the then physician of the House of Refuge and of the Pennsylvania Institution for the Instruction of the Blind, Dr. T. S. Kirkbride, (*Amer. Journ. of the Med. Sciences*, Jan. 1841, p. 109,) was induced to re-vaccinate the inmates of those institutions. Two hundred and nine children were re-vaccinated. In all, a perfectly formed, rounded, stellated, or punctuated cicatrix was found. All others, on whom this indication of previous vaccination was not discovered, were excluded from the report. Of the total number, 134 were boys, and 75 girls; — the average age was 12,—the extremes being 6 and 20. The dry vaccine scab was used in every instance to communicate the disease. Of the 209 children with perfect cicatrices, 44, or rather more than 21 per cent., had the disease perfectly.

The results of re-vaccination in France give even a less proportion than this. Of 2199 cases, in which, according to M. Villeneuve, it was performed on persons of different ages and sexes, who had been successfully vaccinated at some previous period of their lives, the operation took effect in 223 cases only,—which would give the proportion of about 1 to 13 or 14. (See, on all this subject, the interesting observations of Dr. Condie: *A Practical Treatise on the Diseases of Children*, p. 460, Philad. 1844.)

It has long been a prevalent idea, that vaccine matter may lose some of its efficacy in passing through so many human bodies, and that it would, therefore, be advisable to recur to the original source; and although it has been maintained, that this view is questionable, and that vaccine matter, in its most recent state, possesses no more preventive efficacy, in reference to varioloid, than that which has been in use since the discovery of vaccination, the opposite opinion is steadily gaining ground under better opportunities for observation. The Royal Jennerian Institution, it is said, employs the same lymph now that has been in use since its first foundation, in 1806. The Small-pox Hospital, however, changed their stock of lymph in 1837, and a marked improvement, we are told by Dr. Gregory, (Tweedie's *Library of Medicine*, 2d Amer. edit. i. 346, Philad. 1842,) was perceptible in the resulting vesicles. The local inflammation was more severe; the constitutional symptoms were more violent; the virus was more energetic; the most minute incision took effect, and the lymph, secreted in the pock on the 9th and 10th day, was still in an active state. Such has been the effect of vaccine matter obtained fresh from the cow, in the year 1838, by Mr. Estlin, of Bristol, England. By Mr. Estlin and Dr. Carpenter, of Bristol, the writer was favoured with a few points of lymph, eleven removes from the cow; and it was extensively used by him, and by his friends, Professors Huston and Meigs, and by Drs. Bridges and Kirkbride, of Philadelphia, and others. (*Amer. Med. Intelligencer*, for 1838–9, pp. 275, 290, 303, 363 and 373.) It was with this lymph that Dr. Kirkbride performed the re-vaccinations referred to above; and he remarks, that although some members of the profession appeared disposed to reject the new virus, from the severity of the symptoms which it induces, yet, except in three cases, he never witnessed sloughing or other unpleasant effects. His own observations, he adds, induce him to put more confidence in its prophylactic powers than in the old virus, "although this point can only be settled by time, and an enlarged experience by the profession generally."]

3. *Inoculation at short intervals from the date of Vaccination.* — Very early in the history of vaccination it was proposed to inoculate with the variolous and vaccine virus at the same time, or within such short periods, that the two influences might coexist, the object being to produce artificially that mild form of small-pox which we now so often meet with casually, and at long periods after vaccination. The proposal was revived in 1825 by Dr. Ferguson, (Letter to Sir Henry Halford, &c. London, 1825), and has since been most ably criticised and combated by Mr. Edmonston of Newcastle. (Observations on Cow-pox, 1828. Pages 107 to 119.) The plan consists in allowing vaccination to take the lead of inoculation by four days. The result is, that in some cases no variolous eruption whatever follows, and in other cases the succeeding eruption is of a mild or modified character. At first sight this measure appears to be a philosophical application of the facts and principles already adverted to, but the difficulties which oppose its introduction into practice are great, and in fact insurmountable. It proceeds upon the principle of keeping alive pure small-pox and pure cow-pox. But if the practice were to become general, pure cow-pox would soon become extinct, for the ordinary supply would be contaminated, and recurrence to the cow we have already seen to be both troublesome and precarious. Its application, therefore, at best, could be only on a very limited scale.

4. *Inoculation at distant intervals from the date of Vaccination.*—The early experiments of Jenner and Woodville sufficiently proved that, for two or three years at least after the insertion of the vaccine virus, the human body is unsusceptible of small-pox by inoculation. These testings, however, have long ceased to be made, and very little is known experimentally as to the possibility of communicating small-pox to the vaccinated by inoculation at distant intervals from the date of vaccination. It is extremely difficult to find persons advanced in life willing and able to afford the time requisite for such investigations, independent of the degree of risk thereby entailed. It cannot be doubted that a series of experiments carefully conducted, showing the effects of small-pox inoculation upon persons vaccinated from the year

1800 to the present time, would be eminently useful. They would settle indisputably the question as to the permanency or fugitive nature of vaccine influence, and, as we believe, would strongly fortify the public mind in favour of vaccination. The experiments conducted under our own observation with this view have been too few to warrant any decided conclusions. A fortuitous combination of circumstances may, perhaps, some day afford an opportunity of instituting such experiments, which at present it would be both useless and foolish to recommend.

Extermination of small-pox.—Dr. Jenner originally suggested the notion, which has been reiterated by Sir Gilbert Blane and others, that cow-pox possesses powers adequate to the complete extirpation of small-pox from the face of the earth. Dr. Jenner's statement was, (Petition to Parliament, 1802,) that from its nature it *must* finally eradicate that dreadful disorder. Sir Gilbert Blane remarks, (Statement of Facts, 1820, p. 8,) "that it is now matter of irrefragable historical evidence, that vaccination possesses powers adequate to the great end proposed by its meritorious discoverer, namely, the total extirpation of small-pox." This notion naturally made a strong impression upon the public mind, and contributed in no small degree to encourage that ardour in the cause of vaccination which is so honourable to the country of its birth. We cannot, however, understand, how such an event could be brought about by the means proposed. Parents vaccinate their children to escape the dangers of small-pox. Should this disease subside, and its dangers become less known, the necessity of any precaution against it would become less apparent, and the preservative practice would ultimately fall into neglect. And so, in fact, it has always proved in small isolated communities where small-pox is rarely seen, and even in larger towns where government does not enforce vaccination under penalties. This fact is strikingly illustrated in Mr. Cross's valuable history of the variolous epidemic which ravaged Norwich in 1819. The doctrine that cow-pox possesses an exterminating power, assumes, first, that small-pox arises invariably from contagion; secondly, that the susceptibility of cow-pox is universal in mankind; and, thirdly, that the influence of vaccination is permanent through life. All these are questionable points, and therefore on physiological grounds the notion must be abandoned. It has, indeed, been confidently urged in support of this position, that in some foreign countries the great object of extermination has actually been attained. This, however, is a complete error. In Ceylon, Sweden, Italy, and Austria, countries that have often been referred to as free from small-pox, that disease has recently raged with great violence; and both in Russia and Germany, where the exertions of the government in support of vaccination have been most energetic, not only does small-pox exist, but much uneasiness has lately been displayed on the question of vaccine security. Vaccination, then, we may confidently affirm, can be maintained only by having small-pox constantly before our eyes; and nothing warrants us in the expectation of banishing the bane by even the most liberal application of the antidote.

[From accurate statistical accounts taken by the Registrar-General of England, it would appear, that in 1837 there were only five diseases more fatal in England, and that the deaths throughout England and Wales amounted to about 12,000 annually. Since then, the number has fluctuated from 16,268 in 1838 to 9,131 in 1839. (W Farr, *Third Report of Registrar-General*, 1841.)]

In the remarks which we have now brought to a conclusion on the momentous question of vaccine protection, we trust not to be misunderstood. The spirit and tendency of them has been to show that small-pox and cow-pox must exist together, and that the history of vaccination offers no exception to that general law of our physical and moral nature by which good and evil are blended. Although unable to eradicate small-pox, we have in vaccination a powerful means of lessening its virulence and contracting the sphere of its ravages. It has been our further object to show that the study of the laws which regulate vaccine influence is both intricate and interesting; and while on the one hand much has been done towards explaining them, much still remains to excite and reward the labours of posterity.

GEORGE GREGORY.

VARICELLA.—*History of Varicella.*—The milder forms of varioloid eruption attracted attention at very early periods. Rhazes, the first acknowledged author on small-pox, noticed a mild or spurious eruption which gave no protection from that disease when it prevailed epidemically. (De Variolis et Morbillis, cap. v.) Ingrassias, a Sicilian physician, described such a disorder in 1550 with considerable accuracy, (De Tumoribus contra Naturam, tr. i. cap. i.) and he has, consequently, been dignified as the original writer on *varicella*. The claim, however, may be disputed in favour of Vidus Vidius, who about the same period alludes to the disease under the title of *chrystalli*, in the following explicit terms:—"Sunt qui, præter duas species (variolas scilicet, et morbillos,) chrystallos adjiciant. Sic enim appellant quasdam veluti vesiculas, plenas aqua, instar chrystalli splendentes, quibus cutis variis locis distinguitur. In quas non ita incurrunt omnes homines, sicut in variolas et morbillos, neque sub ipsis ita affliguntur." (De Chrystallis, 1550.) This disorder, he adds, the Italians called then, as now, *ravaglione*.

Nearly a century afterwards, (namely, in 1646,) Riverius quotes this description, and gives, chiefly from Ingrassias, the following account of the malady:—"Est et tertium pustularum genus, pueris familiare, et variolis simile quoad magnitudinem et figuram; sed in eo ab iis distinguitur quod variolæ cum rubore et inflammatione appareant. Hæ vero albæ sint, et veluti vesiculæ, seroso humore repletæ, quæ intra triduum disrumpuntur, et exsiccantur, nullumque afferre solent periculum, et plerumque sine febre erumpunt. Id pustularum genus a nostratibus fœminis *la verolette* nominari solet."

Sydenham, at a somewhat later period, passes varicella over almost without notice; but Morton, in 1690, (Opera, tom. iii. p. 58,) details several cases of it under the title of *variolæ maxime benignæ*, and to him we are indebted for introducing

into medical nomenclature the name by which it was then, and has since been familiarly known, the *chicken-pox*. The authors of this early period concurred in opinion that such a disorder afforded no protection from small-pox, but with regard to its nature, they differed, some regarding it as allied to small-pox, others viewing it as altogether distinct from that disease.

The principal writer on varicella during the eighteenth century was Dr. Heberden, who, in 1767, published in the first volume, page 427, of the Transactions of the Royal College of Physicians, a description of the disease, professing to give a full and accurate account, not only of its symptoms, but of its pathological relations. Dr. Heberden paid little attention to the statements of preceding writers; his descriptions and doctrines are obviously drawn from his own extensive experience, and in such repute was he held, that for a long series of years this paper was looked upon as the standard authority on the disease. The leading characters of chicken-pox, as given by Dr. Heberden, are as follows. The initiatory fever is slight. The eruption is vesicular, terminating on the fifth day by minute crusts. It occurs both prior to and after small-pox. It is a different disease from small-pox, and gives no protection from it. It arises from a specific contagion, and affects the same individual but once during life. It is capable of being transmitted by inoculation. The eruption thence resulting may, with hasty and inexperienced observers, pass for the small-pox, and mistakes have in consequence arisen.

It is curious to observe that, notwithstanding his conviction of the essential differences between chicken-pox and small-pox, Heberden applied to the former disease the name of *variolæ pusillæ*. The term varicella was first employed by Vogel in 1764.

In 1805, Dr. Frank of Vienna undertook an investigation of the subject. (De Curandis Hominum Morbis Epitome, vol. iii. p. 167.) He carefully distinguished the several kinds of spurious small-pox, and by way of distinction applied to them the names of *pemphigus variolodes vesicularis*, and *solidescens*. His description of the former disease corresponds accurately with the complaint hitherto called chrystal-pock, water-pock, and chicken-pock. In 1809, a very detailed account of varicella was published by Dr. Heim of Berlin, (see Cross on the Variolous Epidemic of Norwich. Appendix, No. 1); but much confusion is occasioned by his applying the same term to designate three kinds of spurious small-pox, the water-pock, the horn-pock, and the swine-pock. In this paper it is affirmed that matter taken from a subject who has chicken-pox will only produce chicken-pox, and afford no protection from small-pox. It is also stated that the cicatrices left by varicella are different from those of variola, and that a careful inspection of *them* is alone sufficient to distinguish the one disorder from the other.

Dr. Willan, in 1806, contributed a little to our knowledge of varicella by some observations published in the seventh and eighth sections of his work. (On Vaccine Inoculation 4to. p. 86.) He therein describes, with great minuteness, the appearances of varicellous eruption, which he subdivides into three varieties, the lenticular, conoidal, and globate. In 1820, Dr. Thomson of Edinburgh, in a work of much labour and research, (Account of the Varioloid Epidemic of Scotland 1820,) again opened the questions connected with the subject of varicella. During his investigation of the epidemic which prevailed in Edinburgh and other parts of Scotland during the years 1818 and 1819, he was led to the belief that the chicken-pox of Morton and Heberden was only a modification of variola. This opinion, which is, in fact, but the revival of a very old doctrine, has since found some supporters, and the notion of a common origin of chicken-pox and small-pox is the principal point in the pathology of the disease to which our attention will be directed. Before however, we can with propriety enter into an examination of the arguments for and against it, the phenomena of varicella must be described.

Description of the Varicella Lymphatica.—This disease, called by Vidus Vidius *chrystalli*, by Heberden *variolæ pussilæ*, and by others variolæ spuriæ, lymphaticæ, and volaticæ, the chicken-pox of Morton, the pemphigus variolodes vesicularis of Frank, the varicella of Willan, is a complaint chiefly observed in infants and children of tender years. It generally shows itself without symptoms of premonitory fever. Such, at least, is the opinion of Heberden, Plenk, and Bryce, and with it our own observation corresponds; but Dr. Willan, whose authority on all subjects of cutaneous disorder is deserving of respect, remarks (Op. cit. p. 91,) that he does not remember to have seen any case of varicella without some prior disorder of the constitution, lasting one, two, or even three days. The symptoms then observed, he says, are languor, a disposition to sleep, a furred tongue, hot skin, quick pulse, a sore throat, with pains in the head, back, or limbs. The eruption of chicken-pock usually commences on the shoulders, neck, and breast. The scalp and back are almost invariably occupied with eruption, while the face, which never escapes in small-pox, is for the most part but very slightly affected in chicken-pox.

The eruption is composed, from the very first, of vesicles, about the size of a split pea, perfectly transparent, and covered simply by the cuticle. When very copious, the body has the appearance of having been exposed to a shower of boiling water, each drop of which had occasioned a minute blister. The vesicles of chicken-pox vary in shape. Dr. Willan has described them as being lenticular, conoidal, or globate. They are usually very numerous but distinct. Mr. Ring is, we believe, the only author who has described a case of confluent varicella. (See London Med. and Phys. Journal, vol. xiv. p. 141. 1805.) They are surrounded by a very slight degree of superficial redness or areola. Successive crops of them appear for two or three days, and while the new vesicles are forming, the first are beginning to shrivel. The contained fluid is at first thin and perfectly transparent. On puncturing the vesicle at the period, the clear lymph is evacuated, and the cuticle falls to the level of the surrounding skin. There is no hardness in the subjacent cutis vera. Many of the vesicles burst spontaneously or are broken by the second or third day.

In those that remain after that period the lymph becomes of a light straw colour, or slightly opaque, so as to resemble whey. The vesicles are often accompanied with a sense of tingling. When itchy and irritated by rubbing, they sometimes take on sufficient inflammation to convert the lymph on the third day into an imperfect pus. The scabs of varicella are small and gummy, formed by the concretion of the exuding lymph. They desiccate very quickly, and fall off, not in a mass, but in minute grains. In a few cases superficial marks or cicatrices are left by them, which, however, are rarely permanent in after life. The whole course of the disease seldom if ever exceeds a week. During the progress of the eruption to maturity, there are no constitutional symptoms of the slightest importance. The tongue is clean, the pulse of natural frequency, the appetite good, and the rest undisturbed.

Diagnosis of Varicella Lymphatica.—The only disease with which chicken-pox is liable to be confounded is that which we have already described under the title of modified small-pox, or *varicella variolodes*. There are two principal and characteristic points of difference between the disorders.

First, in the true lymphatic varicella there is no premonitory fever. In even the mildest form of varioloid varicella there is fever, and very often severe affection of the brain and nervous system (headach and delirium) preceding for forty-eight hours the development of the eruption. Secondly, in the true chicken-pox the vesicles have not that regular organization which we have described as belonging to, and actually essential to the existence of, variola, even in its mildest aspect. The vesicles of chicken-pox have neither a hard papuliform base, nor cells, nor central depression. They are mere elevations of cuticle, of irregular and undetermined shape. Such are the *essential* diagnostic characters. Other points of distinction between chicken-pox and modified small-pox have been mentioned, such as the comparatively greater rapidity in the progress of the former, the greater firmness of the resulting scab in the latter, the shape and permanency of the cicatrix, &c.: but these are less to be relied on. There are some circumstances, indeed, connected, not with the aspect of these diseases, but with their origin and mode of propagation, which are important as contributing to establish a correct diagnosis; but these will be better discussed under the head of *pathology*.

We may sum up the whole in the following words. When there is little or no perceptible premonitory fever; when the eruption is distinctly vesicular from the earliest period; when the punctured vesicle falls completely to the level of the surrounding skin; when the crusts which succeed are yellowish, scaly, irregular in shape, and not elevated, the disease is the true chicken-pox. On the other hand, when, after a period of feverish disturbance, the eruption exhibits in its earliest stage the appearance of a solid tumour; when, on the third day, after discharging the contents of the vesicle, a firm tubercle is found beneath it; when the resulting crust is brown, compact, defined, of a clear horny smoothness, and sensibly elevated above the surface of the skin, the disease is small-pox under some of its modifications, capable of communicating small-pox to others, both by inoculation and infection.

Pathology of Varicella Lymphatica.—This disease is almost peculiar to infantile life. It seems as if the fine and delicate skin of the infant was requisite for its development. Willan, however, has described (On Vaccine Inoculation, p. 91) an undoubted case which occurred in the person of a gentleman thirty years of age; and in one instance at the Small-Pox Hospital we observed the disease, in a very genuine form, attacking an adult female. Chicken-pox occurs to persons once only in the course of life. This opinion was first avowed by Dr. Heberden, and its correctness has since been generally acknowledged. Many persons, however, pass through life without undergoing it. It may sometimes be seen running its course along with, and uninfluenced by, perfect vaccination. (See London Medical Gazette, vol. ii. p. 633.)

The points in the pathology of varicella lymphatica which have been principally disputed are, 1. its communicability by inoculation; 2. its origin, whether by specific contagion or by a contagion common to it and to variola. These topics will require distinct investigation.

1. **Inoculation of Chicken-Pox.**—Dr. Heberden does not appear to have witnessed any instance of inoculating with varicellous lymph, but he implies that such a mode of communicating the disease is possible, because he says that mistakes have thence arisen. Dr. Willan has a chapter expressly devoted to the inoculation of varicella; but the evidence on which the author relied as establishing the fact is slender and unsatisfactory. Four cases only are recorded. In two of these the experiment was confused by variolous inoculation being practised at the same time. In one case no result followed. In the only case which can be in any degree relied on as affording a presumption that chicken-pox is communicable by inoculation, a small vesicle raised upon a red and somewhat hard basis was discernible on the twelfth day, followed by two small vesicles on the shoulder, which disappeared in two days. (Op. cit. p. 98.) It is obvious that nothing satisfactory can be deduced from such an occurrence.

The experiments of Mr. Bryce, to determine the question of varicellous inoculation, are far more decisive. This author states, (See Thomson on Varioloid Diseases, p. 74,) that "he has taken lymph from the vesicles of true varicella, with the greatest care, at all periods of the disease and at all seasons of the year; that he has himself inoculated and seen others inoculate with it, children who had never undergone either small-pox or cow-pox, to the number of thirteen, yet in none of these was this disease, nor any thing like small-pox, ever produced. In one or two cases a slight degree of redness was observed for two or three days; but in all the rest no effect followed." These experiments are now justly considered as having settled the question, and satisfactorily shown the impossibility of propagating the genuine lymphatic or infantile chicken-pox by inoculation.

2. **Common Origin of Chicken-Pox and Small Pox.**—All authors are agreed that chicken-pox is readily communicated from one child to

another (not having previously undergone it) by casual infection. It is a disorder often observed to spread epidemically, affecting in succession all the younger branches of a family or school; and it is generally affirmed that the contagious quality of chicken-pox is of a peculiarly diffusible nature. Dr. Thomson of Edinburgh, as we have already remarked, has taken much pains to revive the notion suggested at a very early period, and openly avowed by Van Swieten (Commentarii, vol. v. p. 10) and Sauvages, (Nosologia, vol. i. p. 423,) that the contagion of chicken-pox is not *sui generis*, but merely a modification of the variolous virus; in other words, that the mildest lymphatic chicken-pox and the worst confluent small-pox have a common origin. (Account of the Varioloid Epidemic of Scotland, Edinburgh, 1820.) The principal arguments which Dr. Thomson brings forward in support of this position are,—first, that he finds in the records of medicine no unequivocal examples of chicken-pox prevailing epidemically without cases of small-pox appearing *at the same time*; 2dly, that the most strictly vesicular eruptions have occurred after exposure to *variolous* contagion, and where, in point of time, it was reasonable to refer the disorder to such a source; 3dly, that he had never witnessed chicken-pox in those who had undergone small-pox; 4thly, that chicken-pox and modified small-pox run into each other by such minute shades of difference, that no unerring diagnostic marks between them can possibly be assigned.

Upon the first of these arguments, (the non-occurrence of chicken-pox without simultaneous small-pox,) Dr. Thomson placed great reliance; but since the date of his publication facts have come to light which completely disprove it. Thus, for instance, it has been ascertained that from the year 1809 to 1823, chicken-pox was annually observed at Copenhagen without concomitant small-pox. Since that time both diseases have prevailed at intervals epidemically, but always under circumstances which satisfied the physicians of the town that their sources were distinct. (*Dr. Möhl*, De Varioloidibus et Varicellis. Copenhagen, 1817. Also Edin. Med. and Surg. Journal for January, 1828, No. xciv. p. 186.)

The further arguments which have been adduced in favour of the *specific* nature of varicellous contagion are these — 1. It is contended, in opposition to Dr. Thomson, that the characteristic marks of chicken-pox, particularly during the first three days of eruption, are well-defined and easily distinguished. 2dly, That chicken-pox is not propagable by inoculation; whereas every case of eruption elevated on a solid tuberculous base, and possessing a cellulated structure, however mild in its aspect and accompanying symptoms, is yet capable of communicating genuine small-pox to others by inoculation. (See Willan on Vaccine Inoculation, p. 52–5.) Several cases corroborating this position have occurred within our own observation. 3dly, That the vesicular chicken-pox occurs equally in those who have and those who have not been vaccinated; that prior vaccination in no degree alters its character or course, while, on the other hand, vaccination proceeds with perfect regularity after the occurrence of chicken-pox; a circumstance that never happens after small-pox.

These arguments appear sufficient to establish the doctrine that small-pox and lymphatic chicken-pox are in reality different diseases, arising from different poisons.

Treatment of Chicken-pox.—On the treatment of a disorder so mild in its nature, and so free from all sympathetic disturbance of the system, it is unnecessary to add much. The exhibition of any mild aperient medicine (such as rhubarb and magnesia) during the progress of the eruption, and again towards its decline, includes all that is essential.

GEORGE GREGORY.

VARIOLOID.—See VACCINATION.

VEINS, DISEASES OF THE.—In most of the different textures and organs of the body the capillary branches of the arteries terminate in corresponding minute radicals of the veins, and these, by uniting and re-uniting into larger venous branches and trunks, come at last to form the two venæ cavæ, through which the whole stream of dark-coloured refluent blood passes into the right auricle of the heart. The larger veins consist of three distinct membranous layers or coats, the outermost of which is formed of condensed cellular membrane. The middle or proper coat of veins is of a red or brown colour, thin, soft, and more elastic in the longitudinal direction than the corresponding arterial tissue. The internal or lining membrane of veins which is continuous with that lining the auricles of the heart, adheres very firmly to the middle coat, is thin, smooth, of a bluish colour, and more distensible than the internal coat of arteries. The inner or common venous membrane is the most extensive and the most uniform of all the venous tissues. "It is the only one which is found in the substance of organs, and is present where the cellular and proper membrane is wanting. This is the case not only with venous branches and minute canals as they issue from the substance of muscles, bones, and such organs as the liver, kidneys, spleen, &c. but is also very remarkably observed with regard to the venous canals of the brain." (Pathological Anatomy, by David Craigie, M.D., 8vo. p. 115. Edin. 1828.)

Valves of a lunated shape, which are formed of a duplicature of the lining membrane, are met with in the veins of the extremities, in the azygos, internal jugular, and facial veins, while they are wanting in the veins of the heart, kidney, liver, spleen, intestines, and generally in the uterus and ovaria. Bichat and Travers have showed that the internal tunic of veins is not divided by the application of a tight ligature around the vessel. Mechanical stimuli produce no sensible effects on the coats of veins, but the application of concentrated acids and chemical stimulants, according to the same authors, excite them to contraction. Minute blood-vessels and small nervous filaments can be traced into the larger veins from the surrounding cellular substance, and when the coats of veins are inflamed, their vasa vasorum can readily be filled with injection.

There is, perhaps, no circumstance in which the arteries and veins resemble one another more

clôsely than in the facility with which the circulation is carried on by the anastomosing branches where a large trunk has been permanently obstructed. There is much less resemblance, however, to be traced between the diseases of the arterial and venous system than we might have been led to expect, from the similarity which exists in the structure of their coats, the continuity of their canals, and the function they perform in the body. Diffuse inflammation of the lining membrane of veins, which is a frequent and fatal disease, occurs so seldom in arteries, that Mr. Travers states he has never seen the internal tunic of an artery coated with lymph, and even when lymph is deposited in quantity sufficient to obstruct the current of blood, the deposit occupies a narrow defined space, and the inflammation, by whatever cause excited or however acute, is small and circumscribed. One of the most common morbid appearances observed in the dead bodies of aged persons is the conversion of the arterial tunics into calcareous matter, but the writings of pathologists contain the history of a few examples only in which the coats of the vein had undergone this change.

In the present article we propose to give a succinct account, 1. of inflammation of veins; 2. of phlebolites, vein-stones, or calculi in the veins, and conversion of the coats of veins into calcareous matter; 3. of obliteration of veins; 4. of varicose veins; and, 5. of of rupture and perforation of veins.

1. **Of Phlebitis, or Inflammation of Veins.** — Inflammation of the lining membrane of veins was unknown to all the writers on medicine before the year 1784, when many of the most important facts relating to this dangerous affection were pointed out by Mr. Hunter, in a paper which he read to a Society for the Improvement of Medical and Chirurgical Knowledge, and which was published in the first volume of their Transactions in 1793.

"I have found," observes Mr. Hunter, "in all violent inflammations of the cellular membrane, whether spontaneous or in consequence of accident, as in compound fractures, or of surgical operations, as in the removal of an extremity, that the coats of the larger veins passing through the inflamed part become also considerably inflamed, and that their inner surface takes on the adhesive, suppurative, and ulcerative inflammation: for in such inflammations I have found in many places of the veins adhesions, in others matter, and in others ulceration. Under such circumstances the veins would have abscesses formed in them if the matter did not find in many cases an easy passage to the heart along with the circulating blood, so as to prevent the accumulation of the pus: but this ready passage of the matter into the common circulation does not always happen. It is in some cases prevented by the adhesive inflammation taking place in the vein between the place of suppuration and the heart, so that an abscess is formed, as will be further observed; where the inflammation is most violent, there we find the vein most inflamed; there also, after suppuration, we find the purest pus; and as we trace the vessels from this part either further from or nearer to the heart, we find the pus more and more mixed with blood, and having more and more of the coagulated parts of the blood in it. As these appearances are only to be seen in dead bodies, they cannot be described but from thence; but it is so common a case, that I have hardly ever seen an instance of suppuration in any part furnished with large veins where these appearances are not evident after death. I have found them in the bodies of those who have died from amputation, compound fractures, and mortification."

These circumstances led Mr. Hunter to suspect that the fatal effects sometimes succeeding to venesection, which had usually been attributed by authors to injuries of tendons and nerves, depended on inflammation of the internal coat of the veins. He observed similar morbid appearances in the veins of the arm after bleeding, and he has stated that in many cases the inflammation and suppuration are not confined to the part, from the adhesion not having taken place, and that an abscess is frequently formed which occupies a considerable length of the vein, both between the wound and the heart, and between the wound and the extreme parts. "Upon examining the arm of a man who died in St. George's Hospital, Mr. Hunter found the veins, both above and below the orifice, in many places united by the adhesive inflammation. He also found, in many parts of the veins, that suppuration had begun as on inflamed surfaces, but had not arrived at ulceration; and in several other places ulceration had taken place, so as to have destroyed that surface next the skin, and a circumscribed abscess was formed. The veins near to the axilla had taken on suppuration, beyond which adhesion had not formed, and thus had given a free passage for the matter into the circulation, of which most probably the patient died."

Mr. Hunter likewise observed fatal inflammation of the jugular veins in horses after bleeding, extending into the chest. "Many horses," he says, "die of this disease, but what is the peculiar circumstance which occasions their death I have not been able to determine; it may either be that the inflammation extends itself to the heart, or that the matter secreted from the inside of the vein passes along the tube in considerable quantity to the heart, and mixes with the blood. I am inclined to believe that the exposure of cavities of the larger veins in cases of accidents and also of operations, is often the cause of many of the extensive inflammations which sometimes attend these cases, and indeed may be the reason why inflammations extend or spread at all beyond the sphere of continued sympathy." (Trans. of a Society for the Improvement of Med. and Chir. Knowledge, vol. i. Lond. 1793.)

Mr. Abernethy, who was a pupil of Mr. Hunter, described three cases of phlebitis in the arm, but in none of these did suppuration take place. In the first, about three inches of the tube inflamed both above and below the orifice, it was accompanied with much tumour, redness, and pain of the covering integuments, and much fever; the pulse was rapid, and the tongue furred. In the third case the inflammation was not continued in the course of the vein towards the heart, but extended as low as the wrist.

Mr. Abernethy offered the following explana-

tion of the manner in which the constitutional symptoms of phlebitis are produced. "When the inflammation of the venous tube is extensive, it is indeed very probable that much sympathetic fever will ensue, not merely from the excitement which inflammation usually produces, but also because irritation will be continued along the membranous lining of the vein to the heart." (Surgical and Pathological Essays. Lond. 1793.)

About the same time it was pointed out by Dr. John Clarke and Mr. Wilson that inflammation sometimes occurs in the uterine veins of puerperal women. "Upon cutting into the substance of the uterus," observes Dr. Clarke, "pus is often found, which in all the cases, I have met with, is situated in the large veins." (Practical Essays on the Management of Pregnancy, &c. by J. Clarke, M.D., 1793.) In dissecting the body of a woman who died several weeks after delivery, Mr. Wilson found the uterine veins thickened and partially obliterated. The iliac, emulgent, and spermatic veins exhibited the usual effects produced by inflammation. The coats of the vena cava were thickened and adherent to the surrounding part, and the vessel, which was contracted below the entrance of the hepatic veins, contained about four ounces of pus. (Trans. of a Society for the Improvement of Med. and Chir. Knowledge, vol. iii. p. 65.) Mr. Wilson met with similar appearances in the bodies of two women who died soon after parturition, and the uterine veins also contained pus. Meckel communicated to Sasse the history of a case of puerperal fever, in which he found on dissection "all the veins which surround the uterus, the hypogastric trunks, and the vena cava, enlarged in volume. The place where the placenta had adhered was distinguished at the posterior part of the uterus by a fungous mass. The veins, whose exterior appearance had arrested the attention, were examined with care; they were separated from the surrounding cellular substance, and in this state the whole system of uterine and spermatic veins presented an extraordinary augmentation of the calibre of the vessels and thickness of their coats; when opened, there escaped from them a true purulent fluid. The vena cava, where the right renal vein entered, presented a resisting tumefaction; and when laid open, its coats were of double the natural thickness, and the cavity was filled with pus, and a polypus formed of pseudo-membranous and puriform concretions." (De Vasor. Sanguif. Inflammat. auct. J. Georg. Sasse. Halle, 1797.) Not long after this period, Professor Osiander found the lungs inflamed, and the umbilical vein from the navel to the liver filled with a yellow purulent fluid, in a child who died of erysipelas shortly after birth. In the body of a child who died seven days after birth, Meckel found the umbilical vein inflamed, and its inner membrane covered with a layer of pus and perforated with small ulcerations. In another child, attacked soon after birth with vomiting, colic, diarrhœa, jaundice, and fever, and who died on the tenth day, he found the peritoneum inflamed, and puriform effusion in the abdominal cavity. The branches of the vena portæ, and those of the umbilical vein were swollen and their coats much thickened. M. Breschet and the writer of this article have repeatedly observed this inflammation of the umbilical vein extending into the substance of the liver and vena cavæ, in the bodies of children who died a few days subsequent to birth; and they are disposed to consider this organic lesion as the sole causes of infantile erysipelas and death in many fatal cases soon after delivery. (Dict. de Méd. t. xvi. p. 400.) Palletta published in 1807 an observation which he had made in 1787, of a case of inflammation of a pelvic vein, from which he was led to suspect that pus, which had been secreted by the lining membrane of the vessel, had been carried into the circulation, and produced the abscesses in the lungs and other organs which were discovered on dissection. "Si itaque hæc transvectio causâ est apostematum in memoratis visceribus observatorum; nonne idem sentiendum est de abscessibus, qui post graves capitis lesiones in hepate, liene, pulmone pericardii consequuntur? Possint utique sanguineæ venæ ob ictuum vehementiam et capitis concussionem, &c. inflammationi ut aliæ partes esse obnoxiæ." (Exercitationes Pathologicæ, cap. ii. 1807.)

With the researches of Mr. Hunter on inflammation of veins, the French pathologists appear to have remained almost entirely unacquainted for many years. It is truly a remarkable circumstance that Bichat, whose Anatomie Générale appeared in 1801, and which contains a minute account of the origin, structure, and functions of veins, should have said nothing respecting diffuse suppurative inflammation of their lining membrane; and but for the acuteness of Mr. Hunter's powers of observation, it seems not improbable that the disease might have remained much longer undiscovered. The following case of phlebitis after venesection, cited by Mr. Arnott, is the only one, as far as we have been able to discover, which was recorded in the French journals between the years 1784 and 1815, when Mr. Hodgson's valuable Treatise on the Diseases of Arteries and Veins was published. In this case some of the more remarkable secondary effects of phlebitis are described. "Gasper Goldinger, subject for the last six weeks to epilepsy, was bled twice from the arm on the 1st of November, 1806; on the 8th from the foot, and on the 10th and 13th from the jugular vein. On the 16th he was again bled from the arm (the right), which on the following day felt painful; some redness and tension were observed round the aperture; 15th, arm very painful and swollen from the shoulder to below the elbow; edges of the puncture red; face and skin of the body of a yellowish colour, pulse feeble and frequent; 19th and 20th, fever more intense; tongue dry and coated; great pain in the arm; 21st and 22d, lies supine; prostration of strength; heat of skin; tongue dry; pain in the right side of the chest; respiration short; 23d, tension of the arm diminished, some pus flowed from the wound made in bleeding; respiration short. Died at night, seven days after the receipt of the wound in the vein.

"*Dissection.*—The wound in the cephalic open; the vein filled with pus through its whole length, i. e. from where it terminates in the axillary to the bend of the elbow, where it divides into the median cephalic and superficial radial; the latter

of which contained pus for two inches below its origin. The coats of the vein were much thickened, indurated, and red. In the interfibrilear cellular tissue of the pectoral muscle of the right side was a quantity of thick greenish pus. Eight or ten ounces of a yellowish opaque serosity were contained in the right sac of the pleura. The lung of this side was unadherent, that of the left was adherent over its whole surface by a delicate false membrane. Both lungs presented a number of hepatized portions, varying in size from that of a nut to that of a large walnut, gorged with fluid, which in some of them was puriform. The arachnoid membrane was opaque, thickened, and indurated; effusion of fluid between it and the pia mater, and into the texture of the latter. Some yellowish serum into the ventricles." (M. Le Herissé, Journal de Médicine, tom. xii. p. 417, Paris, 1806.)

Even in the medical literature of this country few cases of phlebitis were recorded in the interval above-mentioned, and the great importance of Mr. Hunter's observations does not appear to have been perceived before the publication of the essays of Hodgson, Travers, and Carmichael, (Transactions of King's and Queen's College of Physicians in Ireland, vol. ii. Dublin,) on venous inflammation.

After relating the history of a fatal case of phlebitis from venesection, in which there had been a high degree of constitutional irritation, with symptoms which strikingly resemble typhus, the first of these authors observes, that "several cases of extensive inflammation of veins after the operation of venesection have been communicated to me, and I have seen one in which the symptoms and appearances upon dissection, although not so extensive, were similar to those described in the preceding case. The symptoms were very like those of typhus fever, and the appearances on dissection were in some places adhesion and obliteration of the vessels, in others effusion of coagulated lymph or pus into their cavities, with great induration, thickening, and adhesion of the surrounding parts." "The constitutional irritation," Mr. Hodgson adds, "which takes place in extensive inflammation of veins is attended with symptoms of greater debility than acute inflammation in general. This circumstance may probably arise from the extent of the inflamed surface, but it is not improbable that it may be an effect produced upon the nervous system by the pus which is secreted into the vessel, being mixed with the circulating blood." (A Treatise on the Diseases of Arteries and Veins, by Joseph Hodgson. London, 1815, p. 515.)

Having inquired into the essential points of distinction between veins and arteries, as far as regards their texture and properties, and considered the relative pathology of these vessels, Mr. Travers observes that "the contrasted character of the inflammation of arteries and veins abovementioned explains the active constitutional sympathy peculiar to the latter. This corresponds with our observations of the difference in this respect presented by the bounded and undefined inflammation of joints, the peritoneal or pleural cavities, and the other shut sacs of the body. The constitutional symptoms excited by inflamed veins resemble in type those of diffused inflammation in other organs. They are similar to those of inflamed absorbents, which vessels also resemble the veins in their disposition to continuous inflammation." Respecting the manner in which the constitutional symptoms are produced, Mr. Travers further observes that "there have been many conjectures respecting the cause of the fatal termination of these cases, at which I confess I feel surprised. Among others, the inflammation by extension to the heart or the membranes of the brain, and the conveyance of pus into the circulation, have been mentioned. Not to insist on the innocuous quality of pus, it should be observed that the most rapidly destructive inflammation is that which has the true adhesive progress, in which no pus is secreted. But if we consider the importance of the veins in the economy, the extent of surface which the collective area of the venous trunks afford, larger I imagine than any of the shut sacs of the body, and the diffused disorganizing character of the inflammation, we can surely be at no loss to account for the disturbance of the system. It is an error to suppose that any greater sympathy exists between the constitution and the venous than the arterial or absorbent system. I say this because I have observed something like that superstitious alarm which is excited by events that we do not expect and cannot explain, has been produced by the fatal catalogue of tied veins, and a comparison of these with the generally successful cases of tied arteries. All the mystery of veins is, as I have attempted to show, that they are indisposed to inflammation but when excited to inflammation by continuity, and therefore it is that the constitution sympathises so deeply. (Cooper and Travers, Surgical Essays, vol. i. London, 1818.)

The essay of Mr. Travers contains the histories of several examples of venous inflammation after venesection and the application of a ligature, and he has also related a case of obliteration and ulceration of the internal jugular vein, communicating with an abscess and tumour situated deeply over the right side of the trachea, and covering the great vessels.

In the course of the last fifteen years numerous important observations have been made in this country and on the continent of Europe on inflammation of veins, whereby the symptoms and causes of the disease have been more accurately ascertained, and many obscure pathological phenomena satisfactorily explained.

In the articles Puerperal Fever and Phlegmasia Dolens, the author has given a full history of the local and constitutional symptoms, the alterations of structure, the causes and the treatment of inflammation of the veins of the uterus, and of those which bring back the blood from the lower extremities. Inflammation has likewise been observed in the superficial and deep-seated veins of the upper extremities, in the vena cava, splenic, spermatic, renal, and vesical veins, azygos, vena portæ, vena innominata, jugulars, sinuses of the brain, pulmonary veins, and in the veins returning the blood from the larger bones of the body. Redness of the lining membrane of a vein is an appearance often produced, as in arteries, without inflammation. When inflamed, the coats of veins become

vascular and thickened, and their lining membrane coated with lymph or pus. Their cavities are also obstructed by coagula of lymph and of the fibrine of the blood. When permanently obstructed, their coats are gradually converted into ligamentous cords, and the circulation of the blood is carried on by the collateral vessels.

When inflammation takes place in the veins of the arm after venesection, it may proceed upward in the direction of the heart, or toward the distal extremity of the limb contrary to the current of blood circulating in the vessel. The same circumstance takes place in crural phlebitis originating in the branches of the internal iliac vein, the inflammation spreading upwards along the common iliac to the vena cava, or in the opposite direction from the trunk to the branches along the external iliac and femoral veins to the thigh and leg. In traumatic phlebitis of the arm, the wound which had been made with the lancet in the vessel becomes painful and festers, and there flows from it either a small quantity of red-coloured serous or puriform fluid, or a small crust forms over the opening. Along the course of the inflamed vein, a hard, painful, sometimes knotty, cord, which rolls under the finger when pressed, can be distinctly traced, and more or less redness, swelling, and stiffness take place in the soft parts covering the vein. Sometimes the whole inner surface of the arm or even the entire limb becomes tense, swollen, red, painful, as in erysipelatous inflammation of the parts. Not only are the coats of the vein inflamed in some cases of phlebitis, but the cellular membrane, skin, and other contiguous parts participate in the disease, and suffer from the usual consequences of inflammation. The severity and extent of phlebitis vary considerably in different cases. In some it is of an adhesive character, and produces only a thickening of the coats of the vessel and obliteration of a small portion of its canal. In diffuse suppurative phlebitis, however induced, severe constitutional disturbance is speedily excited, and death not unfrequently follows, whatever plan of treatment be adopted.

The researches of recent pathologists lead to the conclusion that, in the greater number of cases of phlebitis, death does not result from the extension of the inflammation of the vein to the heart, the inflammation having been sometimes limited to a few inches only of the vessel. From the resemblance which the symptoms of phlebitis bear to those produced by injecting acrid and poisonous fluids into the veins of animals, and from pus being generally found in the veins of those who have died of phlebitis, the conclusion seems legitimate that the constitutional symptoms of venous inflammation generally, though not invariably, depend on the introduction of a fluid into the circulation, which contaminates the blood and operates as a poison. Recent pathological researches likewise prove that phlebitis is generally the cause of the formation of abscesses in the liver, joints, lungs, cellular membrane, &c. after injuries of the head, parturition, amputation, and other great surgical operations.

M. Cruveilhier states that phlebitis of the bones is one of the most frequent causes of visceral abscess, the consequence of wounds and operations in which the bones are interested. In 1814 he examined the medullary membrane of the long bones of those who died after amputation in the Hôtel Dieu, with typhoid symptoms and visceral abscesses. In the greater number of these there was suppuration of the medullary membrane; sometimes this occupied the whole length of the bone. Operations upon the bones, M. Cruveilhier says, are extremely liable to produce phlebitis. The constitutional symptoms are referred by him to a miasmatic infection of the whole mass of fluids. However extensive the phlebitis may be, if the pus does not enter the circulation, he affirms that no accident follows from it, but as soon as the impediment formed by the coagula is removed, atonic adynamic fever, preceded by intense shivering, takes place, and is speedily followed by death.

Mr. Arnott, to whom we are so deeply indebted for his observations on phlebitis in the fifteenth volume of the Medical and Chirurgical Transactions, and who has contributed more than any other writer to elucidate the phenomena of the disease, has given the following account of the general effects of inflammation of veins.

"In from two to ten or twelve days after the receipt of the injury, the secondary or constitutional symptoms of phlebitis manifest themselves, and they may be thus briefly characterized. Great restlessness and anxiety, prostration of strength and depression of spirits, sense of weight at the præcordia, frequent sighing or rather moaning, with paroxysms of oppressed and hurried breathing, the patient at the same time being unable to refer his sufferings to any specific source. The common symptoms of fever are present; the pulse is rapid, reaching to 130 or 140 in a minute, but is in other respects extremely variable. There is often sickness and violent vomiting, especially of bilious matter. Frequent and severe rigors almost invariably occur, sometimes to the number of three or four in the course of a few hours. The general irritability and deep anxiety of countenance increase; the manner is quick, and the look occasionally wild and distracted. When left to himself, the patient is apt to mutter incoherently, but on being directly addressed, is found clear and collected. The features are pinched, and the skin of the whole body becomes of a sallow or even yellow colour.

"Under symptoms of increasing debility, and at a time when the local affection may appear to be in a great degree subsiding, secondary inflammations of violent character, and quickly terminating in effusions of pus or lymph, very frequently take place in situations remote from the original injury [*consecutive abscesses, metastatic abscesses*]; the cellular substance, the joints, and the eye have been affected; but it is more particularly under a rapidly developed attack of inflammation of the viscera of the chest that the fatal issue usually occurs. Whether this is observed or not, death is always preceded by symptoms of extreme exhaustion, such as those of a rapid feeble pulse, dry, brown or black tongue, teeth and lips covered with sordes, haggard countenance, low delirium." [See Abscess, Internal, and Dance, art. *Abces Métastatiques* in *Dict. de Médecine*, i. 87. Paris, 1832.]

Causes of phlebitis. — Inflammation of veins rarely takes place in any part of the body where it cannot be referred to a wound or some specific cause, externally applied to the coats of the vessels. Exposure to the cavities of veins by phlebotomy, amputation, and the separation of the placenta from the uterus in parturition, are the most frequent causes of this disease. It has arisen also in many cases from the application of a ligature around the coats of a vein, or after their division for the cure of varix in the lower extremities; and in some instances phlebitis has been produced by the application of cold to the limbs, or by chilblains or gangrene affecting a part.

Mr. Hodgson mentions two cases in which the division of a varicose vein terminated fatally; the first on the morning of the fourth day, the second on the seventh or eighth day. He likewise relates a case which came under the observation of Mr. Freer, in which the ligature of a varicose vein was followed by violent pain in the left side of the chest, laborious breathing, and a violent vomiting of blood, four hours after the operation. The ligature was removed from the vein by dividing the noose which surrounded the latter. The symptoms were immediately relieved; she became easy, and her pulse rose from sixty to eighty. On the sixth day the swelling and pain in the knee had subsided. On the eighteenth day the limb was painful: the vein appeared to be impervious below the part which had been tied, and several varices upon the calf of the leg were harder than before the operation. About six weeks after the operation, a large vein, a little above the outer ankle, was tied with a single ligature, which was immediately removed; she became feverish soon after, and vomited twice. During the following day her pulse was natural; on the third day after the operation, the vessels to which the ligature had been applied were found to be impervious; but as other veins in the limb were varicose, and caused great pain and inconvenience, two of the largest of them were tied in a similar manner. The operations were performed nine weeks after the last which has been described. The ligatures were cut away immediately after their application. In three hours the patient vomited a fluid slightly tinged with blood. On the second day her pulse was almost imperceptible, and she was attacked with delirium and severe vomiting. On the third day the symptoms had increased; the pulse was scarcely to be felt on the fourth day. On the sixth she was delirious and oppressed; after a bleeding from the arm the pulse became fuller, and she began gradually to recover; the incision healed, and obliteration of the vein was produced by a ligature, which was immediately removed.

Mr. Oldknow relates a case in the fifth volume of the Edinburgh Medical and Surgical Journal in which death took place from the application of a ligature around a varicose saphena vein. Mr. Travers has given the history of a fatal case of ligature in a wound of the femoral vein. Many other cases are to be met with in the writings of different authors, which prove that the application of a ligature around a vein may produce fatal phlebitis, and the same result has frequently followed the division of the saphena with a cutting instrument for the removal of varix.

Sir Astley Cooper has informed the writer that he met with a tumour upon the saphena major vein. The tumour was laid open or removed, and inflammation of the vein soon succeeded, which destroyed life. A lady having a varicose enlargement of the vena saphena above the ankle, Sir Astley cut it out, compressed the vein below, and desired her to keep quiet. Three or four days after, she was labouring under high constitutional irritation, and had an erysipelatous appearance in the leg. The great saphena vein became inflamed as high as the groin, and the patient died. Another lady had a fungoid tumour just below the knee; in removing this, Sir Astley found the saphena passed through its centre. The saphena vein was cut through, and the portion removed which was imbedded in the tumour. In three days she had great inflammation in the leg low; high constitutional irritation; in different branches of the saphena below there was a disposition to form abcesses, with very little corresponding inflammation above, and she died in a week. Other similar cases have been related to us by Sir A. Cooper, and Breschet observes that the modern history of surgery contains multiplied observations of accidents produced by incision, excision, or the ligature of varicose veins. In all cases it is phlebitis which takes place, and which occasions the danger.

Mr. Abernethy believed that moving the arm soon after bleeding produced the disease. Dr. J. Thomson of Edinburgh thinks the state of the lancet as to sharpness has a considerable share in producing the morbid effects. A bad lancet, says Mr. Abernethy, may contribute to produce the disease, yet this is not sufficient to account for the accident without supposing a peculiar irritability of the constitution to be present. From the frequent occurrence of phlebitis at particular seasons, certain unknown conditions of the atmosphere have probably a more powerful influence than any other cause in the production of traumatic and other varieties of phlebitis.

M. Breschet states that punctured wounds, particularly when the instrument is charged with some putrid or irritating matter, are often followed by inflammation of the deep-seated veins, and he attributes the greater frequency, at present than in former times, of inflammation of the veins of the arm to the circumstance that many persons bleed with the same lancets which they have employed in vaccination. A powerful cause of phlebitis, though less common than that of venesection, he considers to be the inoculation of a deterious matter under the skin or in a vein during the dissection of putrid bodies, and of those more particularly who have died of peritonitis. The same effect is produced by the immersion of the hands in animal fluids, more or less acrid. Several persons connected with the Faculty of Medicine at Paris became affected with phlebitis from plunging their hands when excoriated into water containing portions of a dead body.

The pus of some ulcers, and the fluid discharged from certain blisters, are likewise considered as so many causes of inflammation of veins. M. Breschet quotes the case of a distinguished young physician (Dr. Jerrin) who died of plebitis with abscess and suppuration of the cellular tissue of the

arm and armpit, from a prick of a pin employed in dressing a blister. M. Dance has published an account of the death of a young physician from phlebitis which was produced by puncturing a small phlegmon on his hand with a bistoury which he had employed a month before to lay open an anthrax, and which had been very carefully wiped. A young veterinary surgeon likewise perished from puncturing his hand while dissecting the body of a man who had died of gangrene. (Dictionnaire de Médecine, tom. xvi. p. 396.)

Dr. Carswell has related to us a case of gangrene of the sole of the foot, in which, after death, he found the cellular sheath of the veins proceeding from the part filled with pus, and the coats of the veins greatly thickened.

In Mr. Howship's collection there is a fine specimen of inflamed varicose saphena vein. The vein is tortuous and elongated, and connected with it are several pouches formed by the coats of the vessel, which are filled with coagulated blood. At the bottom of one of these sacs, which has been laid open, there is a small circular opening, which communicates with the cavity of the vein. Mr. Howship informed the writer that the individual from whom the diseased vessel was removed after death, had an attack of gout in the foot, and that the gouty inflammation was suddenly transferred to the saphena vein, and extended a considerable way up the limb.

Chronic ulcers of the legs, of the rectum, uterus, &c., have given rise to inflammation of the coats of their veins. The application of cold, internal violence, or even simple pressure, or the long-continued pressure of tumours, may produce inflammation and obstruction of the superficial veins of the extremities. Mr. Travers succeeded in obliterating a varicose saphena behind the inner condyle of the knee in a labouring man, by means of adhesive plaister applied in stripes around the limb, with as much firmness as could be borne. The vein took on inflammation, became hard, tense and painful, and afterwards perfectly impervious.

Mr. Travers relates another case where this change took place spontaneously, and was accompanied by like symptoms and consequences. The saphena, spermatic, and epigastric veins were several years afterwards greatly distended and tortuous. Mr. Travers considers this as an example of the phlebitis produced by arrest of the circulation in the vein, and he refers to Mr. Hodgson as being the first who observed the fact that blood occasionally deposits strings of coagulum in varicose veins, and that the vessel in such a case becomes firm, and incapable of being emptied by pressure. "I have seen four cases," observes Mr. Hodgson, "in which this event terminated in a spontaneous cure of varices. In these instances it is probable that the coagulum accumulated until it completely filled the varix or the upper portion of the vein communicating with it; the blood, being unable to pass forward, coagulated in the vessel to a considerable extent. This coagulum was gradually absorbed; as its absorption advanced, the coats of the vein contracted; the vessel was ultimately obliterated, and the blood was conveyed through collateral channels." In these cases the coagulation of the blood in the veins was probably the consequence and not the cause of phlebitis.

Cases of spontaneous inflammation of the veins of the extremities, and also of the veins of the great viscera, have occurred. Cruveilhier relates a case which came under his own observation, in which suppuration had taken place in the cellular sheath of all the divisions of the vena portæ, the vein itself remaining sound. Broussais states that the veins are often inflamed in small-pox, measles and scarlatina. Purpura hemorrhage is also affirmed by some writers to depend on inflammation of veins. According to Ribes, erysipelas is seated in the extremities of veins; and Bouillaud has referred the phenomena of typhous fever to phlebitis. A case occurred about a year ago in this metropolis, where fatal inflammation of the great dental and maxillary veins followed the extraction of a tooth. Pus was also found in the veins of the brain.

Treatment of phlebitis.—Mr. Hunter applied firm compresses above the wound in the arm after bleeding to produce obliteration of the canal of the vessel, by bringing its sides into contact; but observation has not proved this practice to be successful in arresting the progress of the inflammation. Our chief reliance in the treatment of this affection at the commencement should be placed on the vigorous employment of local antiphlogistic remedies. Almost all the cases of traumatic phlebitis which have been treated with stimulants have proved fatal. The arm should be supported and preserved in a state of rest, and leeches applied along the course of the inflamed vessel. Their number should be proportioned to the severity of the attack, and their application should be repeated until the inflammation is subdued. This is by far the most important part of the treatment, and the leeches should be repeatedly applied in large numbers. The arm should afterwards be covered with an emollient or saturnine poultice, or an evaporating lotion. Diaphoretics and cooling saline purgatives should also be exhibited.

"With respect to general treatment when the primary inflammation alone is to be considered, I apprehend," observes Mr. James, "that it cannot be too decidedly antiphlogistic; when, from the continuance of the disease or other symptoms, secondary inflammation may be suspected, this mode of treatment is more questionable, and its results often unfavourable. General bloodletting is certainly a remedy of great efficacy where it is proper, but opinions are much divided on this head; and at all events, when the secondary inflammations are running into rapid suppuration, it is likely rather to expedite the process than to prevent it. Mr. Sanson has treated phlebitis with tartrate of antimony with success: it is at all events a safer mode than bleeding." (Observations on Inflammation, by J. H. James, p. 458. Lond. 1832.)

It must be acknowledged that no treatment of the constitutional symptoms has yet been discovered on which much reliance can be placed. When the symptoms indicate great depression of the system, recourse must be had to wine, ammonia, quinine, camphor, and other stimulants, as we

have already fully described in the article Puerperal Fever.

2. **Of Phlebolites, Vein-stones, or Calculi in the Veins, and conversion of the Coats of Veins into Calcareous Matter.**—Phlebolites have been found most frequently in the veins which return the blood from the uterine organs, the bladder, prostate gland, and rectum; but they have been met with also in the veins of the spleen, spermatic cord of aged men, the anterior and posterior tibial veins, and in varicose subcutaneous veins of the leg. Otto found them most frequently in the veins of the uterus, vagina, and bladder of persons who were more than fifty years of age. He discovered them once within the veins of the prostate in an old man. In all the cases the veins were varicose, and contained coagulated blood. In two instances gouty concretions existed at the same time in the joints; and such was the case in the man in whom the calculi were found in the veins of the prostate. Otto refers to Realdus Columbus for an example of phlebolites in the hemorrhoidal veins, and to Bartholin, Tulpius, and Walter, for the history of cases where they were found in the renal, meseraic, dorsal, and vesical veins. Mr. Langstaff saw three calculi as large as peas in the veins of the uterus, and he has observed them also in the veins of the prostate, and he thinks they are formed most frequently in those who have diseases of the prostate and bladder. (Hodgson's Treatise, p. 522: 1815.) Lobstein has found them in the veins of the testicle, uterus, bladder, rectum, and once in the veins of the spleen. (Traité d'Anatomie Pathologique: Paris, 1829.) Tiedemann found numerous concretions in the varicose veins of both spermatic cords of a man fifty-one years old. There were fifteen of these calculi in the right; in that of the left twenty-one. They were of different sizes, of a round or oval form, had a yellowish-white colour, and lay loosely imbedded in coagulated blood. Some were, however, adhering to the inner coat of the vessel by a fine transparent membrane.

In one case the writer discovered several phlebolites in the spermatic veins of a lady who died at the age of thirty-five, and who had suffered repeatedly from abortion, and once from inflammation of the uterus. In a case which we examined with Mr. Holberton of Hampton Court, where the mucous membrane of the rectum was ulcerated, we found several phlebolites in the left hemorrhoidal and vaginal veins. One of these was as large as a pea, and smooth on the outer surface; there were two others much smaller, which were deposited in the centre of small clots of the fibrine of the blood. The fibrine surrounding these was formed into thin concentric layers. The coats of the veins surrounding these bodies were healthy, but between these points and the ulcerations in the rectum their coats were disorganized by inflammation. We have repeatedly met with phlebolites perfectly or imperfectly formed in the spermatic and hypogastric veins of women who had died from malignant disease of the uterus. While engaged in writing this article, 24th of July, 1833, we found a phlebolite of an oval shape, smooth on the outer surface, and about two lines in diameter, in the anterior tibial vein of an aged woman, who died in the St. Marylebone Infirmary of cancerous ulceration of the bones of the face. The coats of the veins enclosing the concretion were thin and pellucid: over the tibia, two inches nearer the ankle, there was the cicatrix of a large ulcer. An aged female, with varicose veins, now under our care, has a large phlebolite in the anterior tibial vein of the right leg, which produces little or no uneasiness. In the right common iliac vein of Lord Liverpool there was contained a cylindrical concretion, an inch or more in length. Sir Astley Cooper, to whom the writer is indebted for an opportunity of examining this rare specimen, believes the deposit of calcareous matter to have taken place within the vein, and consequently that it is not an example of ossification of the coats of the vessel, as had originally been suspected. The iliac and femoral veins of Lord Liverpool, on the opposite side, had been completely disorganized by inflammation. It does not appear that phlebolites have yet been observed in the sinuses of the brain.

Phlebolites often attain the size of a common pea; more frequently they are smaller, and sometimes they do not exceed a millet-seed in size. Otto states that he saw one in the anatomical museum at Strasburgh of the size of a hazel-nut. They are usually of a yellow colour, and consist of concentric lamellæ, and are more frequently of an oval than round shape. According to the analysis of Iohn and Gmelin, they are principally composed of carbonate and phosphate of lime with animal matter. Dr. Prout has more recently analysed some of these concretions, and his results are nearly the same.

A difference of opinion has prevailed respecting the mode of their formation. Mr. Hodgson thought it not improbable that phlebolites were formed in the surrounding parts, and made their way into the veins by progressive absorption. Meckel entertained an opinion that they were formed like encysted tumours. Andral states that calculous concretions sometimes push the internal membrane before them, and descend with them into the cavity of the vein. The membrane, he adds, becomes thin, and forms a true peduncle to the concretion. There is the closest analogy, M. Andral thinks, between these pedunculated concretions and those concretions sometimes met with in the interior of the joints; and he inquires whether it may not be possible for these bodies sometimes completely to detach themselves from the coats of veins, and become loose in the cavity. Tiedemann believes them to be formed from the blood itself: this opinion Otto states is also supported by the observation of Errhman, according to which some of the concretions were still soft and appeared to be formed from the fibrous matter of the blood, a mode of formation which Cruveilhier had previously noticed. That this view of the mode in which phlebolites are formed is correct does not admit of dispute, and Dr. Carswell has executed drawings to illustrate the various stages of their formation. The observations of Dr. Carswell prove that there is first formed a small coagulum of blood in the vein, and that in the centre of this clot a little nucleus with concentric layers gradually appears. By-and-by the red part of the blood is partly absorbed, and the

fibrine makes its appearance with the usual physical characters. Then a certain arrangement can be perceived taking place in the fibrine forming lamellæ, the central one first formed apparently becoming cretaceous; and this cretaceous induration takes place throughout the different lamellæ until the whole is converted into a solid phlebolite. In the point towards the distal extremity of the vein there is sometimes a little nucleus of blood or fibrine, which becomes a concretion; and thus the phlebolites sometimes get a caudal extremity.

But in what manner the blood becomes coagulated in the veins so as to give origin to the formation of phlebolites, it is not so easy to determine. That this is sometimes the result of a slight degree of inflammation or irritation propagated from diseased organs along the vessels is highly probable from the facts already noticed respecting the consequences of phlebitis. It must, however, be admitted that at the part where the phlebolite is formed there is in general no perceptible alteration of structure in the surrounding coats of the vein, although it has been employed in bringing back the blood from a diseased organ.

The conversion of the tissues which compose the veins into calcareous matter takes place so seldom that Bichat questioned the possibility of its occurrence. The lining membrane of veins, he observes, does not become ossified in aged persons, as we observe in the arteries; its organization prevents it from being penetrated by the phosphate of lime. When it does happen, it is an unnatural condition; whereas ossification of the common membrane of red blood is a state almost natural to the aged. (Anatomie Générale, t. ii. p. 404.) Morgagni has, however, related a case in which the coats of the vena cava were in great measure cartilaginous, and even in some degree bony. (*Morgagni*, letter lxiv. art. ix.) Dr. Baillie mentions an instance where a considerable ossification was found in the coats of the vena cava inferior near its bifurcation into the two iliacs. (Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge, vol. i. p. 134.) Dr. Macartney informed Mr. Hodgson that he met with several depositions of calcareous matter in the external saphena vein in a man who died of a diseased liver. There was an ulcer on the leg; but the depositions of calcareous matter appeared to have no immediate connection with the ulcer. One of the depositions was nearly an inch in length, and was situated on the internal surface of the vessel. (Hodgson's Treatise on Disease of Arteries, &c., p. 521.) Beclard found the femoral vein ossified at one point where it was in contact with the crural artery, which was converted into bone. M. Andral likewise found in one part of the thickened walls of a varicose femoral vein a very hard concretion, of the size of a small nut, formed by a deposit of phosphate of lime. (*Andral*, Précis d'Anatomie Pathologique, t. ii. p. 411.) M. Otto, after alluding to various other authors who have observed ossification of the coronary veins, vena portæ, the brachial vein, &c., states that he has never himself met with ossification of the veins, but that he saw, in the Museum of Pathological Anatomy at Vienna, a splenic vein, a vena portæ, the brachial and femoral veins of an old man and woman, and also, in the Veterinary school at Munich, the preputial veins of a horse ossified. (South's Translation of Otto's compend. of Pathol. Anatomy, 8vo. 1831, p. 350.)

3. **Of obliteration of the cavities of Veins.**—This is one of the most frequent consequences of phlebitis; and it would be difficult to prove that obliteration of the cavities of veins which nature intended should remain pervious through life, ever takes place but as a consequence of inflammation. In the umbilical vein, the ductus venosus, and the ductus arteriosus, which is properly a venous, and not arterial canal, which are not designed to remain open after birth, obliteration of their cavities takes place, it is true, without our having any ground to suppose that inflammation existed. Coagulation of the blood takes place in the umbilical vein after it has been tied; the red particles become gradually absorbed, the fibrine which remains is slowly converted into a fibrous tissue, and that tissue, according to Dr. Carswell's observations, becomes organized, and unites with the walls of the vein. The sudden mechanical arrest of the blood circulating in a vein might also give rise to the formation of a clot of fibrine in the vessel between the obstructed part and the nearest collateral branch, and subsequent complete obstruction without inflammation, but this must be a rare occurrence; and where we meet with an obliterated vein, it ought generally to be considered as the result of phlebitis, however induced.

4. **Of Varicose Veins.**—The term varix signifies simply a swollen vein, and does not, therefore, express the precise nature of the disease. When a vein becomes varicose, it has a blue colour, becomes dilated, knotty, and irregular, and winds in a serpentine manner under the skin. The actual state of the coats and valves of a vein affected with varix has not, perhaps, been satisfactorily ascertained. Mr. Hodgson thinks it probable that the valves are ruptured in this affection; but this does not appear to be demonstrated by observation, nor is it proved that the valves are thickened. In some cases strings of coagula form in the veins; and this may be either the cause or the consequence of inflammation of the coats. Spontaneous obliteration of the vein sometimes results from a phlebitis thus produced. Mr. Stanley had an opportunity of opening a varicose vein, and the valves were in a healthy condition, thin and transparent. In one part of the vein, where there was externally an appearance of tortuosity, he found internally a pouch projecting from the side; precisely the same pouch in the vein which occurs in an artery producing a true aneurism. This pouch had formed at some distance from the valves and below them. There was no coagulated blood in the pouch, as has been observed in other similar cases. There was an appearance of circular fibres in the lining membrane of the vessel. Mr. Langstaff has likewise examined varicose veins, and perceived an appearance of circular muscular fibres in their lining membrane. The valves he also found healthy in their structure, but not sufficiently large to close the vein.

On the 14th August 1833 we examined the body of a man who had died of cholera in the Saint Marylebone Infirmary. There was a large

varicose ulcer situated over both the right and left tibia, and there were several branches of the saphena veins tortuous and apparently greatly dilated, which extended above the knee. We cut down to the trunk of the left saphena, where it was about to enter the femoral vein, and introduced the pipe of a syphon and threw water into the vessel, which immediately distended the trunk and all the varicose branches along the tibia. On removing the vein, its coats were found to be hypertrophied and thickened like those of an artery, and the inner surface of the vessel was rugous in the longitudinal direction. The valves were thin, pellucid, and perfectly healthy in appearance, though insufficient to close the vessel. Two enlarged and indurated glands pressed on the trunk of the saphena were entering the femoral vein. Around the cicatrix there was a large cluster of enlarged veins, and passing from these, through the fascia, was a large branch, which formed a communication with the deep-seated veins of the leg.

Andral admits six different varieties of varix, and he states that varix may exist with the coats of the veins in three different conditions: 1. simple dilatation, without any other alteration, extending through their whole length or at intervals: 2. dilatation of veins with thinness of the walls of the dilated points: 3. uniform dilatation of veins with thickening of their coats: 4. dilatation at intervals with thickening of the coats in the points where the enlargements exist. In these two latter varieties the capacity and length of the vein are both increased, and it becomes tortuous in consequence: 5. dilatation of veins with the development of septa in their interior, which divide the vein into little cells (locules), where the blood accumulates and coagulates: 6. the same disposition exists as in the last species; but besides there are numerous small openings in the walls of the vein which communicate with the surrounding cellular tissue more or less changed. In dissecting many true hemorrhoidal tumours, M. Andral found nothing but one or other of these varieties of varix; and the same is the case, he observes, with many other veins. (Précis d'Anatomie Pathologique, t. ii. p. 402.)

Where the veins of a part become varicose, all the evil consequences of interrupted circulation are experienced, as swelling and sense of weight, heaviness, and numbness in the limb. Œdema often takes place, or inflammation of the skin and cellular membrane, and sometimes ulceration and hemorrhage ensue. Chronic inflammation of the coats of the vein itself probably also takes place.

The disease is rarely met with in the deep-seated veins. Most frequently it is observed in the veins of the lower extremities; but it has also occurred in the upper extremities, where the veins have been obstructed from pressure, inflammation, or any other cause. Varix has been observed likewise in the vena azygos, internal jugular, and right subclavian vein. The veins of the spermatic cord and scrotum are also not unfrequently affected from pressure and from supporting a long column of blood, and varices sometimes appear around certain tumours, more particularly those of a malignant nature.

The morbid condition of the veins constituting varix is produced in almost all cases by the presence of some cause which obstructs the free circulation of the blood in the vessel. Obliteration of the cavities of veins by inflammation and the pressure of tumours, and the pressure of the gravid uterus, are perhaps the most frequent causes of the disease in the lower extremities. The vein becomes over-distended with blood from the point of pressure to the capillaries; the minute venous capillaries gradually become congested and dilated by the arteries pushing forward their blood into them with the usual force; and in consequence of this, the extreme branches of the vein first assume the varicose appearance. This gradually extends until the branches and trunk of the vein are affected to a greater or less extent, and sometimes it proceeds until nearly all the superficial veins of the limb are diseased. If this view of the manner in which varix is produced be correct, it will follow that the disease does not arise from thickening or rupture of the valves, and their incapability of approximating and closing the vessel, but from the dilatation of the coats of the vein from the undiminished impetus of the blood in the capillary arteries, and the obstruction to its free circulation in the capillary veins.

Treatment of Varicose Veins.—After what has been stated respecting the causes of phlebitis, it will be unnecessary to say more in condemnation of the ancient practice of destroying varicose veins of the lower extremities by excision or the application of the actual cautery. The division of the varicose vein with the knife, practised by modern surgeons, however effected, is so hazardous a practice, that it also has been almost universally abandoned of late years.

In the milder forms of the disease, permanent compression by means of rollers, bandages, or laced stockings, is sometimes an effectual remedy. When the vein becomes inflamed, recourse must be had to leeches and soothing applications, as emollient cataplasms, with tepid or cold lotions, and rest in the horizontal position. When these means fail, caustic may be applied so as to produce a slough of the skin, cellular membrane, and coats of the vein. Sir Charles Bell has informed us that this plan was practised many years ago by Mr. Cartwright extensively and with great success in the Middlesex Hospital. Mr. Mayo has treated upwards of fifty cases in this way, and he has assured us that in not one instance has any bad symptom been produced by the caustic. Mr. Berry has, however, related to us a case where phlebitis and death followed its use; and as the caustic must act in all cases by producing inflammation of the coats of the vessel, care should be taken to excite this only in a mild degree. The following is the method in which the caustic is applied by Mr. Mayo to the varicose veins of the lower extremities; and in a case which we saw under treatment at the Middlesex Hospital in August, it promised the best result, many of the enlarged veins having disappeared. "The method which I employ consists in applying potassa fusa, made into a paste with soft soap, to the integuments covering the vein. I cut a hole one-third of an inch in depth, and of the requisite length, (from an inch to two inches,) in a piece of leather, upon which adhesive plaister has been spread:

the plaister is then applied to the skin, so that the length of the aperture is transverse to the vein or veins I would obliterate. The hole in the plaister is then filled with the caustic paste; and a piece of adhesive plaister, and a roller applied over that, prevents its shifting. In seven hours the roller, plaister, and paste are removed, the part washed with warm water, and a linseed poultice applied. In about ten days the slough produced by the action of the caustic separates; in a week to ten days more the sore is cicatrized, and the cavity of the vein is found to have become obliterated.

"For the first two days after the application of the caustic paste, the adjoining part of the vein is hard and sore upon pressure; to relieve this, nothing has been necessary besides desiring the patient to remain at rest, with the leg on a sofa, to take opening medicine, and to live upon broth and tea, and to apply to the part the liquor plumbi dilutus as a lotion. The flow of blood through the vein has commonly ceased about the fifth or sixth day: sometimes I have found, on tapping with my hand the swollen vein below the caustic, that by the second day the fluctuation has ceased to be communicated to the blood in the part above. In a few instances, when the slough of the integument has separated, the vein has been seen as a second slough, traversing the bottom of the ulcer. The vein always appears to be obliterated for some little distance above and below the part exposed to the action of the caustic.

"I have applied caustic thus upon the great saphena vein above the knee, but more commonly to the same vein below the knee; to a part evenly dilated, and across a knotted part; to the saphena minor, immediately below the knee, and to the saphena major in two places at once, near the knee and near the ankle: it has never failed to obliterate the vein in any case which I have witnessed; no hemorrhage has ever taken place; no local inflammation more than I have described; no symptomatic fever; and I think it may be considered as a useful addition to the means commonly employed in the treatment of varicose veins of the lower extremities." (Med. Gazette, vol. ii. p. 813. 1828.)

Tincture of iodine, it is reported, has recently been employed by Mr. Guthrie with success in the treatment of varicose veins. In the treatment of varicose ulcers, Sir Astley Cooper observes that the recumbent posture must be strictly enforced. Lint wetted by the mercurial wash should be laid on the ulcer, oil-silk over this, and then the limb should be well and regularly bandaged, beginning at the foot. Opening the veins about twice a week, if necessary, Sir Astley Cooper adds, is a very safe and effective practice: then applying a bandage, and keeping the parts wet by means of an evaporating lotion. If the punctures at any time should fret, and should not unite, but pass into ulcers, the black wash should be applied.

In varix of the veins of the scrotum and spermatic cord, M. Breschet applies pressure to the veins, so as to produce obliteration of their canals, by iron forceps, the branches of which are approximated with a screw. Slight pain and inflammation followed their application to the veins of the scrotum, and as the branches of the forceps were brought closer to each other, they produced a true eschar, which soon became converted into an ulcer. The ulcer healed in a few days without having discharged any blood, and the vein was gradually obliterated, leaving no trace of its existence either by its colour or size. A larger pair of forceps was required for the veins of the cord, and its application was attended with more difficulty than pain.

5. **Of Rupture and Perforation of Veins.**—The vena cava superior within and exterior to the pericardium, the vena cava inferior, the jugular and subclavian veins, the veins of the extremities, intestinal canal, and spleen, and the vena portæ, have all been ruptured spontaneously or after violent muscular exertion and external injury. The coats of the vessels have in some of these cases presented no morbid appearance, but in others around the opening in the vein different alterations of structure, as softening and ulceration, have been observed. Bichat (Anat. Général, t. ii. p. 415) says these ruptures have happened in the veins of the inferior extremities during pregnancy, and that there are examples of the superficial veins of the head being ruptured in violent attacks of cephalalgia. He thinks the extreme tenuity of the walls of the cerebral veins exposes them frequently to be torn by violent blows upon the head. We are disposed to believe that the sudden extravasation of blood into the labia during labour, which occasionally happens, is to be attributed to a rupture of a large vein from the violent muscular effort required to propel the child. When the effusion is into the cavity of the arachnoid membrane, it can have no other source, he believes, but the venous trunks. Haller cites examples of rupture of the larger veins; and Portal relates the case of a young woman who died suddenly, while in a cold bath, from rupture of the vena cava superior, immediately above the right auricle. (Anat. Méd. t. iii. p. 355.) Senac also relates cases of death taking place in the cold stage of intermittents from bursting of the veins. Mr. Hodgson has seen two cases in which a vein on the calf of the leg was ruptured during violent attacks of cramps in the gastro-enemius muscle. Accumulations of blood underneath the skin were the consequence. Andral has given the history of a fatal case of rupture of the abdominal cava. The edges of the perforation had an appearance of being torn, but around it the walls of the vein were in a sound state. The accident happened in a healthy man, who in the heat of a quarrel suddenly fell down in a state of insensibility and expired. (Précis d'Anat. Pathol. p. 399.) Hemorrhage from the bowels sometimes arises from rupture of the hemorrhoidal veins. Malignant ulceration of the stomach and uterus sometimes also gives rise to perforation of veins and the extravasation of a large quantity of blood. The same occurrence has followed the perforation or rupture of a varicose vein. Mr. Cline described a case of this kind, in which it occurred in the internal jugular vein. It is highly probable, though it has not been clearly ascertained, that in most of these cases some morbid alteration of structure had previously taken place in the coats of the ruptured veins.

ROBERT LEE.

VENTILATION. — Air confined within a limited space is generally subject to the operation of causes which affect its salubrity in various ways. The respiration of living beings and the processes of combustion which take place in most dwellings, are gradually consuming its oxygenous or vital portion ; the effluvia from healthy human bodies, and still more from those labouring under disease, if allowed to stagnate, are very injurious to life ; whilst certain animal and vegetable decompositions, from which few of even cleanly houses are totally exempt, are depriving the limited atmosphere of its oxygen, and adding to its deleterious gases. Nature, ever vigilant for the preservation of her offspring, is unceasingly endeavouring to remedy these sources of disease and decay, by pouring in through every aperture a supply of fresh air to replace that which is becoming effete or deleterious. This is effected by means of the greater coldness, condensation, and consequently superior gravity of the external air, compared with that within the dwelling, — a superiority which for obvious reasons is much more decided in the colder than the warmer regions of the earth. In these last, however, the deficiency is amply compensated by a freedom of ventilation which establishes almost a community of atmospheric temperature and mobility without and within a dwelling. This extreme of perflation is, however, totally inadmissible in cold climates; but in England the gradual change of the column of atmosphere which is perpetually taking place by the introduction of cold air from the exterior through the small apertures left by the best-adjusted doors and windows, whilst a current of heated air is forced up the chimney, is sufficient to preserve the families of the comfortable and the opulent in good health in their spacious dwellings during winter; whilst in summer a more liberal system of ventilation is perfectly consistent with warmth and comfort. In the crowded dwellings of the poor, however, situated often in narrow lanes and alleys where the external air is frequently heated and confined, the supply through accidental apertures is inadequate to the preservation of health ; and hence in ordinary seasons the deficient supply of pure air is one of the many causes which deteriorate the health and vigour of the poor, whilst during the prevalence of epidemics the same cause is instrumental both in the production and diffusion of pestilence.

Whilst we admit that the houses of the respectable classes of the community of this country furnish sufficient security to their inhabitants against any evils arising from defective ventilation, we must acknowledge that the mode adopted of warming them is not the best calculated to impart that uniform temperature and exemption from partial currents which are most conducive to health. As Dr. Arnott happily expresses it, "in England the apartments, with their open chimneys, may be compared to great aerial funnels, constantly pouring out their warm air through a large opening, and constantly requiring to be replenished ; and where, from the irregularity of the supply or of the discharge, the temperature is constantly fluctuating." (Elements of Physics, vol. i. p. 387.) The blazing and cheerful fire has, however, such charms for Englishmen, and good fuel is so abundant in this island, that we see little chance of the sea-coal fire, with its unequal temperature but very free ventilation, being supplanted by the uniform and economical, but certainly close warmth of the stove.

[The subject of warming and ventilating houses and especially large establishments — legislative halls, hospitals, penitentiaries, &c., has recently received great attention. Nothing, indeed, has been more defective than the plan usually adopted in our dwelling-houses of leaving the halls and bed-rooms at a freezing temperature, whilst the parlours are comfortably and perhaps inordinately warmed. The strong individual may not suffer from this ; but to the invalid it is a monstrous evil. They who have lived for a time in St. Petersburg actually suffer less during the winter than they do in England or this country, because all the arrangements adopted there are to guard them against cold. Sir George Lefevre, who spent a long time in the Russian metropolis, in a small work which he has published, urges upon his countrymen the necessity (and his remarks are also applicable to us,) of a greater attention to the preservation of warmth and the protection against cold. Speaking of the peasants dwelling in Russia, he says (*Thermal Comfort*, Amer. edit. New York, 1844, p. 15) : "A log hut, made of entire trees, the corners dovetailed into each other, the spaces between the bulks filled up with moss or oakum (caulked) ; no breath of air can penetrate the room, for its boundaries present no crevices. His door shuts close, his window frames are double, two feet by three, the glass or oiled part fixed in. In the corner of his room is a stove, whose chimney finds exit through the roof, no wide space open to allow of heat to ascend, and cause a continual draft of air. His hut is insupportable to those who are unaccustomed to such indoor temperature. The flies, congregated in some corner, hang down like a swarm of bees, happy and buzzing in *the winter season*. He himself lies prostrate on his stone, which serves him for a bedstead. This man is a rare subject for consumption. Still, I repeat, it is not the man who resists the cold. It is the man's clothing ; it is the prevention he makes against the cold. Herein lies the proof. Remove him from his sphere of life, put him in livery, let him remain for hours behind a carriage in the winter season ; let him imprudently traverse the courtyards without his hat, and with no clothing beyond what he wears in the warm halls, and then what awaits him ? Pleurisy, dropsy, slow death!" And he adds : "Ascending higher in the scale, how does the man in easy circumstances sustain the cold ? By opposing to it its fell antagonist *warmth*, — not himself; he knows better. You enter his chamber—"How warm your rooms are, Ivan Ivanowitch." "Slava Bogu Gospadin" — *Heat breaks no bones*. You dare not, as in England, enter his parlour with a great-coat upon your back. That would be a woful offence,—a reflection upon him,—as much as to say, "You have economized your fuel ; you have not heated your stoves." Such conduct would be an absolute misdemeanour. On quitting his rooms, he does not leave warmth behind him. He conveys

it about with him, close confined, in a fur pelisse, whose non-conducting qualities will neither suffer animal heat to escape from within, nor cold to penetrate from without. These precautions are not regulated by whim or pleasure. They are peremptory."

The following remarks of the same writer are worthy of marked attention. "The introduction of double windows is certainly one of the most essential points towards securing an equable temperature in chambers. It constitutes a desideratum in English houses, but as it can be effected only in few instances, and as double windows must be the portion of the affluent, so I would simply suggest that the *single* windows in all houses should be made *air-tight*, and that the casements should not rock, as many of them do. This, particularly with respect to the bed-room windows, for that is the frugality of an English house. The windows in the bed-room of an invalid should be made air-tight by good carpenters' work, but where old casements rattle, they should be made steady by a nail or two driven into the sides of the sash, and then paper should be pasted or glued all around, so as to prevent any wind from coming in at the sides. The sash must be provided with a little door, which may be opened at pleasure,—when the room is arranged in the morning,—but not left open too long, so as to reduce the temperature too low. Here, I am well aware, I have to contend with the strong and general national prejudices of a cleanly people. There is 'nothing like fresh air.' If the room have a close smell, the windows are opened until the apartment gets down to the freezing point, and much below it, and then it 'smells wholesome.' That is true; but still it is death to tender lungs, and many a soul is sent to its long home by the currents of air in an English house. The expression of natives may be bandied about, for there is truth in them. 'Your rooms have a close, musty, sickly smell," says the English traveller in St. Petersburg. 'On est toujours dans un air coulant,' said a lady to me who had passed two years in London and Edinburgh.

"The *juste milieu*, so difficult to be accomplished in the political world, may be found in the physical; and as foreigners in Russia do not sacrifice all their old habits, but blend them with those of the natives, so I think the same may be done in England with very great advantage; and in this respect attention to the window-frames is of the first importance. The Russian rooms are provided with stoves, but these are not necessary. A well-built fire-place, which throws the heat into the room, and allows only the smoke to go up the chimney,—not one of the old-fashioned sort, which takes in half of one side of the dining-room,—but a well-constructed, well-fitted grate, is quite sufficient to keep the apartment warm, provided that the doors and windows be air-tight; but there must be no rattling of casements, no gust of wind from under the doors to make the carpet dance, or adieu to *comfort*. This English word, so little understood by foreigners, is not even so by ourselves, as regards either the construction of our houses or the mode of heating them. In cold weather, fires should be kept up day and night. The secret consists in *keeping the enemy out of the house*. If he enter, it is difficult to turn him back. By well-regulated fires, Russian stoves may be dispensed with. The air is more pure, too, in rooms where there are grates; and if the room and windows be tight, there will be no draft of consequence. The room which requires the most attention, and which is always the most neglected, is the *ante-room* or *hall*, or *long passage*, or that space into which the *street-door* opens. There a warm stove is imperative. Who is not acquainted with the sound of the instantaneous, spasmodic, choking cough, which seizes the invalid in his transit from the warm parlour through the cold hall and up the chilly staircase. This is a cruel experiment for tender lungs,—an antidote to all the good which medicine can effect. Here is the comfort of a day destroyed in a few seconds, and a night of cough and uneasiness ensues which might be avoided. It is in this respect, that Russian houses are so preferable. The *hall* is the warmest of all the apartments, for it is the most heated, in order to defy the admission of the greatest cold. How is this to be accomplished in English houses? It is not easy to alter their construction. A stove will, however, warm the ante-room; and it might be so constructed as to allow of a long chimney, which could be carried along the wall and up the staircase. The wealthy only can accomplish these comforts, but by so doing they may remain more securely at home than by seeking warmth under Italian skies. No houses are so ill-constructed for invalids as the English. The Scotch flats are infinitely preferable, and will allow more easily of all these improvements; but the inhabitant of an English house has to descend to the drawing-room, to the parlour, whence, again, to the former; thence, perhaps, mounting two flights of cold stairs, to the bed-room. Health may brook the varieties of temperature to which these operations expose us, but very delicate beings cannot, and the patient may fall a sacrifice."

In this country many of the houses are warmed by means of heated air, and in this manner an equable temperature may be preserved in the different apartments. Care must be taken, however, that proper ventilation be effected.]

In public institutions, the crowded state of which renders the means adopted in private dwellings inadequate to their perfect ventilation, various plans are employed for securing to their inmates a sufficient supply of air, the nature of certain of which we shall endeavour to make the reader acquainted with.

The ventilator invented by Dr. Hales has enjoyed as high a reputation as any apparatus of this sort. It consists of a square box of any size: in the middle of one side of this box a broad partition or midriff is fixed by hinges, and it moves up and down by means of an iron rod attached at a proper distance to the other end of the midriff, and passing through a small hole in the cover of the box. Two boxes of this kind may be employed at once, and the two iron rods may be fixed to a lever moving on a fixed centre, so that, by the alternate raising and pressing down of the lever, the midriffs are also alternately raised and depressed, by which these double bellows are

at the same time both drawing in air and pouring it out through apertures with valves made on the same side with, and placed both above and below, the hinges of the midriffs. These valves are eight in number in each box, and are so constructed that certain of them open inward to admit the air to enter, whilst others allow the air to pass outward. The air enters through the valves numbered 1, 3, 6, 8, and escapes through valves 2, 4, 5, 7. Before these last valves there is fixed to the ventilator a box as a common receptacle for all the air which is discharged through them, which air passes off by a trunk through the wall of the building.

By this apparatus the old prison at Newgate, where it was worked by a small wind-mill at the top of the building, was rendered much more healthy than it had been for years. The ventilators were placed there by a worthy magistrate in 1752 after the fatal occurrence, with which our readers are well acquainted, arising from the dirty and ill-ventilated condition of the jail. The ventilator is recommended by Dr. Hales as a means of preserving pure the holds of vessels, particularly those of ships of war and transports, for the accomplishment of which object he deems the common wind-sail, from their crowded state, often inadequate; mines, barracks, hospitals, &c.; but for a full account of the instrument and the purposes to which it may be applied we beg to refer the reader to the author's "Description of the Ventilators, 8vo. London, 1743."

The structure of the wind-sail is very simple. It is made of canvass, and is in the form of a cylinder or obtuse ending cone, and is adapted to the size of the ship. Four breadths of canvass are sewed together, and the outer salvages are joined with an inch seam, leaving one cloth four feet short of the top. A three-inch tabling goes round the top and bottom. It is kept distended by circular hoops made of ash, sewed to the inside, one at top, and one at every interval of six feet. The upper part or top is covered with canvass, and a small rope sewed round the edge; into which are spliced, at the quarters, the ends of two pieces of rope, that are sewed up to the middle, and an eye is formed by "seizing the bights." The length of a wind-sail is taken nine feet above the deck to three or four below the lower hatchway.

These, of which there are generally three or four in our first-rate ships of war, have the advantage of taking little room, of requiring no labour in working, and are of a simple construction, so that they can fail in no hands; but they cannot be put up in hard gales of wind, and are of no use in dead calms, when the air most requires renewal. [An excellent article on the ventilation of ships is contained in the recent valuable work of Dr. D. B. Reid: (*Illustrations of the Theory and Practice of Ventilation, with remarks on warming, exclusive lighting, and the communication of sound*, p. 348, London, 1844.) See also Dr. Ure, *Recent Improvements in Arts, Manufactures, and Mines*, p. 258. Lond. 1844.]

It would be tedious to describe all the contrivances which various individuals have adapted to buildings to secure to their inmates an adequate supply of fresh air. We believe that the most successful attempts of this sort are those founded on what may be justly termed the great principle of ventilation, rarefaction of the internal air by the agency of heat. Apartments, though considerably crowded, in which a fire is kept constantly burning, require no means of ventilation but apertures properly situated, either designedly formed in the walls, or afforded by windows and doors. Rooms in which this perpetual consumption of fuel is inadmissible, may be made to communicate with a fire or stove wherever situated within the building; and the mode of accomplishing this, suggested by Dr. Hawthorne, seems well calculated for the attainment of the object in view.

This gentleman suggests that in an hospital, the common kitchen, with a fire constantly burning in it, should be, as is usual, on the ground floor. A tube of from six to twelve inches in diameter, for the purpose of admitting a sufficient supply of pure air to every apartment, opening without, and at that side of the building from which the purest air is likely to be obtained, should pass through some place so contiguous to the fire, that the air which it conveys might be heated from 60 to 100 of Fahrenheit, according to the magnitude of the building which it is designed to heat. The tube thus heated, passing along and ascending, should send off a communicating branch to every apartment in the building. Each of these communicating branches being again subdivided into three smaller tubes, should open into one end of each apartment, about a foot from the floor—one in each corner, and the third in the middle.

"A second tube, of the same dimensions, for the purpose of admitting pure air in the warm summer season, opening in like manner outside the building, should unite with the former tube, at a proper distance from the fire, and before it gives off the first communicating branch. An air-tight sliding valve should be placed in each of these, at some distance from their point of union. These valves are to be used for the purpose of cutting off all communication with the cold air in winter and the hot in summer. This part of the tube should be made of earthenware, or some such inoxydizable substance. It is not very important, however, of what material it be constructed, provided it be perfectly air-tight; as no metal which might answer the purpose, at any of the degrees of temperature pointed out, is likely to be acted upon so as to produce any disagreeable smell, or to be oxydized so as to decompose or at all deteriorate the air which may pass through it. The air might be heated equally well by causing it to pass through a tube kept constantly surrounded with hot water. As this plan, however, would be attended with some additional labour, and as it does not seem to possess any decided advantage over the other, I prefer the former."

The following are the means to be employed for causing air to circulate through the apartments, and for carrying it off after it has been vitiated:—

"Two tubes, from six to twelve inches in diameter, according to the size of the apartment, should open, one about three feet from the floor, the other at the ceiling; and both tubes exactly in the middle of the end of each apartment opposite to that at which the heating tubes entered.

These tubes should terminate in one common trunk, extending from the upper to the under floor of the building.

"This trunk, after arriving at the under floor of the building, and extending a few feet horizontally, should pass in an ascending direction up through the fire; and then rise perpendicularly, to discharge its contents either into the funnel, or at the top of the building.

"The beds of the patients should be arranged along the middle of the wards, in a direct line between the heating and ventilating tubes, and not along the side-walls, as is generally the case. A wire-net screen, of a close texture, placed about four or six inches from the wall, rising from the floor four feet high, and closed in at the top, should extend across all that end of the ward out of which the heating tubes open, so that the currents may be spread equally over every part of the ward." (A New Mode of Ventilating Hospitals, Ships, Prisons, &c., by G. Hawthorne, M. D., p. 39 et seq.)

[The progress of ventilation received a great impulse from the appointment of a committee of the House of Commons on Acoustics and Ventilation, in the year 1835. Numerous parliamentary documents, connected not only with the houses of parliament, but with other public buildings, with private dwellings, and with mines, ships, and manufactories were the result of this impulse. "It constitutes," says Dr. Reid, (*Op. cit.* preface ix.) "one of the most important items to which the attention of the Health of Town's Commission is directed. The various statistical and sanitary reports that have been issued from the Home Office, and from the Medical Departments of the Army and of the Navy, under the direction of Sir James M'Grigor and Sir William Burnett, add much interesting information on the same question. And if we look to the medical profession generally, the observations of Sir James Clark on consumption, and on the sanative influence of climate, the remarks of Dr. Combe, Dr. James Johnson, Dr. Forbes, Dr. Southwood Smith, and numerous others, and the ingenious suggestions and improvements introduced by Dr. Arnott, all show how poorly the necessity of improved ventilation is appreciated, more especially since Tredgold had the merit of placing this subject in a more consistent position than it had ever previously presented."

The work of Dr. Reid is the most valuable treatise on the subject of ventilation that has ever appeared, and must be consulted by all who desire to be scientifically acquainted with the subject.]

We do not profess in this article to have detailed every plan that might be devised for supplying with pure air every form of building to whatsoever purpose appropriated. The particular means must have reference to the plan of the building and the number of its inmates; but the principle once understood, much difficulty will not be experienced in its application to individual cases.

JOSEPH BROWN.

WAKEFULNESS, ἀγρυπνία, [*Agrypnia,*] *pervigilium, insomnia.*—Interrupted sleep is but a symptom of disease, yet it is one of the most important of symptoms, and, in chronic diseases, it requires as much attention as interrupted breathing and interrupted pulse do in acute; in short, there is no more important subject in symptomatology.

In sound sleep, the function of the mind is thought to be suspended; the organs of sense, and the muscles by which voluntary motion is carried on, are nearly inactive; while those functions which depend upon the involuntary muscles, such as respiration, the circulation of the blood, digestion, secretion and absorption, are carried on without interruption. In unsound sleep the reasoning powers are not always suspended: some individuals will answer when spoken to, and will show that they have an apprehension, although it may not be perfect, of the subject propounded to them; many walk and talk in their sleep, and even administer to their wants, change from an uneasy to an easy posture without waking, and express discomfort or gratification. We knew an individual who took snuff during sleep, and who, when his snuff-box was removed from under his pillow, where he kept it, after betraying dissatisfaction, invariably awoke. There have been instances in which the intellect has been successfully employed during sleep, in which problems have been solved, or verses composed, which the sleeper was able to reduce to writing when he awoke. Some have imagined that the mind is never altogether inactive,—an opinion which we have no intention of discussing, but which appears to derive support from the following considerations, viz., that when we are roused from incipient sleep, we can generally recollect a train of incoherent thought which had occupied the mind; that when roused from sound sleep, we have a recollection of the mind having been engaged, even when the subject which engaged it has left no trace behind; and lastly, that a sort of displeasure, similar to that which is caused by unseasonable interruption, is felt whenever sleep is broken.

In order that sleep may refresh the wearied body and exhausted mind,—may exercise a restorative influence over the functions of life, certain conditions are requisite: 1st, that it should take place at a stated hour; 2d, that it should continue for a certain period of time; 3d, that the position of the body should be easy; and 4th, that the vital and natural functions should be undisturbed. Who has not experienced that sleep, when obtained at an unusual hour, so far from being uniformly refreshing, often leaves the body torpid, and the mind in a state of languor; and that when our usual portion of sleep during the night is abridged, we are frequently good for nothing next day? It is well known to those who have been obliged to travel in the night, how very uncomfortable the feelings are upon first awaking from sleep which may have overtaken them in a carriage, in a cramped position of body, and with cold feet. Moreover, every one knows that sound sleep is incompatible with increased action of the heart and arteries, heat of surface, oppressed respiration, and disturbed digestion. In order, therefore, to secure refreshing sleep, we ought to retire every night at the same hour, having, during the day, spent a reasonable portion of time in the open air, in active but not violent exercise, the

food and drink being suited to the powers of the stomach, the chamber being airy and dry, and neither hot nor cold, free air and quiet being ensured, and light excluded; and, lastly, the garments which were worn during the day being taken off, the bed being of uniform firmness, but not hard, and the bed-clothes light, but sufficient to maintain proper warmth.

The amount of sleep necessary to preserve health varies according to the state of the body and the habits of the individual. Infants pass much the greater portion of their time in sleep; children sleep twelve or fourteen hours; the schoolboy generally ten; in youth a third part of the twenty-four hours is spent in sleep; while in advanced age many do not spend more than four, five or six hours in sleep. We have known individuals idly consume one-half of their life in sleep, while other individuals, on the contrary, have not slept more than a sixth part of it, both being apparently in good health. As there are many persons whose bowels are not moved more than once in three or four days, and yet who are without any symptom of indigestion, so four or five hours sleep may be sufficient for the exigencies of many; and were a physician, in either case, to endeavour to alter the habit of his patient, he would probably rather injure than improve the health. Our observations on wakefulness are meant to apply to that state only in which it is a symptom of disease, which it always is when an individual who has been accustomed to pass seven or eight hours in sleep is reduced to two or three.

Disease or uneasiness of any kind often causes a sort of unsound sleep, in which all consciousness of existence is not destroyed. For hours, it is true, the clock is not heard, nor the watchman's rattle, nor the sentry's challenge, and yet the individual affirms that he has not slept one minute during the livelong night. We are convinced that they who are said not to have slept for weeks or months, pass a considerable portion of time in this unsound sleep, which, however unsatisfactory, in a measure strengthens the body and prevents the utter destruction of the mind.

Wakefulness may be symptomatic of either acute or chronic disease, and under this simple division we mean to consider the subject.

I. The acute diseases of which wakefulness is symptomatic are chiefly the various forms of fever, inflammatory disorders, and some cerebral diseases.

Wakefulness is symptomatic of the early stage of those fevers in which the brain and nervous system are principally affected; but it is still more so of gastric and enteric fevers. The latter are productive of much more of this kind of distress than the former, inasmuch as, in the former, stupor and insensibility often occur at an early period of illness, and take the place of wakefulness; while, in the latter, wakefulness is often unmitigated during the course of a prolonged disease.

In fevers, both continued and eruptive, there is a combination of uneasy symptoms, which render the night wakeful, as dryness and heat of the skin, thirst, an unpleasant taste, and depression of mind.

In eruptive fevers, wakefulness is chiefly produced by heat, itching, and tingling of the skin, and does not altogether subside till the eruption is completed.

In the phlegmasiæ, wakefulness is the consequence of pain in the inflamed organ, together with uneasiness caused by those symptoms of general fever, especially heat of skin, thirst, &c., which the local disease gives rise to.

In acute diseases, agrypnia requires great variety of treatment. In fevers in which in the earlier stages the brain is much affected, wakefulness will often be relieved by those means which relieve vascular congestion in that organ, and consequent headache; as, for example, general or topical bleeding, shaving and sponging the head. It is perhaps not generally known that headache in the beginning of fever, and wakefulness concurring with it, will resist cold, and yield to warm applications. In the intense headache to which we allude, if a warm or rather tepid embrocation is found to soothe the patient, it ought to be continued for an hour or two, and be repeated when headache with pervigilium returns. The efficacy of a blister to the nucha, in relieving the headache with which fever begins, is well understood. Long-continued fomentation of the inferior extremities, and immersion of the hands in tepid water, will often, by equalizing the circulation and relaxing the skin, relieve headache and dispose to sleep, especially if employed at the usual hour of going to bed.

One of the most effectual remedies for the wakefulness which is so distressing a symptom of fever with evening exacerbations, is the tepid shower-bath. When taken late in the evening, especially in the earlier stages of the disease, the surface of the body will be softened by thus reducing its temperature, and the state of the patient will be rendered comparatively easy. We may be permitted to extend an observation which we formerly made, viz., that when a patient in affluence is attacked with fever, various provisions, not always attended to, ought to be made by his physician for abating the sufferings, especially those arising from sleeplessness, which necessarily accompany that disease. If two adjoining bed-chambers can be obtained, we would have the patient removed from the one to the other morning and evening. If this arrangement is unattainable, two beds ought to be placed in the largest and most airy bed-chamber in the house, or in the back drawing-room. A shower-bath ought to be brought into the dressing-room, and the sick-nurse ought never to be left in the sole charge of the patient. For a good many years the writer of this article was attending or consulting physician to a number of his professional brethren, in a city in which fever is a prevalent disease; and whenever a physician, surgeon, or even a medical student contracted fever, there was found no difficulty in obtaining, for the night, the willing aid of a medical friend or companion to assist the sick-nurse in removing the patient from one bed to another; to ensure personal cleanliness and comfort; statedly, as the disease advanced, to inspect the back and hips; to keep off pressure from a surface threatened with ulceration and gangrene, by changing the position of the body; to administer an enema; to attend to the condition of the bladder, with a view to the introduction of a catheter; to exhibit or to

withdraw wine, cordials, or nourishment; to oversee the preparation of drinks; to promote sleep by fomentations or the application of a foot-warmer on the one hand, or on the other by the removal of a blanket, or by sponging part of the surface with cold water or with an aromatic embrocation. Very simple expedients, when judiciously employed, will often soothe and gratify a restless patient, and inspire confidence. Even the letting down of the sash, or shutting it up, will, by change of temperature, shortly be followed by tranquillity and sleep. We recollect having heard the late Dr. Monro say, "When attending cases of fever along with Cullen, I have told him, 'You may have the pen, Doctor, if you will give me the window,' which he agreed to, provided it was kept shut while he was in the chamber with the patient, for he had a great dread of a current of cold air." So much importance did Dr. Monro attach to complete ventilation and properly regulated temperature, as a means not merely of preventing restlessness, but of promoting recovery.

In the more advanced stages of petechial fever, in which the sensorium is much affected, a very obstinate and dangerous form of pervigilium occurs as a symptom of maniacal delirium, and sometimes terminates in fatal convulsions. In this form of pervigilium, we apprehend the treatment ought to resemble that which is applicable to delirium tremens, viz., spirituous embrocations to the shaved head, and opium in accumulating doses, with or without mercurial purgatives.

Opium, as usually administered in the wakefulness which accompanies genuine mania, is of more than questionable utility. This variety of wakefulness admits of relief from blistering the nucha, cold applications to the head, and a combination of camphor, nitre, and James's powder in free doses; and sometimes from leeches and blisters to the head itself. When sleep is forced by the use of opium, without these preparatives, in the early period of mania, the paroxysm is generally aggravated when the patient awakes.

The fever with which paroxysms of mania often begin, is of a mixed inflammatory and nervous kind, being characterized by heat of surface, flushed face, red glancing wild eyes, furred tongue, heavy breath, anorexia, great thirst, red and scanty urine, rapid full pulse, in addition to the violent rambling delirium and wakefulness which more generally belong to the disease. All these febrile symptoms, however, subside after a variable period of time, the skin becoming cool, the pulse quiet, the tongue clean, the urine clear and pale, the appetite natural, and the patient presenting the usual signs of health with the exception of a deranged mind, which persists with little interruption until the end of the attack. When opium was prescribed by our judicious friend, Dr. Adair Crawford, while he was in charge of the Richmond Lunatic Asylum, Dublin, during the febrile stage of mania, either in small or large doses, with a view of quieting the excessive cerebral excitement and procuring rest, it always failed, and sometimes aggravated the delirium. It became evident, therefore, if benefit was to be derived from opium, that this could be expected only in the second stage, when there is no increased vascular action, and the maniacal delirium depends chiefly on cerebral irritation of a nervous character. No decided advantage even in this stage was obtained from opium, when given at night only, how large soever the dose. Then the plan of repeated doses throughout the day was tried, commencing with a grain every four hours, and gradually increasing or lessening the dose according to the effect produced. Dr. Crawford soon observed that very large doses of opium could be taken without making the slightest impression on the delirium, and without any apparent effect on the system. Eight, ten, or twelve grains were taken in the twenty-four hours, without affecting the state of the appetite, condition of the tongue, regularity of the bowels, or disturbing the circulation. It seemed as if the cerebral excitement protected the constitution from the ordinary influences of the remedy. By persevering in the use of cautiously graduated doses of opium in every case, the delirium was sooner or later overcome. The patient first appeared drowsy, and then became calm and rational. In some cases he suffered for a day or two from nausea, thirst, constipation, and vertigo, and the other usual effects of opium, which however soon disappeared. It is remarkable that the remission of delirium thus obtained was not merely temporary; in several cases the relief was permanent, and the patient left the hospital cured. In some the delirium returned after a remission of several days, but was again subdued by opium, and the paroxysm of mania was ultimately cut short. The quantity of opium borne was proportionate to the violence of the delirium; the largest dose to which the remedy was carried, was sixteen grains in twenty-four hours. It is remarkable, that while there was a great tolerancy of opium in the second stage of mania, there is an equally great tolerancy of tartar-emetic in the first or febrile stage; and there is no more simple and effectual means of subduing the febrile action than by full doses of the latter remedy.

Some of the observations applied to the treatment of pervigilium in fevers apply to the treatment of that symptom in the exanthemata. The great restlessness which attends scarlatina, and which arises from itching or from a tingling sensation of the skin and gastric irritation, may be alleviated by an affusion of tepid water over the whole of the body, which is also very useful in moderating pyrexia in the early part of that disorder. In the small-pox, during the first five days, sleep will best be promoted by venesection, purgatives, cool rather than cold air, and cooling drinks, the best of which is the potus tartari in copious libations, a remedy earnestly recommended in the eruptive stage of small-pox by an able predecessor of the writer of this article, the late Dr. Harvey, physician-general to the forces in Ireland. In the second day after the eruption has begun, opium will be found the best remedy for sleeplessness.

For wakefulness as accompanying measles, we must seek relief chiefly from the tepid bath. We ascertained that the frequent application (two or three times a day) of the tepid bath was the chief remedy employed when the measles prevailed, some years ago, in the Foundling Hospital, Dublin, and when, to the best of our recollection, all

the children recovered. If a slipper-bath cannot be obtained, a hip-bath, or even a pediluvium, may be substituted. When infants are thrown into a violent paroxysm of fear by being plunged into a bath, the body may be wrapped in a cradle-blanket, wrung from warm water, and changed every four or five minutes. During this process, the child will often fall into a sound and refreshing sleep.

Wakefulness, as occurring during the phlegmasiæ, will in general yield only to antiphlogistic treatment; if it should continue after the inflammation is subdued, opium will almost always restore sleep.

Long after acute diseases, especially fevers, have terminated, there are instances in which the patient continues sleepless, and does not regain strength. We have reason to think that this state generally arises from irritation of the mucous membrane of the alimentary canal. Even when appetite for food returns, assimilation must be imperfect, as the patient continues to emaciate. Ripe fruits, milk, farinacea, changes of scene, exercise in the open air, and in due time travelling and voyaging, together with that best of cordials, hope of recovery, will remove this description of wakefulness, provided there be no incurable organic disease.

II. We have now to consider wakefulness as a symptom of chronic diseases — as belonging to a declining state of health; and we may here be permitted to observe, that, when it is considered how much the performance of the most important duties of life depends upon the vigour of mind and body which is derived from sound sleep, it would seem wonderful that so little attention has been bestowed on that subject.

An intimation of a wakeful night may often be discovered in the evening, by that overpowering sense of restlessness which is vulgarly called "the fidgets," technically dysphoria, which consists in irritability, dissatisfaction, and a sense of fulness in the extremities, as if they were injected with stagnant blood; uneasiness is felt both in the hands and feet, sometimes running in the course of the ulnar and sciatic nerves. This state leads to an expectation of relief from any change of posture, and the sufferer is constantly throwing his arms and legs from one position into another; but the relief thus obtained is of the most transient kind. The cincture of the clothes feels almost intolerable; and hence, instead of getting up and pacing through the room, or walking in the open air for half an hour, ease is in general unwisely sought for by going to bed before the usual time; after obtaining a short slumber, all the uneasy feelings return, to which are added a pungent heat, with tension and dryness of the skin, some uneasiness of the stomach, and a copious secretion of urine, which, by irritating the bladder, calls the sufferer frequently out of bed. This state often continues for many hours, nor does it subside before two or three o'clock in the morning; after which, the surface of the body becomes perspirable, and a few hours of heavy sleep are obtained, which, however, leaves the frame languid and relaxed, and unequal to encounter the exertions of the day.

Agrypnia often occurs as one of the most troublesome symptoms of anomalous gout and anomalous hysteria. Hence, when it occurs in males advancing in life, and in the upper classes, such an inquiry must be instituted as will detect the gouty diathesis, if it exist. If we discover that the patient has a birth-right to gout; if he is liable to vertigo, irregularity of the pulse, cramps in the inferior extremities, occurring especially after midnight; and there be dyspepsia, marked by sudden failure of appetite at or before meals, nausea, or rather a sense of sinking at the stomach, cardialgia, acidity or flatulence, deep-seated ophthalmia, hæmoptoe, in which the blood is more of a venous than arterial complexion, or spontaneous gonorrhœa; then we may consider agrypnia as symptomatic of irregular gout. In like manner, if any of the symptoms of anomalous hysteria should occur, we may conjecture that agrypnia is one of its symptoms.

Agrypnia is symptomatic of that affection belonging to advancing age, first introduced to public notice by Sir H. Halford, under the title of *climacteric* disease. There is a similar affection of declining life, in which, however, the appetite, so far from being impaired, is keen, at the same time that there is urgent thirst, which remits at certain periods of the day, and in which there is an increased flow of urine, which also has remissions. In this affection there are so many symptoms of the climacteric disease, — for instance, the quick pulse, emaciation, and dryness of the skin, change of expression, confined bowels, and a disposition to œdema, — that probably it is but a variety of that disorder. At present we allude to this latter affection, which has also many things in common with diabetes, chiefly on account of the agrypnia, which is one of its most distressing symptoms.

Probably, however, the simplest way of considering wakefulness in connection with chronic diseases, is not to refer to these diseases seriatim, but rather to direct our attention to the uneasinesses which pertain to them, whether of the digestive organs, nervous system, skin, or of the mind, upon which that symptom more immediately depends.

1st. Impatience of temper, bursting through the restraints of affection or politeness; oppression of the breathing; palpitation of the heart; fidgets, are as certainly symptoms of indigestion, as flatulent distension, acidity, heart-burn, or sickness. Nay, there is another set of symptoms, by which sleep is disturbed, considered as purely nervous, which are also the result of indigestion,—namely, despondency without any mental cause, angina, oppressed breathing from the nostrils becoming dry and stuffed, and cramps, which we have known to take place uniformly when malt liquor or wine was taken during the day, and not when such stimuli were laid aside. Profluvium urinæ equally depends upon indigestion. If we are told that these are all nervous symptoms, we would admit that they occur in persons of a nervous diathesis, but at the same time we would maintain that their proximate cause will be found in a disordered state of the stomach, &c.

Let us inquire into one of the symptoms just alluded to, very subversive of sleep, which is generally considered as purely nervous—an excessive secretion of pale urine. The urine in an hysteric

patient may sometimes be reduced to a third part of the quantity usually passed in the night, by a judicious change in the patient's diet even for one day, or by medicine given at bed-time, by which the action of the stomach is invigorated, and the secerning functions of the alimentary canal improved. There is another fact to which we may allude, which bears upon this point. When the appetite is craving, and more food is taken than is needful, instead of passing off by the bowels in larger or more frequent stools, constipation is sometimes produced, and the kidney assumes increased activity, so that urine passes off by quarts instead of pints.

In order to obviate wakefulness from dyspepsia, we must look to the condition of the kidney: it will be found that the nervous dyspeptic will generally pass his nights well or the contrary, according as the flow of urine is moderate or excessive; and that, by attending to the state of that excretion, the physician will be better able to regulate the diet of such patients so as materially to improve their sleep: it will be found that those articles of food will digest the easiest, and prove most nutritious, which are least provocative of urine.

When agrypnia is supposed to proceed from indigestion, the points to be ascertained before we can hope to relieve that symptom, are, 1st, Whether indigestion is maintained merely by diurnal imprudence with respect to the quality, or by excess in the quantity of the ingesta. 2dly, The organ primitively affected, whether the stomach, liver, or intestines. 3dly, The stage of dyspepsia. 4thly, Whether the dyspepsia, when traceable to the floating viscera, is of a nervous or inflammatory kind. To the wakeful from dyspepsia, the benefits are very great which arise from strong food, tonics, and stimulants, aided by change of residence, and relaxation from care, when once the acute stage of dyspepsia is subdued. (See Dr. Johnson's valuable work.)

Distension of the bowels from flatulence will often interrupt sleep. But this and other consequences of indigestion, arising from a mixture of incompatible articles of food, will generally be corrected when the sufferer discovers that there is more enjoyment in digestion unattended with disturbance of body and mind and calm refreshing sleep, than in gratification of the palate.

Those who are wakeful from indigestion ought to be taught to experiment upon their food: they may thus discover that some unsuspected article of their accustomed ingesta, such as a draught of cold water at bed-time, malt liquor, wine, or mixed spirits, at or after dinner, tea, often the cause of fidgets, or coffee in the evening—something, in short, which agrees perfectly well with nineteen stomachs out of twenty, may disagree with theirs, and require to be given up. Some require the stomach to be nearly empty when they lay themselves down to sleep; others sleep best when there is food to be digested. We have known some who were obliged to have food by their bedside, to take in the night when their sleep was interrupted, otherwise they would have remained awake. We have an impression that many persons who are wakeful might, under the direction of their physician, form a rule of diet, by adhering to which they might sleep soundly, instead of passing their nights in sleepless disquietude.

When those who have been accustomed to sleep equally well on either side of the body, find that their sleep when on one side is disturbed, a physician ought to be consulted, as this may be a symptom of commencing disease in the heart or liver. Dyspeptics generally find the right side most favourable to quiet rest. Heartburn, preventing sleep, will sometimes subside upon turning from the left to the right side.

2dly. As regards the condition of the skin,—itching, which is the most troublesome symptom of many affections of the skin, characterized by scales, papulæ, pustules, &c., is an inveterate enemy to sleep. But as these diseases and their appropriate treatment are ably described in this work, we will pass them by, and limit our observations to certain other uneasy sensations; as, for example, excess or defect of heat, tingling, smarting, pins and needles, fidgets, &c.

We attended a lady, who attained her eighty-fifth year, who was unable to sleep when her feet were warm; when they were covered even in the depth of winter with more than a sheet, her rest was broken, which was the only exception to the rule we have ever known, that cold extremities prove unfriendly to sleep. Many a delicate female, from going to bed with cold feet, is deprived of hours of sleep in the early part of the night, and thereby falls into nervous complaints, obstinate dyspepsia, and uterine irregularity, who might have escaped, had the circulation of the surface of the body been properly sustained by the tepid bath or semicupium, frictions of the extremities, and the use of Merino, Angola, or Shetland stockings, or of a very soft pillow placed within the sheets for the feet to rest upon, and proper covering.

We often discover that rest is broken by tingling heat of the extremities, fugitive pains, which would seem to be seated very superficially, probably in the skin, and by fidgets already described. These are often merely symptoms of indigestion, and may be prevented by attention to diet. They may often be removed by magnesia and ammonia in some of the distilled waters, or perhaps camphor julep; or by half a bottle of soda water added to twenty-five or thirty grains of the carbonate of soda. But much discomfort may also be obviated by exposing the person to cool air, or, according to the advice of Franklin, by a change from one bed to another, the bed occasionally slept in being as little like the bed generally slept in as possible, having sheets of different texture, with some difference in the warmth of the bed-clothes. When the fidgets affect the upper extremities, we have known instant relief obtained from the immersion of the hands and arms in water; when the lower extremities are attacked, the passing of a sponge, squeezed after it has been dipped in water, and damp rather than wet, rapidly over the lower extremities, in these cases will be found even more efficacious than Dr. Franklin's air-bath. Those who are delicate and susceptible of cold may have, in their dressing-room, a supply of tepid water whereby a foot-bath may be obtained, by means of which the action of the skin may be altered more effectually and safely.

3dly. In various ways is wakefulness produced by disturbance or over-activity of the mind. Exhausted by the fatigues and cares of the day, the eyelids will often be sealed by solicitude; but as, by most men of the middle ranks in these countries, the game of life is played for an excessive stake, so when sleep is casually broken, the mind is too anxious to admit of its being restored—self-reproach, carking care, or blighted hope, will destroy all that composedness upon which rest so much depends—a promise imprudently given, a debt thoughtlessly contracted, suretyship, reputation threatened, conscience wounded, will render a pillow of down hard and uneasy.

When sleeplessness arises from over-activity of the mind, the faculty generally in exercise is the imagination. When this is the case, an endeavour must be made to change the current of thought. But if our endeavour to introduce new and less exciting subjects of thought should fail, we ought to procure a light and a book suited to the occasion. Sometimes the best procedure is to present to an excited imagination some work of fiction so agreeable as to divert the mind from its engrossing object; and this, when accomplished, may be followed up by a change to a graver or duller narration.

While the condition of the mind with respect to sleep is before us, we would beg to add that sensitive persons ought to avoid every occasion of excitement for some time before going to bed. In fine weather, a walk in a garden at eventide, and such a course of meditation as may lead to a quiet mind, will be an excellent preparative for repose. Beddoes, when alluding to the importance of the frame of mind in which we close our eyes, observes, "that the chapter on this subject which is commonly to be found in books of practical piety ought to be transferred to those of medicine."

If every other means of courting a return of sleep should fail, it will be better to get up and dress, and engage in reading, writing, or some other appropriate occupation for an hour or two, than to have recourse to the usual alternative of an opiate. This ought ever to be the last resource of the wakeful, and when taken, it ought not to exceed six or eight drops of the Lancaster black-drop, or as many minims of Battley's liquor in some camphor julep; or instead of this draught, an eighth or a sixth part of a grain of the acetate, or what is preferable, the muriate of morphia.

To conclude, wakeful persons are recommended to pay more attention to the construction of their bed, which ought to be ample. An elastic mattress ought to be laid over a well-stuffed bed, so as to ensure an equable surface and a slight elevation under the shoulders. The head and foot-boards ought to be well padded, the padding of the former deepest below. The sheets ought not to be too fine; the counterpane ought to be laid aside; and on no account must blankets, which have been frequently washed, be retained.

J. Cheyne.

WATERS, MINERAL.—The epithet *mineral* is applied to all waters which contain a sufficient quantity of foreign matter in solution to affect the taste or smell, or which differ from the common spring or river water of the country in which they occur by a difference in their temperature.

Heat being one of the most remarkable circumstances by which one spring is distinguished from another, seems first to have attracted the attention of mankind; accordingly it is to *hot waters* that we find the earliest allusion in ancient writers. The Greeks, who possessed various hot springs, considered them as presents from a divinity, and they were all dedicated to Hercules. Hippocrates mentions hot springs, which, in his opinion, were impregnated with copper, silver, gold, sulphur, bitumen, nitre; and forbids them to be used for the common purposes of drink.

Waters containing various saline substances in solution, occur in such abundance in almost every part of the world that they must have soon drawn the attention of mankind. Accordingly we find them mentioned and even celebrated for their cures at a very early period. Aristotle attempts an explanation of their nature, and Strabo notices a mineral water, which, he assures us, possessed the property of dissolving urinary calculi, and of causing the evacuation of gravel when it was lodged in the kidney or bladder. The ancients even distinguished the different kinds of mineral waters, and applied to them different names. Thus Pliny mentions an *acidulated* water in Macedonia, which, he assures us, possessed intoxicating properties. (Lyncestis aqua, quæ vocatur *acidula*, vini modo temulentos facit: lib. ii. c. 103.) This was obviously a water impregnated with carbonic acid gas. Horace celebrates the waters of Baiæ, (Epist. lib. i. Epist. 15, line 7,) which are still much resorted to and well known under the name of *sulphureous*, being impregnated with sulphuretted hydrogen gas. The *ferruginous* and *saline* waters were equally distinguished by the ancients, and celebrated for the cures which they performed; and different mineral waters both in Italy and France, which still remain unchanged, were frequented by them; as for example, Barège, Aix, Mont d'Or, and probably Bath.

It has been already observed that the Greeks and Romans were in the habit of consecrating the various mineral springs which they frequented to a divinity. This introduced priests and a ritual, which was observed in making use of the waters; and the priests had address enough to persuade their votaries that the various cures produced by the waters were the result, not of the medicinal properties of the waters, but of the immediate action of the divinity under whose protection they were. This circumstance occasioned an universal desertion of mineral waters as soon as the inhabitants of the Roman empire became Christians, the use of them being considered as a kind of acknowledgment of the power and authority of the heathen divinities.

This neglect, or rather abhorrence, of mineral waters continued till the reign of Charlemagne in the ninth century. This prince was so delighted with the mineral waters of Aix-la-Chapelle, that he constructed a large basin as a bath for himself and his family, and was in the habit of holding his levees there. This naturally drew the attention of the French to mineral waters in general;

but the death of this great prince, and the subsequent division of his vast dominions among his descendants, again plunged the south of Europe into ignorance and barbarism. From the term *Akemanceastre*, (*city of afflicted men*,) applied to Bath by the Saxons, it is probable that about the same time it was resorted to by the inhabitants of England, though it did not come into high repute as a watering-place till the reign of Charles the Second.

It was towards the end of the fifteeth century that *mineral waters* began to recover their ancient celebrity; and it was in Italy, at that time the great centre of science and literature, where the revival of their reputation commenced. In the year 1498, Savonarola of Padua published a work on baths, and upon all the hot mineral waters of Italy. In 1596, (or about a century later,) Baccius, likewise an Italian physician, gave to the world a treatise on the most celebrated hot springs in France. In England various attempts were made to analyze mineral waters, and to point out the diseases which they were capable of curing, as early as the reign of Charles II. or even earlier. Thus we have Dr. Jones *On the Virtues of Buxton Water*, printed in 1572; and Simpson's *Chemical Anatomy of the Scarborough and other Spaws in Yorkshire*, published in 1669. But we are not aware of any attempt to describe the English mineral waters in general till Allen published his "Natural History of the Mineral Waters of Great Britain," in the year 1711. It was he that first detected the presence of gypsum in mineral waters. The labours of Dr. Shaw and Dr. Short succeeded after an interval of some years; and Dr. Rutty's Methodical Synopsis of Mineral Waters, which appeared in the year 1757, was an excellent book at the time of its publication. Indeed, we are not aware of much addition to the history or analyses of Irish mineral waters since that period, distant as it is.

In Germany, Tabernæmontanus, one of the most eminent botanists of his time, and physician to the Elector Palatine, enumerates, towards the end of the sixteenth century, various mineral waters, among others the Seltzer. (*Bergmann*, Opusc. 1. 69.)

Perhaps the first person who attempted to determine the constituents of mineral waters was Dominic Duclos, who, in the fourth volume of the Memoirs of the French Academy of Sciences, inserted two dissertations on the subject. In the first, he gives an account of the methods employed by him to determine the constituents of the different mineral waters; and in the second, the result of a set of experiments made by the members of the French Academy during the years 1670 and 1671, to determine the compositions of sixty-eight different kinds of mineral waters from various places of France. *Common salt* and *carbonate of soda* (which Duclos calls the *nitre* of the ancients) were detected in many mineral waters; but *alum* and *green vitriol*, he says, they met with in none of those that they examined. Different species of nitre and common salt were distinguished; but from the little progress at that time made in the knowledge of salts, nothing very satisfactory could be expected. The acidulous waters were particularly noted and distinguished by the name of *vinous*; though nothing was made out respecting the nature of the substance to which this quality was due. It must be admitted, however, that the experiments related in these papers do great credit both to the industry and sagacity of Duclos and his associates in the Academy. If they did not succeed in determining the true constituents, they went fully as far as the infant state of chemistry permitted them.

About the year 1680, as we are informed by Bergmann, Urban Hjerne made an attempt to analyse the mineral waters of Sweden by no means contemptible. He seems to have attended chiefly to the gaseous or volatile ingredients of mineral waters, and neglected what remained after distilling off the water as a sediment of no consequence. He divided mineral waters into three classes, namely, *acid*, *vinous*, and those that contained an *occult* acid. His analyses were continued and made public at different intervals down to the year 1685.

In the year 1684 Mr. Boyle published his *Natural History of Mineral Waters*. It consists merely of a set of observations pointing out the best way of determining the constituents of mineral waters, with hints respecting the nature of these constituents, and animadversions upon the methods employed commonly at that time to detect them. But we find no analysis of any particular mineral water, nor any classifications of them such as had been attempted by Duclos and Hjerne. Boyle first employed the sulpho-hydrate of ammonia as a re-agent in the analysis of mineral waters.

Various re-agents were introduced by different chemists as means of detecting the presence of different constituents of mineral waters. Thus Boulduc proposed the use of lime-water and of sugar of lead; Burlet, the solution of alum, litmus paper, and the tincture of roses. In 1707 Geoffroi substituted open glass evaporating dishes for the glass alembics previously employed in the evaporation of mineral waters; and in 1726 Boulduc pointed out a method of precipitating several of the saline contents of mineral waters by concentrating them to a certain point, and then mixing them with alcohol. This method was afterwards practised by Lavoisier in his analysis of the waters of the Dead Sea.

The different saline constituents of mineral waters were detected successively. Sulphate of magnesia was known as a constituent of the spring at Epsom as early at least as the year 1610; but its nature was not understood till after the publication of Dr. Black's celebrated essay on lime and magnesia in 1755. Before that time Epsom salt was usually called *nitre*, or *calcareous nitre*, when it was met with in mineral waters. The chloride of magnesium was first discovered in waters by Margraaff in 1759. The chloride of calcium had been detected in 1752, by Le Roy, in the springs of Balaruc. (Mem. Paris, 1752, p. 630.) The discovery of carbonic acid gas, and the property which water has of imbibing it, and of thus becoming acid and brisk like cider or champagne, which were pointed out by Cavendish and Priestley soon after 1765, was a great step towards the analysis of mineral waters, because it accounted for the peculiar properties of acidulous waters, and explained why lime and

oxide of iron held in solution by certain waters disappeared when these waters were heated, or even left exposed to the air.

Bergmann's dissertation on the *Method of Analysing Mineral Waters*, published in 1778, together with his analysis of various cold mineral waters, of sea-water, &c. and his essay on the method of preparing artificial hot mineral waters, constitutes an important era in the history of the investigation of important springs. In that dissertation he gives a list of all the different salts which occur in such waters; he analysed these salts, determined the proportion of their constituents, and pointed out the method of detecting their presence and determining their quantity. In this country, Mr. Kirwan's work on mineral waters was not without its utility, though his methods were too complicated to be followed by practical chemists, or to lead to the requisite precision. Dr. Murray, of Edinburgh, was occupied during the last years of his life in analysing various mineral waters, and he gave a general formula for the analysis of mineral waters of every species. This formula has been condemned by Dr. Marcet, (who distinguished himself by the number of analyses of mineral waters which he made, and by the accuracy with which his analyses were conducted,) as likely to mislead. It is certainly possible that Murray's formula may sometimes lead us to false conclusions; yet it is the rule which has always in some measure regulated chemists in their analyses, and by which their conclusions have been determined. The formula or rule of Dr. Murray, in fact, reduces itself to this:—determine all the acids and all the bases which exist in a mineral water: these acids in the water are each combined to saturation with a base. Now, in Dr. Murray's opinion these combinations were such that the salts formed are always as soluble as possible. Suppose we find in a mineral water—

Sulphuric acid	5·
Muriatic acid	4·625
Lime	3·5
Soda	4·

If we evaporate this water to dryness, and redissolve the residue in a little water, we shall find that common salt will be dissolved while sulphate of lime remains in the state of a white powder. According to Dr. Murray the mineral water did not contain sulphate of lime and common salt, but sulphate of soda and chloride of calcium. During the evaporation a double decomposition took place, and the two new salts were formed. Now this opinion of Dr. Murray is probably not always correct; but it is undoubtedly frequently so, as is obvious from no deposit of sulphate of lime falling when the water is concentrated beyond the point of crystallization of that salt.

Dr. Saunders's work on mineral waters is a book of considerable value, especially in a medical point of view. The analyses in the second edition of that work were chiefly by Dr. Marcet, and greatly superior in point of precision to those contained in the first edition. Dr. Monro's list of mineral waters in the second volume of his *Medical Chemistry* is much more complete than that of Dr. Saunders, but his analyses are necessarily much less accurate, as they were made before 1788, the date of the publication. Dr. Scudamore's book on mineral waters, published in 1822, is very valuable and accurate so far as it goes; but we do not consider it as necessary to notice, in this historical sketch, all the latter labourers in this fertile field. We shall state their experiments when we come to treat of the particular mineral waters to which their attention was directed.

Our object in this article is to consider mineral waters in a medicinal point of view. Now, as medicines, these waters may act either as simple water, or in consequence of an augmentation of temperature, or from some foreign ingredient or ingredients which they may contain. We shall therefore divide this article into five sections. We shall in the first place make a few very brief remarks on water in general, and then treat of mineral waters, distinguished, in consequence of the most remarkable substances which they hold in solution, into *saline*, *chalybeate*, *sulphureous*, *acidulous*, and *tepid* or *hot*. These are the usual subdivisions of mineral waters; and though not very precise, they will sufficiently answer our present purpose. We must premise, however, that we have no intention of attempting a description of all the mineral waters which have been noticed in Great Britain, far less on the Continent. The British and Irish mineral waters noticed by Rutty and Monro, exceed one hundred. Those in France are not fewer than eighty; while Germany is richer in these medicinal springs than either Britain or France. There are many in Italy, Spain, Greece, Turkey, Sweden, Russia, and Switzerland. Even a cursory notice of the whole would form a large work; and the information gained by such a universal enumeration of all the mineral springs on the face of the earth, even if it were possible, would not repay the labour of a perusal; because many of them bear a striking resemblance to each other in their saline contents, and of course their medicinal virtues are similar. Hence the observations made upon one will, in general, apply to the whole of a class. We shall, therefore, satisfy ourselves with a few remarks on the general characters of each class, and an enumeration of the constituents of the most remarkable waters belonging to it in Great Britain or on the continent.

We will, however, premise a few observations on common or simple water.

Water is a transparent, colourless liquid, destitute of smell, and having but little taste. It boils when heated to 212° under the mean pressure of the atmosphere, and freezes into ice when cooled down to 32°. A cubic inch of water at the temperature of 60°, when weighed in air by brass weights, weighs almost exactly 252½ grains. Under the mean temperature and pressure, it is about 810¾ times heavier than the same volume of atmospherical air. It is a compound of eight parts (by weight) of oxygen, and one part of hydrogen, or of one volume of oxygen gas and two volumes of hydrogen gas.

Water, whether in ponds, rivers, or wells, always contains a quantity of atmospherical air. Now, common air is a mixture of four volumes of azotic gas and one volume of oxygen gas. One hundred cubic inches of water under the mean pressure of the atmosphere absorb 3·7 cubic inches

of oxygen gas, and 2·5 cubic inches of azotic gas; and this absorbability is not altered by varying the density of these gases. In air the density of azotic gas is 4-5ths of what it would be if no oxygen gas were present, while the density of oxygen gas in air is only 1-5th of what it would be if the azotic gas were absent. Hence 100 cubic inches of water, left a sufficient time exposed to the air, will contain

	Cubic inches.
4-5ths of 2·5 cubic inches =	2 of azote.
1-5th of 3·7 cubic inches =	0·74 oxygen.
	2·74

Whoever will take the trouble of examining the water of lakes or rivers, will find that every 100 cubic inches of it contains 2·74 cubic inches of air composed as above stated, which is very nearly

Azotic gas	73
Oxygen gas	27
	100

Thus the air contained in water is somewhat purer, or contains a greater proportion of oxygen gas than atmospherical air. But this rule does not hold good when the water is stagnant, or when it is impregnated with vegetable or animal matter. For example, the water of the Thames at London contains so little oxygen gas, that phosphuretted hydrogen gas may be left standing over it for twenty-four hours without losing its combustibility; while a very short exposure over the water of the Clyde destroys the spontaneous combustibility of this gas. It is to the presence of air that water is indebted for its agreeable flavour; for when boiled and thus deprived of its air, its taste is vapid and much less agreeable.

Well-water not unfrequently contains carbonic acid gas, which contributes still more to render water an agreeable beverage. When water contains the remains of animal or vegetable substances, it may contain azotic gas and carbonic acid gas without any trace of oxygen gas, because these substances combine with the oxygen gas, and of course abstract it. For the same reason oxygen gas is never present in water impregnated with sulphuretted hydrogen; though azotic gas is pretty generally found in such waters in small quantity. The reason obviously is, that the oxygen portion of the air contained in the water has combined with the sulphuretted hydrogen, while the azotic gas has remained unaltered. The existence of carbonate of iron in water is also incompatible with the presence of oxygen gas in it.

It is universally known that water constitutes a most important and essential part of the food of man, as well as of all animals and vegetables. Even of the solid food which we eat, water constitutes not less than four-fifths. It may be said, without any exaggeration, that nine-tenths of the whole of our food is nothing else than pure water. Such being the case, it is needless to remark that water must constitute a very important article of food, and that therefore the proper use of it is requisite for the maintenance of health.

There is another circumstance which may contribute to the value of water when taken into the stomach; and that is, the property which it has of diluting those articles which are of too stimulating a nature, and which, on that account, when taken by themselves, are apt to injure the tone of the stomach by urging it to over-exertion; for it is a well-known property of living bodies that all over-exertion, all undue action, is followed by a corresponding languor and debility. Many individuals are accustomed to indulge in too great a quantity of food, and in order to enable their stomachs to digest it, they mix it with wine or spirits, or some equally stimulating substances. These gradually exhaust the tone of the organ, and produce a state of languor, which must at last terminate in disease. Dilution with water corrects the stimulating property of these substances, and renders them comparatively innocent. Hence, a course of water-drinking to those who are accustomed to live high and indulge in wine or spirits, must frequently be attended with the most beneficial effects. [Guersent, art. *Eaux Minérales*, in *Dict. de Médecine*, xi. 35, Paris, 1835, and Osann, art. *Mineralquellen*, in *Encyclopäd. Wörterb. der Medicin. Wissenschaft.* xxiii. 499, Berlin, 1840; also, J. Bell, *On Baths and Mineral Waters*, Philad. 1831.]

I.—Of Saline Mineral Waters.

When a spring of water contains in solution a sufficient quantity of saline matter to alter its taste and physical qualities, and to render it unfit for the common purposes of life, it is called a *mineral water*. The salts thus held in solution are probably in most cases derived from the soil through which the water flows. In some cases there may be beds of certain salts, which are partially dissolved by the water while it passes over them. In this way the brine springs are formed by passing over beds of common salt. In the same way alkaline springs may owe their origin to beds of carbonated alkali, over which they flow.

The salts hitherto most commonly found in saline mineral waters, are the following :—

1. Chlorides of sodium, calcium, magnesium.
2. Sulphates of potash, soda, lime, magnesia, alumina.
3. Carbonates of potash, soda.
4. Bicarbonates of lime, magnesia, strontia.
5. Certain silicates.
6. Nitrates of potash, magnesia.
7. Acetate of potash.
8. Iodide of sodium.
9. Bromide of sodium.
10. Subphosphate of alumina.

The sulphate of potash, sulphate of alumina, carbonate of potash, the nitrates, the acetate of potash, the bromide of sodium, and the subphosphate of alumina are very rare, or at least exist in such minute quantities that it is impossible to detect their presence. The chloride of sodium, chloride of calcium, and chloride of magnesium are exceedingly abundant. The sulphate of soda and sulphate of lime are also very common in mineral waters; and the same remark applies to the carbonate of soda and the bicarbonate of lime and of magnesia.

The salts which exist most commonly and in greatest abundance in mineral waters possess purgative qualities. Hence it happens that saline waters are generally purgative. The salts which

they contain being usually diluted with a great quantity of water, act more mildly than purgatives generally do, and frequently remove indigestion, &c. without the debilitating consequences that sometimes follow the long-continued use of evacuant medicines.

In determining the nature of saline waters, the first step is to ascertain their specific gravity, their taste, and their smell, and to observe whether they be transparent and colourless, or muddy and coloured. The specific gravity of distilled water is 1·0000. That of river water rarely exceeds 1·0002 or 1·0003; but that of mineral waters is sometimes as high as 1·028, or even higher.

The next step is to determine the quantity of foreign matter which the water under examination contains. For this purpose, the best vessel that can be employed is a common eight-ounce phial. Balance a clean dry eight-ounce phial in a pair of scales, and mark its weight upon its surface with a diamond, then introduce it into 1000 grains of the mineral water. Place it in a sloping direction on a sand-bath, so that its mouth (which must be open) is a little more elevated than its bottom, to preclude the possibility of any being spilled. Then continue the heat of the sand-bath till the whole water is evaporated, and nothing remains but the saline residue, which must be exposed to a heat of about 500°, in order to drive off the whole of the water. The advantage of this method is, that if the water be made to boil during the evaporation, none of it is lost. The small drops, as they rise, strike the side of the phial and run down again. Nothing makes its escape but the portion of water which is really in the state of vapour. The phial being now weighed a second time when nearly cold, it is obvious that the excess of the weight above that of the empty clean phial must represent the weight of the saline residue from 1000 grains of the water.

The next step in the examination is to determine the nature of the saline constituents which it may contain. When the water is very strong, we may employ it in its natural state; but in general it requires to be concentrated before we subject it to examination. Indeed, the quantity of some of the ingredients is so small that their presence can scarcely be ascertained unless we concentrate the water. Thus the saline mineral water of Dumblane and of Airthrey, in Scotland, contains magnesia, but in such a minute proportion that we would search for it in vain, with the most sensible reagents, in its natural state. But if these waters be concentrated to the tenth part of their natural volume, and tested for magnesia (after being freed from lime), the presence of that substance becomes very evident.

1. Sulphuric acid is detected by mixing with a little of the water, put into a watch-glass, a drop or two of the solution of chloride of barium. A white heavy powder precipitates, which is not re-dissolved by the addition of nitric or muriatic acids.

2. If the white precipitate by chloride of barium were re-dissolved by nitric or muriatic acid, it would indicate the presence of phosphoric acid in the water.

3. When nitrate of silver throws down a white precipitate in heavy flocks, which are re-dissolved by the addition of ammonia, the presence of chlorine or muriatic acid is indicated. Iodine and bromine would also occasion a precipitate with nitrate of silver, but differing somewhat in the shade of colour.

It is, however, a very rare thing to find iodine or bromine in a mineral water in such quantity as would cause a precipitate with nitrate of silver.

4. To determine whether a water contains nitric acid, reduce it by concentration to one-tenth of its natural volume. Introduce the concentrated water into a flask, with a piece of gold leaf, while a little sulphuric acid is introduced at the same time. Heat the flask: if nitric acid be present, the water will gradually dissolve some of the gold, and acquire a yellow colour; but if no nitric acid be present, no gold will dissolve, and the liquid will continue colourless.*

5. When a mineral water has an acidulous taste, and when it loses that taste by boiling, we may in general conclude that it contains carbonic acid gas. When paper stained blue by litmus is dipped into a water containing uncombined carbonic acid, it is reddened, but recovers its original blue colour on exposure to the air.

The best method of determining the quantity of carbonic acid gas in a mineral water containing it, is to put a given weight of the water (2000 grains, for example) into a retort with a long beak. Into a receiver sufficiently secured from all contact with the external air, put a solution of chloride of calcium or chloride of barium, mixed with a certain quantity of caustic ammonia. Plunge the beak of the retort into this solution; then heat the liquid contained in it, and keep it for some time at the temperature of about 180°. When gas ceases to come over, raise the liquid in the retort to a boiling temperature, and boil it briskly for a quarter of an hour; then suddenly withdraw the beak from the liquid in the receiver, to prevent any of that liquid from making its way into the retort, which would happen were the heat withdrawn before the beak of the retort was freed from the liquid. Close the receiver with its contents, and set it aside. The carbonic acid which passes over unites to the lime or barytes in the liquid contained in the receiver, and the carbonate thus formed precipitates in the form of a white powder. When this powder has subsided, draw off the clear liquid with a syphon, and then fill up the receiver as at first with distilled water which has been recently boiled, and cork it up as at first. When the carbonate of lime or barytes has subsided, draw off the clear liquid again with a syphon. Repeat this washing till nothing remains but the carbonate; then collect it on a filter, dry it, and expose it to an incipient red heat, and weigh it. If the powder be carbonate of lime, the carbonic acid which it contains amounts to 11-25ths or 0.44 of the weight. If it be carbonate of barytes, the carbonic acid amounts to 11-49ths or 0.224 of the weight. Many other methods have been practised; but we have found the preceding on the whole the simplest and easiest.

* Should the water happen to contain no chlorine or muriatic acid, which, however, is a very rare occurrence it will be necessary, in applying this test, to dissolve a little common salt in the water.

To convert a given weight of carbonic acid into volume, is attended with no difficulty. The specific gravity of carbonic acid gas is 1·5277, that of air being reckoned 1. Now, at the temperature of 60°, and when the barometer stands at 30 inches, 100 cubic inches of dry air weigh 31·1446 grains; hence 100 cubic inches of carbonic acid gas, at the same temperature, and under the same pressure, weigh 47·4691 grains, or one cubic inch weighs 0·474691 grains. Therefore, if the weight of carbonic acid found be a, we have 0·474691 : a : : 1 : $\frac{a}{0.474691}$ = the number of cubic inches of carbonic acid found in the quantity of water examined.

6. Acetic acid, when it happens to be present in a mineral water, is best detected by the smell. but we must first get rid of the muriatic acid or chlorine, which might, by its greater abundance, overpower the smell of the acetic acid, and prevent us from perceiving it. The best method of proceeding is this : reduce a portion of the water in which you suspect the presence of acetic acid, to a tenth part of its volume, by evaporation at a low heat; then add a solution of sulphate of silver till all the chlorine is thrown down. Evaporate the liquid (after having filtered it) to the consistence of a syrup, and then mix it with alcohol. All the sulphates will be precipitated; but the acetate will be dissolved in the alcohol. Filter, introduce the alcoholic liquor into a retort, and distil off the alcohol (previously adding a little water, if necessary); then add sulphuric acid, change the receiver, and distil nearly to dryness. The presence of acetic acid in the liquid in the receiver will easily be perceived by the smell.

7. The presence of iodine in a mineral water is recognised by means of starch. Boil a little starch with water, so as to form a thin paste of the consistency of a syrup; mix a few drops of this with the liquid supposed to contain iodine; then pour over its surface (taking care not to mix) a little water impregnated with chlorine: cover the surface of the vessel with a lid, and set it aside. If iodine be present, we shall perceive within less than twenty-four hours a thin diaphragm of blue colour in the plane of contact of the mineral water and chlorine water.

8. The presence of bromine may be detected in a similar way. It has the property of giving an orange colour to starch instead of a blue. But we have never had an opportunity of trying the delicacy of this test. The common mode hitherto followed of detecting the presence of bromine in a mineral water, is to concentrate the liquid, and to mix it with some sulphuric acid and native black oxide of manganese, and distil. Bromine, if present, is indicated by the formation of red vapours.

Such are the methods by which the presence of the acids, or simple bodies which act the part of acids in mineral waters, may be ascertained. We shall now state the way of distinguishing the presence of the different bases.

9. The presence of strontian or barytes in a mineral water is incompatible with that of sulphuric acid. Hence their presence must be very rare, for very few mineral waters exist which contain no traces of that acid.

10. When oxalate of ammonia dropped into a mineral water occasions a white precipitate, or renders the liquid milky, the presence of lime is indicated. Should no precipitate appear on the addition of oxalate of ammonia, we must not at once conclude that the liquid contains no traces of lime. We must take a new portion of the water, and reduce it by gentle evaporation to one-tenth of its original bulk, and repeat the experiment again. It will often happen that oxalate of ammonia will give a precipitate with the concentrated liquid, though it had no sensible action on the water, in its original state. When this takes place, we may conclude that the water contains a salt of lime, though the quantity is but small. In some cases we have been obliged to reduce the water by evaporation to the hundredth part of its original volume, or even further, before the presence of lime became sensible to the test of oxalate of ammonia.

11. If a mineral water, after being boiled to expel any free carbonic acid which it may contain, be mixed with lime-water, and a white flaky precipitate fall, we may conclude that it contains a salt of magnesia. When we obtain such a precipitate, in order to make ourselves certain of the presence of magnesia, the best way is to reduce a quantity of the water by evaporation to one-tenth of its volume, to heat it, and then drop into it the quantity of oxalate of ammonia which from previous trials is known to be just sufficient to throw down the whole of the lime. Filter; and to a few drops of the clear liquid put upon a watch-glass, add a drop or two of solution of phosphate of ammonia and then a drop or two of carbonate of ammonia. If a precipitate immediately falls we may conclude that magnesia is present in some quantity; if there be no immediate precipitate, draw lines with a glass rod upon the bottom of the watch-glass. In two or three minutes (if any magnesia be present) these lines will become visible to the eye in consequence of the deposition of ammonia-phosphate of magnesia upon them. When no precipitate whatever appears, we may conclude that the waters contain no sensible quantity of magnesia.

12. When alumina is present in a mineral water, it is thrown down from the concentrated liquid by means of ammonia or carbonate of ammonia. But as ammonia throws down also oxide of iron, and may likewise throw down some magnesia, and as carbonate of ammonia will throw down lime, magnesia, oxide of iron, and barytes and strontian, this precipitation alone would not be sufficient to prove the existence of albumina in a mineral water. Collect the precipitate on a filter, wash it well with water, and then boil it in a solution of caustic potash in water for some time. Decant off the potash ley, saturate it with muriatic acid, and pour carbonate of ammonia into the saturated solution. If a precipitate fall, it is a proof that the mineral water contains alumina. The weight of this precipitate after ignition gives us the weight of alumina in the quantity of water which was subjected to examination.

13. We have now stated the mode of determining all the constituents of a saline mineral water, except the potash and soda. The way of proceeding with respect to these alkalies is this :—

precipitate the lime (if any) by means of oxalate of ammonia, and then, after filtration, evaporate the liquid to dryness, and expose the dry residue to a red heat. Re-dissolve the residue thus treated in water. If any chloride of magnesium was present, the magnesia of that salt will remain undissolved. The solution will contain the sulphates of potash and soda and magnesia (supposing them present), and the chlorides of potassium and sodium. The greatest part of the magnesia may be precipitated by carbonate of ammonia. If we have recourse to that method, we must filter the liquid, evaporate it to dryness, ignite the residue, and re-dissolve it in water. Mix this solution with a little chloride of platinum, and evaporate the solution till it is reduced to a small quantity. If the alkali present be potash, a precipitate will fall; if it be soda, there will be no deposit. Suppose a precipitate to appear, we must next ascertain whether soda may not be present as well as potash. For this purpose evaporate the liquid to dryness at a low temperature, and digest the residual salt in alcohol of the specific gravity 0.896. The chloro-platinate of potassium will remain undissolved; but the chloro-platinate of sodium will be dissolved by the alcohol. Evaporate the alcoholic solution to dryness, and expose the residual salt to ignition. The platinum will be reduced to the metallic state. Digest the residue in water; it will take up the chloride of sodium and leave the metallic platinum. Evaporate the solution: the salt obtained will be chloride of sodium, 8-15ths of which represent the weight of soda in the water, or the sodium (supposing it to have existed in that state) amounts to 2-5ths of the chloride obtained. In the same way may the potash be determined, the potassium being 10-19ths and the potash 12-19ths of the weight of the chloride of potassium obtained.

Such is the method of determining the nature of the constituents of saline waters, or the *qualitative analysis*, as it is called by modern chemists. The next process is to determine the weight of the different constituents in a given weight of the mineral water. There are various methods of accomplishing this, each of which has its advantages. A pretty common method is to concentrate the water to be analysed till it is reduced almost, but not quite, to dryness. The residual liquid, which has the consistency of a thick syrup, is now digested in alcohol of about the specific gravity 0·830, and the whole is thrown upon a filter, and after the alcoholic liquid has passed through, the saline matter remaining on the filter is to be washed repeatedly with alcohol, till that liquid passes through pure. By this process the chlorides of calcium, magnesium, and part of the chloride of sodium or potassium (if it be present) are dissolved, while all the sulphates are left upon the filter.

The alcoholic liquid is drawn off by distillation, and the dry residue is exposed to a strong red heat. The magnesia is by this process disengaged, and remains, while the alkaline chlorides and that of calcium are dissolved. The lime is thrown down by oxalate of ammonia. The precipitate, after being washed and dried, is ignited in a platinum crucible. What remains is carbonate of lime. The lime constitutes 0·56 of the weight of this carbonate. The liquid thus freed from lime and magnesia is to be evaporated to dryness and ignited. The salt remaining consists of chloride of sodium or chloride of potassium, or of a mixture of the two. These chlorides are to be separated from each other, and the quantity of each determined by the methods already explained.

Every 2·5 of magnesia is equivalent to 6 of chloride of magnesium, and every 3·5 of lime is equivalent to 7 of chloride of calcium; or if we multiply the magnesia by 2·4 and the lime by 2, the product will be the equivalent quantities of chlorides corresponding to the weight of each.

The objections to this method of separating the chlorides from the sulphates by means of alcohol are—1. that the whole alkaline chlorides are seldom or never dissolved by the alcohol; a portion remains among the sulphates, and requires a separate process to determine it. 2. If the mixed chlorides be exposed to too high a temperature, a portion of lime may be disengaged as well as the magnesia; while, if the temperature has been too slow, the whole of the magnesia may not be disengaged, but a portion may still remain in the state of chloride.

The sulphates remaining undissolved by the alcohol may consist of sulphates of lime, magnesia, and soda, and very rarely of sulphate of potash. They may be dissolved by digestion in about 450 times their weight of water. Heat the solution, and mix it with a sufficient quantity of oxalate of ammonia, to throw down the whole of the lime. Let the precipitate subside, draw off the clear liquid, and then wash the precipitate with distilled water. Collect it in a small platinum crucible, the weight of which has been previously ascertained: expose the oxalate of lime to the heat of a spirit-lamp, till the oxalic acid is destroyed. It is now carbonate of lime, every 6·25 grains of which is equivalent to 8·5 grains of anhydrous sulphate of lime. If we therefore multiply the weight of carbonate of lime obtained by 1·36, the product will give us the weight of sulphate of lime present in the saline mixture under examination; or we may add to the carbonate of lime in the crucible an excess of sulphuric acid, and after digesting till all effervescence is at an end, expose the crucible to a strong red heat to drive off the excess of acid. The lime is now in the state of sulphate, and has only to be weighed. For the sake of exactness, both of these methods of determining the quantity of sulphate of lime may be taken; the one will serve as a check on the other.

The magnesia may be precipitated from the residual solution by means of carbonate of ammonia, and after being well washed, may be exposed to a strong red heat. If we now determine its weight, and multiply that weight by three, the product will represent the anhydrous sulphate of magnesia present in the water.

The liquid thus freed from lime and magnesia is to be evaporated to dryness, and exposed to a heat sufficiently high to draw off the ammoniacal salts. It may be then dissolved in water, and after separating the clear liquid from the sediment, if there should be any, evaporate it to dryness, and expose the dry salt to a red heat. It will be sulphate of soda or sulphate of potash, or it may con-

sist of a mixture of the two. The proportion of each may be determined by the method formerly described.

The above method of proceeding may appear at first sight simpler and more precise than any other, because it enables us to separate the sulphates and chlorides, and to analyze each set separately. But we are by no means sure that we do not alter the nature of the salts held in solution in saline waters by our process of concentrating them. It not unfrequently happens that when we evaporate a given bulk of a mineral water to dryness, and then digest the saline residue in a quantity of distilled water equal in bulk to that originally present, we do not obtain a complete solution. A portion of sulphate of lime often continues undissolved, and requires for complete solution a considerably greater quantity of water than was originally present. In such cases it is clear that the lime in the original condition of the water was not in the state of sulphate, but combined with some other acid, while the sulphuric acid was also united to some other base. In the original water the lime was probably in the state of chloride of calcium, and the acid in that of sulphate of soda. By concentrating the liquid, the particles of each salt were brought nearer and nearer to those of the other, till at last they reached the distance at which they were capable of acting on each other. Double decomposition is then the consequence, sulphate of lime and chloride of sodium being formed.

Nor are we certain that no change is induced upon the salts contained in mineral waters by the action of the alcohol. It is not at all unlikely that the alcohol may have a tendency to hasten these kinds of decompositions, or to carry them to a greater extent than would otherwise take place.

These reasons lead to the inference that the salts contained in mineral waters may not in all cases be those which we extract from them. Nor have we any method at present of deciding by satisfactory experiment what the salts really are which constitute the saline constituents of mineral waters. We can do nothing more than determine the nature and quantity of the different acids and bases that exist in a water. If the salts present be neutral, it is clear that these acids and bases must naturally saturate each other; there can be no redundancy of the one and deficiency of the other. The simplest method of proceeding, therefore, seems to be to determine separately the weight of each acid and each base, and then to suppose them combined in the way most conformable to the known affinities of the acids and bases, or to the known properties of the water. Thus, if a water be eminently purgative, and if we extract from a certain quantity of it chlorine, sulphuric acid, sodium, and lime, it is much more likely from the purgative nature of the water, that these bodies are so combined in it as to produce sulphate of soda and chloride of calcium, both of which are eminently purgative salts, than that they constitute sulphate of lime and chloride of sodium, salts much less eminently purgative than the preceding, and one of which indeed is quite inert, or nearly so. The method which we are in the habit of following, while it is simpler and easier than the one just described, seems also to be equally accurate.

We take a certain quantity of the liquid, usually 1000 grains, and after reducing it by evaporation to about one-fourth of its original volume, the chlorine is thrown down by nitrate of silver. The chloride of silver, washed, dried, and fused, gives the quantity of chlorine in the 1000 grains of liquid; every 18.25 of chloride indicating 4.5 of chlorine; or we obtain the chlorine by dividing the weight of chloride by 4.055.

To the liquid thus freed from chlorine add a little common salt, to get rid of any excess of nitrate of silver that may have been added. Then throw down the sulphuric acid by chloride of barium. Wash, dry, and ignite the precipitate: it gives the quantity of sulphuric acid in 1000 grains of the liquid. Every 14.5 grains of sulphate of barytes indicates five grains of sulphuric acid. Therefore, if we divide the weight of the sulphate of barytes obtained by 2.9, the quotient will be the weight of sulphuric acid which it contains.

When the qualitative analysis has indicated the presence of nitric acid in the water, we may proceed in this way to determine its quantity. The chlorine from 1000 grains of the water is to be thrown down by means of sulphate of silver. The liquid freed from chlorine is to be evaporated to dryness, mixed with its own weight of sulphuric acid, and cautiously distilled in a small retort, taking care not to apply so much heat as to drive over any of the sulphuric acid. The liquid in the receiver will contain the whole nitric acid in the 1000 grains of the water. Saturate it exactly with barytes water, and then evaporate to dryness. The weight of nitrate of barytes thus obtained indicates the quantity of nitric acid; for 16·25 nitrate of barytes contain 6·75 nitric acid. Hence, if we divide the weight of the nitrate of barytes by 2·4071, the quotient will indicate the weight of nitric acid contained in 1000 grains of the mineral water.

The lime may be thrown down by oxalate of ammonia from another 1000 grains of the liquid previously concentrated and heated. The mode of determining the quantity of lime from the oxalate has been already stated. When that oxalate is heated to redness, it is converted into carbonate of lime, every 6·25 of which is equivalent to 3·5 of lime. If, therefore, we divide the quantity of carbonate of lime obtained by 1·7857, the quotient will be the quantity of pure lime contained in 1000 grains of the water.

The 1000 grains of concentrated water thus freed from lime may be used to obtain the magnesia also. Add to it a little phosphate of ammonia, and afterwards a few drops of carbonate of ammonia, and then evaporate till the liquid is reduced to a very small quantity. The magnesia is precipitated in the state of ammonia phosphate. Wash the precipitate with water, then dry it and expose it to ignition. The weight of biphosphate of magnesia thus obtained indicates the quantity of magnesia in 1000 grains of the water. Every 11·5 grains of the biphosphate contain 2·5 grains of magnesia. If, therefore, we divide the weight of the biphosphate of magnesia by 4·6, the quotient will be the quantity of magnesia contained in it.

Iodine and bromine are best estimated by converting them into iodide and bromide of silver. Let us suppose a mineral water to contain chlorine, iodine, and bromine all at once. To 1000 grains of it previously sufficiently concentrated, add nitrate of silver. The three chlorides precipitate together. Digest the precipitate in caustic ammonia, the chloride and bromide of silver will dissolve; but the iodide will remain unaltered. Wash it and dry it. Every 29·5 of it contain 15·75 of iodine. Hence, if we divide the weight of iodide of silver obtained by 1·873, the quotient will be the weight of iodine contained in 1000 grains of the water.

To the ammoniacal solution add nitric acid in slight excess. The bromide and chloride of silver precipitate. Wash this precipitate and put it into a phial with a ground stopper, containing water saturated with chlorine, and agitated frequently for twenty-four hours. Then add some sulphuric ether, and agitate again. When the phial is left at rest, the ether floats on the chlorine liquid, and speedily acquires an orange or reddish colour. This ether may be decanted off and a new portion added. To these ethers introduced into a retort add barytes water, and distil off the ether. Evaporate the residue to dryness. Ignite the dry matter remaining, and digest it in alcohol of the specific gravity 0·810. The bromide of barium alone dissolves. Evaporate to dryness, and weigh the bromide of barium remaining; every 18·5 of it contains 10 of bromine. If, therefore, we divide the weight of the bromide of barium obtained by 1·85, the quotient will give the quantity of bromine contained in 1000 grains of the mineral water.

The silica, which most waters contain, is easily obtained by evaporating a given weight of the water to dryness, and digesting the saline residue, first in a sufficient quantity of water, and afterwards in aqua regia. What remains undissolved is silica.

Such is a sketch of the method of analysing saline waters. The processes are not difficult; but they require either to be performed on a large scale, that is to say, with several gallons of water reduced by evaporation to a manageable quantity; or, if we employ smaller quantities, very great attention must be paid to precision, and the balance used must be capable of weighing with precision to the hundredth of a grain, even when loaded with the small platinum crucibles in which the sediments are contained.

[The SALINE APERIENT WATERS contain chiefly sulphate of soda, sulphate of magnesia, chloride of sodium, and chloride of magnesium, singly or associated. Most of these are cold springs—as those of Kissingen, Marienbad, Franzensbad, Cheltenham, Leamington, Harrowgate, and Scarborough; and, in this country, the White Sulphur, Salt Sulphur, and Red Sulphur, of Virginia.

THERMAL SALINE WATERS are found at Wiesbaden, and Baden-Baden in the neighbourhood of Wiesbaden. The Hot Springs and Warm Springs of Virginia contain but little saline impregnation. All these waters act as cathartics and diuretics; but they require to be taken with caution; for, if used too freely, they bring on fever with gastro-intestinal irritation, and a sense of fulness in the head. Their protracted use, too, may be of great advantage in diseases that require the employment of saline eutrophics.

The important ingredients in the ALKALINE WATERS are bicarbonate of soda and carbonic acid. Vichy is the most celebrated of these. It is thermal alkaline; and so are Mont-Dore, Ems, Töplitz, Schlangenbad, and Roisdorff. The alkaline springs of this country are cold. Those of Saratoga and Balston are the most celebrated.

The IODURETTED WATERS always contain a salt of iodine associated with chloride of sodium. The chief springs of this kind are those of Saratoga and Ballston, in this country; of Woodhall, near Ashby de la Zouch, in England; and of Creuznach, in Germany. The properties of these waters are, therefore, dependent upon the united influence of the iodine and the chloride of sodium; and their prolonged use is beneficial in scrofula, and in other cases in which the eutrophic agency of iodine, or of chloride of sodium, or of both, is indicated.]

We shall now take a view of the most remarkable saline waters in Great Britain and on the continent.

I. Cheltenham.

Cheltenham is situated in a sandy vale in Gloucestershire, surrounded by hills of a moderate height, in the midst of a fertile and well cultivated country. The mineral waters which it contains were first noticed about a century ago, and gradually attracted the attention of the public. At first only one scanty spring was known, *the old well*; but as the number of visitors increased, it became insufficient to supply them. This led to a farther search, in consequence of which three new wells were discovered in the immediate neighbourhood of the original spa. Between the years 1770 and 1780, the mineral waters of Cheltenham acquired so much reputation, that the town became a great place of resort for invalids from all parts of the kingdom. It was soon found that the wells could not supply the additional demand. In the year 1788 a new well was sunk by order of George III., known by the name of the *King's Well*. At first the supply from this well was very abundant, but it afterwards decreased so much that it was often drunk out by the company in half an hour.

In 1806, a gentleman of the name of Thompson, who had purchased a great part of the land in the vicinity of Cheltenham, determined to search for mineral water on his own estate, and to try to supply the deficiency so much complained of. The success which he met with soon induced him to think of turning his discovery to his own advantage; and accordingly a new pump-room was erected, and no exertions were spared till a sufficiency of water was obtained for the supply of whatever company might resort to the room and neighbourhood. Six different wells were discovered by him, to which he gave the following names:

1. Strong chalybeate saline water.
2. Strong sulphuretted saline water.
3. Weak sulphuretted saline water.
4. Pure saline water.
5. Bitter saline water.
6. Saline chalybeate.

But from the analyses of these waters by Dr.

Scudamore, it does not appear that these names are very appropriate.

There is another pump-room, situated between the old well and Thompson's Spa, called the Sherborne Spa. To it are attached four pumps, belonging to as many wells, which appear, from Dr. [Sir C.] Scudamore's observations, to correspond very closely with the analogous wells at Thompson's Spa. Thus the different wells at present at Cheltenham amount to fourteen. We shall now give the constituents of these different wells, so far as they have been determined by analysis.

1. *The Original Spa, or Old Well.*—The four springs belonging to this spa were analysed in 1820, by Dr. [Sir C.] Scudamore assisted by Mr. Garden. They were distinguished by the following names:—

1. Strong aerated chalybeate saline.
2. Strong sulphureous chalybeate.
3. Magnesian saline.
4. Pure saline.

The specific gravities of these waters were as follows:—

1. 1·0091. Taste mildly saline.
2. 1·0089. Taste saline and very slightly chalybeate.
3. 1·0083. Taste saline and chalybeate.
4. 1·0122. Taste strongly saline.

The saline constituents in an imperial gallon of each of these waters, according to the analysis of Dr. Scudamore, are as follows:—

No. 1.

Common salt	561·17 grs.
Chloride of calcium	59·89
Chloride of magnesium	24·49*
Sulphate of soda	140·41
	785·96

No. 2.

Common salt	217·95 grs.
Chloride of calcium	35·49
Chloride of magnesium	49·76
Sulphate of soda	504·57
	807·77

No. 3.

Chloride of sodium	169·73 grs.
Chloride of calcium	29·70
Chloride of magnesium	31·83
Sulphate of soda	416·62
	647·88

Oxide of iron, probably a grain in the gallon.

No. 4.

Chloride of sodium	460·98 grs.
Chloride of calcium	41·38
Chloride of magnesium	70·40
Sulphate of soda	570·92
	1143·68

Oxide of iron, a trace.

The wells belonging to Thompson's Spa were analysed by Messrs. Brande and Parkes in 1817; and the analysis was again repeated by Dr. [Sir C.] Scudamore and Mr. Garden in 1820. The results of these two analyses are so different as to occasion considerable surprise. If both be accurate, we must conclude that in the short space of three years these waters have totally altered their saline nature. This is so uncommon a circumstance in the history of mineral waters, that it is very desirable that a new analysis of these waters should be made, that we may be enabled to judge whether the alteration is still going on, or whether one or other of the experimenters has not fallen into mistakes with respect to the conclusions drawn regarding the saline constituents of these waters. The following table exhibits a view of both analyses:—

	1817.	1820.
No. 1. Sp. gr.	1·0092	1·0085
2.	1·0085	1·0065
3.	1·006	1·0067
4.	1·010	1·0077
5.	1·008	1·0065
6.	1·004	1·0098

It appears from this table that in three years the specific gravity of the first, second, fourth, and fifth of these springs has diminished considerably; while that of the sixth well, which is 126 feet in depth, has very much increased. All the other waters are from wells, but much less deep. No. 1 is 48 feet deep; Nos. 2 and 3 (the same well but at different depths) 48 feet; Nos. 4 and 5, each 50 feet. An accurate geological description of the strata through which these wells are sunk, might throw some light upon the alteration in the saline constituents of their waters.

No. 1.

1817.

Imperial gallon.

Common salt	398·30 grs.
Sulphate of soda	221·12
Sulphate of magnesia	57·86
Sulphate of lime	24·11
Carbonate of soda and iron	14·47
	715·86

Carbonic acid gas ..... 2·5 cubic inches.

1820.

Common salt	535·24 grs.
Chloride of calcium	31·92
Chloride of magnesium	20·45
Sulphate of soda	210·24
	797·85

Oxide of iron, a minute portion.

No. 2.

1817.

Common salt	337·54 grs.
Sulphate of soda	206·63
Sulphate of magnesia	48·22
Sulphate of lime	11·57
Oxide of iron	2·89
	606·85

Sulphuretted hydrogen gas 24·11 cub. in.
Carbonic acid ..... 14·46

* The chlorides are given by Dr. [Sir C.] Scudamore as muriates. Probably, therefore, the numbers may be in excess; but as no details of the analysis are given, we have not ventured to alter the original numbers of Dr. [Sir C.] Scudamore. The same observation applies to all the subsequent analyses of the same gentleman.

1820.

Common salt	247·85 grs.
Chloride of calcium	31·92
Chloride of magnesium	14·66
Sulphate of soda	209·85
	504·28

Oxide of iron, a minute portion.

No. 3.
1817.

Common salt	144·66 grs.
Sulphate of soda	135·02
Sulphate of magnesia	48·22
Sulphate of lime	14·47
Oxide of iron	4·82
	347·19

Sulphuretted hydrogen 24·11 cubic inches.
Carbonic acid .....14·46

1820.

Common salt	298·96 grs.
Chloride of calcium	17·74
Chloride of magnesium	19·77
Sulphate of soda	209·85
	546·32

Oxide of iron, a trace.

No. 4.
1817.

Common salt	482·20 grs.
Sulphate of soda	144·66
Sulphate of magnesia	106·08
Sulphate of lime	43·40
	776·34

1820.

Common salt	447·48 grs.
Chloride of calcium	29·61
Chloride of magnesium	19·48
Sulphate of soda	276·20
	772·78

No. 5.
1817.

Sulphate of magnesia	350·81 grs.
Chloride of magnesium	86·80
Common salt	91·62
Sulphate of lime	33·75
Oxide of iron	9·64
	572·62

1820.

Common salt	226·63
Chloride of calcium	47·35
Chloride of magnesium	34·81
Sulphate of soda	374·19
	682·98

No. 6.
1817.

Common salt	212·17 grs.
Sulphate of soda	96·44
Oxide of iron	14·47
	323·08

Carbonic acid .....96.44 cubic inches.

1820.

Common salt	734·39 grs.
Chloride of calcium	29·61
Chloride of magnesium	29·12
Sulphate of soda	112·06
	905·18

Oxide of iron, a minute portion.

Some of the differences in these two sets of analyses are owing to the different modes of estimating the nature of the salts; but there are others for which no such difference can account, and which serve to throw doubts upon the accuracy of the experiments. Thus, the saline constituents of No. 4, by both analyses, amount to nearly the same weight; yet there is a considerable difference in the specific gravity of the two liquids; that analysed by Brande was 1·01, while that analysed by Scudamore was only 1·0077. On the contrary, in No. 3 there is a great difference in the weight of the saline contents found by the two analists, yet the specific gravity of the water was nearly the same.

It is evident from the preceding analysis that the Cheltenham waters possess cathartic properties. The chief salts to which they are indebted for this effect are common salt and sulphate of soda. The first of these in a concentrated solution acts as an emetic; but when more diluted, it possesses the properties of a strong purgative. This is the well-known effect of sea-water when taken internally. The purgative qualities of sulphate of soda are universally known. The chlorides of calcium and of magnesium, which are also present in small quantities, are powerful purgatives, and when much diluted with water, as they are in the Cheltenham springs, they constitute a very excellent purgative. All these salts in the Cheltenham waters are very much diluted—a circumstance which greatly enhances their virtues by rendering them exceedingly mild, so that they may be persisted in for a length of time without bringing on debility. It is this diluted state that constitutes the chief excellency of saline mineral waters. They can only be imitated by administering a mixture of various purgative salts in a similar state of dilution. It will be found upon trial that when three or four purgative salts are mixed together and administered in a state of great dilution, they may be persisted in for a considerable time without inducing debility; whereas concentrated solutions of the same salts very speedily reduce the strength of the patients.

Cheltenham has been chiefly resorted to by those invalids who have resided long in hot climates, and who labour under a diseased liver. Such persons not unfrequently derive much benefit from a judicious use of Cheltenham water. The individuals who have been in the habit of carrying the pleasures of the table to excess, and whose stomachs are debilitated from being habitually overloaded, likewise derive much benefit from the use of these waters.

II. Leamington.

Leamington is situated about two miles east from Warwick, in a flat, but rich, beautiful, and highly cultivated country. Its name is derived from the Leam, a torpid stream, which passes through it. The existence of saline springs in this place was known to Cambden and Speed, who lived about the end of the sixteenth century: but it did not attract much notice till about the

year 1786. Since that period it has advanced with almost unexampled celerity, and is now a magnificent watering-place, scarcely inferior to Cheltenham itself. The wells, as at Cheltenham, are situated in the new red sandstone formation, in which, indeed, most of the saline springs in Great Britain take their rise. There are no fewer than eleven springs, all of them saline, but some of them containing, also, iron; and one or two of them slightly impregnated with sulphuretted hydrogen. The first analysis of these waters was made by Dr. Lambe in 1797. He published, in the fifth volume of the Manchester Memoirs, an account of the constituents of two of the springs, under the name of the water of the *old baths*, discovered in 1786, and of the *new baths*, discovered in 1790. Dr. [Sir C.] Scudamore, in 1820, published an analysis of eight of the springs; and in 1828, Dr. Loudon, in his *Practical Dissertation on the Waters of Leamington Spa*, gave the analysis of the whole eleven. The saline constituents of these waters were determined by Dr. Thomson of Glasgow, and the gaseous constituents by Dr. Louden himself, with the assistance of Mr. Gossage, chemist, of Leamington.

The following table exhibits the specific gravity of these various springs, as determined by Dr. [Sir C.] Scudamore in 1820, and Dr. Thomson in 1827.

	Scudamore.	*Thomson.*
Lord Aylesford's	1·0093	1·0098
Mr. Smith's	1·0085	1·01015
Mr. Wise's	1·010	1·01017
Mr. Robbins's	1·0118	1·00825
Mr. Reid's (sulphureous)		1·00736
Do. (saline)		1·00995
Imperial Fount (chalybeate,)	1·0067	1·01114
Do. (saline)	1·0054	1·00858
Do. (sulphureous)	1·011	1·00900
Pump-room (sulphureous)	1·0042	1·00144
Do. (saline)	1·0119	1·01223

It is obvious from these specific gravities that the water is liable to undergo changes in its strength at different times.

We shall now give the constituents in an imperial gallon of each of these waters as determined by the analyses of Dr. [Sir C.] Scudamore and Dr. Thomson. The differences between them are doubtless owing in part to differences in the strength of the waters at different times; though errors in the analysis may also have an effect in rendering the constituents more different than they otherwise would be.

1. Lord Aylesford's.

Scudamore.

	Imperial gallon.
Chloride of sodium	118·14 grs.
Chloride of calcium	272·35
Chloride of magnesium	50·34
Sulphate of soda	317·86
	758·69
Oxygen gas	0·6 cubic inches.
Azotic	4·296
Carbonic acid	16·830

Thomson.

Sulphate of soda	323·19 grs.
Chloride of sodium	326·16
Chloride of calcium	164·49
Chloride of magnesium	26·93
	840·77
Oxygen gas	0·6 cubic inches.
Azotic	4·296
Carbonic acid	16·830

2. Mr. Smith's.

Scudamore.

Chloride of sodium	219·88 grs.
Chloride of calcium	194·19
Chloride of magnesium	50·34
Sulphate of soda	271·57
	735·98

Thomson.

Sulphate of soda	321·87 grs.
Chloride of sodium	382·92
Chloride of calcium	158·18
Chloride of magnesium	16·97
	879·94
Oxygen gas	0·36 cubic inches.
Azotic	5·264
Carbonic acid	20·025
	25·649

3. Mr. Wise's.

Scudamore.

Chloride of sodium	292·21 grs.
Chloride of calcium	207·54
Chloride of magnesium	50·34
Sulphate of soda	322·50
	872·59

Thomson.

Sulphate of soda	315·66 grs.
Chloride of sodium	212·88
Chloride of calcium	149·90
Chloride of magnesium	180·74
	859·18
Oxygen gas	0·704 cubic inches.
Azotic	3·904
Carbonic acid	17·440
	22·048

4. Mr. Robbins's.

Scudamore.

Chloride of sodium	450·86 grs.
Chloride of calcium	165·88
Chloride of magnesium	
Sulphate of soda	300·85
	917·59

Thomson.

Sulphate of soda	228·95 grs.
Chloride of sodium	282·80
Chloride of calcium	188·09
Chloride of magnesium	67·75
	767·59
Oxygen gas	0·600 cubic inches.
Azotic	4·464
Carbonic acid	18·850
	23·914

5. Mr. Reid's (sulphureous.)

Thomson.

Sulphate of soda	264·52 grs.
Chloride of sodium	204·84
Chloride of calcium	126·22
Chloride of magnesium	77.56
	633·14
Oxygen gas	0.200* cubic inches.
Azotic gas	3·400
Carbonic acid	25·250
Sulphuretted hydrogen	9·152
	38·002

6. Mr. Reid's (saline).

Thomson.

Sulphate of soda	244·88 grs.
Chloride of sodium	343·38
Chloride of calcium	143·90
Chloride of magnesium	86·55
Silica	7·78
Peroxide of iron	2·12
	828·61
Oxygen gas	0·20 cubic inches.
Azotic	4·52
Carbonic acid	17·30
	22·02

Imperial Fount (chalybeate).

Scudamore.

Chloride of sodium	71·17
Chloride of calcium	88·72
Chloride of magnesium	30·19
Sulphate of soda	107·01
	297·09

Thomson.

Sulphate of soda	274·35
Chloride of sodium	442·17
Chloride of calcium	200·47
Chloride of magnesium	31·42
Silica	68·64
Peroxide of iron	68·64
	1085·69
Oxygen gas	0·60 cubic inches.
Azotic	5·16
Carbonic Acid	26·35
	32·11

8. Imperial Fount (saline).

Scudamore.

Chloride of sodium	89·97 grs.
Chloride of calcium	29·61
Chloride of magnesium	65·29
Sulphate of soda	79·47
Oxide of iron	1·00
	265·34

Thomson.

Sulphate of soda	275·48
Chloride of sodium	116·27
Chloride of calcium	140·56
Chloride of magnesium	208·40
	740·71
Oxygen gas	0·784 cubic inches.
Azotic	6·104
Carbonic acid	25·250
	32·138

9. Imperial Fount (sulphureous).

Scudamore.

Chloride of sodium	144·66 grs.
Chloride of calcium	76·77
Chloride of magnesium	31·82
Sulphate of soda	111·87
	365·12

Oxide of iron, a minute portion.

Thomson.

Sulphate of soda	248·90 grs.
Chloride of sodium	58·41
Chloride of calcium	314·44
Chloride of magnesium	155·95
Silica	28·96
Peroxide of iron	4·24†
	810·90
Oxygen gas	0·960‡ cubic inches.
Azotic	4·896
Carbonic acid	28·250
Sulphuretted hydrogen	9·136
	43·242

10. Pump-room, (sulphureous).

Scudamore.

Chloride of sodium	144·66 grs.
Chloride of calcium	76·77
Chloride of magnesium	31·82
Sulphate of soda	111·87
	365·12

Thomson.

Sulphate of soda	44·37 grs.
Chloride of sodium	41·15
Chloride of calcium	6·92
Chloride of magnesium	9·25
	121·69
Oxygen gas	0·512 cubic inches.
Azotic	3·984
Carbonic acid	25·250
Sulphuretted hydrogen	9·120
	38·866

* There is no doubt a mistake in this statement of oxygen gas, as it is well known that oxygen gas and sulphuretted hydrogen cannot exist together in the same water. The origin of the azotic gas, so generally found in sulphureous waters, is probably this:—these waters absorb air in the usual proportion; but the sulphuretted hydrogen unites with the oxygen and leaves the azote.

† Peroxide of iron being incompatible with sulphuretted hydrogen, it may be requisite to state that the saline contents of the water were determined in Glasgow. The water, when examined, contained no sulphuretted hydrogen, and the peroxide of iron was found combined with the silica. Nothing is predicted respecting the state of the iron in the spring.

‡ This must be considered as a mistake, as oxygen gas is incompatible with sulphuretted hydrogen.

11. Pump-room, (saline).

Scudamore.

Chloride of sodium	518·36 grs.
Chloride of calcium	276·20
Chloride of magnesium	193·42
Sulphate of soda	75·51
	1063·49

Thomson.

Sulphate of soda	261·95 grs.
Chloride of sodium	542·26
Chloride of calcium	167·22
Chloride of magnesium	98·91
Silici	8.36
Peroxide of iron	7.65
	1086·35

Oxygen gas	0·528 cubic inches.
Azotic	4·704
Carbonic acid	23·600
	28·832

Upon comparing the saline contents of these waters with those of Cheltenham, we cannot avoid observing a striking similarity. Nor is this surprising, when we consider that both are situated in the same formation, the new red sandstone or *red marl*, as it is frequently called by British geologists. Sulphuretted hydrogen gas occurs in both waters in small quantity, and the same remark applies to oxide of iron. It is obvious from this that the waters of Leamington will be useful in the same diseases as are cured or alleviated by Cheltenham waters. The two watering-places are so nearly on a par, that invalids may repair to each with equal advantage. Convenience or caprice, therefore, may be left to decide the difference between them.

III. Scarborough.

The town of Scarborough is situated at the foot of a very high cliff on the Yorkshire coast, overlooking a spacious bay, surrounded by lofty rocks. It has been long famous for two mineral springs, which issue from the bottom of a large cliff, about a quarter of a mile south from the town. These springs have been long frequented; and many attempts to analyse them were made before the science of chemistry had advanced sufficiently to enable the experimenters to draw any accurate inferences respecting the true constituents of the water. Simpson's analysis of the Scarborough Spa, published in the reign of Charles II., may be mentioned as an unsuccessful attempt to rectify previous errors. The Scarborough wells are two in number, and are distinguished by the names of the *North* and *South Wells*. They are, to a certain extent, impregnated with iron; but as the protoxide of iron in these waters is held in solution by carbonic acid, they cannot be carried to a distance without losing their chalybeate qualities. They owe their celebrity chiefly to their purging nature, for which they are indebted to their saline contents; and as they are weaker than the purging waters of Cheltenham and Leamington, the town of Scarborough has become less frequented since these places have risen into celebrity.

Of the two Scarborough wells, the south is the strongest. The specific gravity of each, as determined by Dr. Thomson, is as follows:—

North Well	1·003354
South Well	1·00349

The following table exhibits the saline contents of an imperial gallon of each, as analysed by Dr. Thomson. The analysis was made in Glasgow: the quantity analysed was a wine-bottle full of each, sent for the purpose from Scarborough to Glasgow. Of course, neither the quantity of iron which the waters originally contained, nor their gaseous contents, could be determined.

1. North Well.

Sulphate of magnesia	105·94 grs.
Sulphate of lime	47·64
Chloride of calcium	38·00
Common salt	7·23
	198.81

2. South Well.

Sulphate of magnesia	22·41 grs.
Sulphate of lime	147·12
Chloride of sodium	25·36
Chloride of magnesium	3·88
Carbonate of lime	9·97
	208·74

But though the South well be most impregnated with salts, as more than three-fourths of these consist of sulphate of lime and carbonate of lime, it is obvious that, as a purgative, the North well must act much more powerfully. Accordingly, it is always stated as the strongest, though both the specific gravity and the quantity of salts are greatest in the water of the South well.

IV. Spital Water.

The village of Spital lies on the south side of the Tweed, very near Tweedmouth, which may be considered as a suburb of Berwick. There is a mineral spring in this village, possessing purging qualities, which has been long resorted to by the people in the neighbourhood, and has been found useful in those diseases for which saline waters are had recourse to. The water of this spring rises from the coal formation which constitutes the surface of the earth in that part of the country. It is transparent and colourless, and has a slightly saline and unpleasant taste. Its specific gravity was found to be 1·00312. The saline contents in the imperial gallon, as determined by Dr. Thomson, are as follows:—

Chloride of calcium	71·92 grs.
Sulphate of soda	145·39
Sulphate of lime	31·60
Carbonate of lime	15·87
	264·78

Carbonic acid ..... 14·3 cubic inches.

The analysis was made in Glasgow. Hence it is probable that the quantity of carbonic acid gas originally contained in the gallon of this water, exceeded 14·3 cubic inches. This was the quantity necessary to keep 15·87 grains of carbonate of lime in solution. Of course it was necessarily present.

V. Pitkaithley, Airthrey, and Dunblane.

These three watering-places in Scotland are situated at no great distance from the Ochil Hills, a beautiful range of mountains which adorn the southern part of Perthshire, and in the neighbourhood of which some of the finest tracts of land in Scotland are situated. It is curious that all the three sets of springs rise in the new red sandstone formation, and in this respect resemble the waters of Cheltenham and Leamington. It is in this formation that the great deposits of common salt occur. It is in it, also, that the gypsum beds are situated, which constitute so abundant a deposit in Germany, though they are almost wanting in England. This makes the origin of these saline waters less remarkable than would otherwise be the case; for almost all the purging salts noticed in these waters are to be found in greater or smaller quantity mixed with common salt, both in the sea and in those beds which occur in the new red sandstone.

Pitkaithley lies near the Earn, a little west of the spot where it discharges itself into the Tay, and distant about four miles from Perth, from the valley of which it is separated by the hill of Moncrief. This mineral water has been longest known; and the locality being provided with suitable and genteel accommodations for visitors, it is better frequented perhaps than any other Scottish watering-place. How long it has been in repute as a medicinal spring we do not know; but the first notice of it which we have seen was by Dr. Donald Monro, in the Philosophical Transactions for 1772, page 15. It appears from that notice that Pitkaithley water was well known and much frequented as a mild purging water in the year 1770. Dr. Monro even attempted to determine its saline constituents; but from the imperfect state of analytical chemistry at that period, his results were unsatisfactory. It was analysed by Dr. Murray of Edinburgh about the year 1815, who found its saline contents in the imperial gallon as follows:

Common salt	128·67 grs.
Chloride of calcium	187·15
Sulphate of lime	8·64
Carbonate of lime	4·80
	329·26

Dunblane is situated at the western extremity of the Ochils, and not far distant from the Grampians. The saline springs were discovered in 1813, from the frequent resort of a flock of pigeons to the ground were they break out. There are two different springs situated about half a mile north from Dunblane. Nothing has been done by the proprietor for the accommodation of visitors, and no houses have been erected near the spring; yet notwithstanding these discouraging circumstances, such is the celebrity which the water has acquired, and such the opinion entertained of its salutary properties, that many invalids repair to it every summer, being obliged to put up with such accommodations as they can procure in the village of Dunblane. If able, they walk every day to the springs; if too feeble for so long a walk, the water is regularly brought to their lodgings and used by them as a purgative. The water is saline, with some bitterness. It is transparent and colourless, and destitute of smell as it issues from the ground. There are two springs; the one situated a little to the north of the other, and the most northern is rather the strongest. The specific gravity of these waters, as determined by Dr. Murray, is as follows:—

North spring ..... 1·00475*
South spring ..... 1·00419

We have two analyses of this water. It was first analysed by Dr. Murray in 1814. In 1821 it was a second time subjected to analysis by Dr. Thomson of Glasgow. The following table exhibits the saline constituents in the imperial gallon according to these analyses.

1. North spring.

Murray.

Common salt	231·46 grs.
Chloride of calcium	173·59
Sulphate of lime	33·75
Carbonate of lime	4·82
Oxide of iron	1·64
	445·26

Thomson.

Common salt	320·96 grs.
Chloride of calcium	174·36
Sulphate of lime	48·55
Chloride of magnesium	2·41
	546·28

2. South spring.

Murray.

Common salt	216·99 grs.
Chloride of calcium	154·30
Sulphate of lime	22·18
Carbonate of lime	2·89
Oxide of iron	1·45
	397·81

Airthrey is situated at the bottom of one of the most westerly of the Ochil hills, about two miles north from Stirling, and commands a magnificent prospect of one of the richest districts of Scotland. The view to the west is bounded by the Grampians, which are seen to greater advantage from Stirling and its vicinity than from any other place, forming a vast amphitheatre equally remarkable for the boldness of the outline and the beauty and height of the most prominent mountains. The Ochils bound the prospect on the north, beginning apparently where the Grampians recede from the view, and continuing without interruption to the east as far as the eye can reach. These mountains, though very steep on the south side, are mostly covered with wood or with grass, and present a back-ground at once lovely and magnificent, while they shelter the villages situated at their southern base so effectually that they have been always considered as the warmest spots in Scotland, and resorted to accordingly by the consumptive as a last resource. The Touch mountains on the southwest skirted with wood; the numerous little hills that rise like castles from the carse of Stirling; the Forth flowing majestically through the level ground, and winding in so intricate a

* Dr. Thomson found it 1·004901.

manner between Stirling and Alloa, that the eye, even in the most favourable situations, cannot trace its course, and spreading out into an extensive frith, which may be followed without interruption till it mingles with the eastern horizon—all these, and a thousand other beautiful, rich, and picturesque objects which it would be vain to attempt to particularize, render the view from Airthrey at once one of the most magnificent and beautiful that Great Britain has to boast of. The roads, during summer, are excellent in every direction. The rides both to the west, east, and south, possess numerous beauties to attract the attention of the man of taste; and being the spots where many of the most eventful actions connected with the history of Scotland were performed, they have claims upon our curiosity of no ordinary nature.

Sir Robert Abercrombie, the proprietor of the wells, had formed a resolution to build a pump-room, and to erect suitable conveniences for the accommodation of the numerous visitors who annually resort to them; but he unfortunately died before he had time to put his plans in execution. His successor, Lord Abercrombie, has unfortunately imbibed a prejudice against the existence of a watering-place so near his park and dwelling-house. The consequence has been that no houses are allowed to be erected at the wells. The visitors are obliged to lodge at the bridge of Allan, a village about a mile and a half from the mineral spring; yet such is the beauty of the country, and such the opinion entertained of the salutary virtues of the Airthrey mineral waters, that during the greatest part of the summer every lodging-house is crowded, and many visitors are obliged to leave the place for want of accommodation.

The mineral springs at Airthrey are six in number. They all contain the same saline constients, but differ considerably from each other in their relative strength. They were analysed by Dr. Thomson of Glasgow in 1827, at the request of Sir Robert Abercrombie. The specific gravity of these springs at that time was as follows:—

Sp. gr.	Sp. gr.
No. 1, 1·00915	No. 4, 1·00346
2, 1·00714	5, 1·00984
3, 1·00611	6, 1·00984

These springs are all transparent, and destitute of smell; their taste is saline and bitter, and they act as purgatives when drunk in sufficient quantity. The following table exhibits the saline contents in an imperial gallon of each, as determined by Dr. Thomson.

No. 1.

Common salt	423·843 grs.
Chloride of calcium	411·551
Sulphate of lime	50·578
Chloride of magnesium	6·075
	892·047

No. 2.

Common salt	359·616 grs.
Chloride of calcium	329·560
Sulphate of lime	18·341
Chloride of magnesium	4.168
	711·685

No. 3.

Common salt	263·948 grs.
Chloride of calcium	185·655
Sulphate of lime	29·776
Chloride of magnesium	1·597
	480·976

No. 4.

Common salt	135·792 grs.
Chloride of calcium	122·280
Sulphate of lime	9·798
Chloride of magnesium	9·546
	277·416

No. 5.

Common salt	513·060 grs.
Chloride of calcium	253·349
Sulphate of lime	28·134
Chloride of magnesium	13·713
	808·256

No. 6.

Common salt	537·567 grs.
Chloride of calcium	282·769
Sulphate of lime	26·084
Chloride of magnesium	2·438
	848·858

Airthrey water is nearly as strongly impregnated with salts as the waters of Cheltenham or Leamington; but the nature of the salts is different. The Airthrey springs contain a great quantity of chloride of calcium, which exists but sparingly in the Cheltenham and Leamington wells; while they are altogether destitute of the sulphate of soda, which constitutes the most important of the purgative salts in the wells of the two English watering-places. There can be no doubt that the mineral waters of Pitkaithley, Dunblane, and Airthrey, are equally valuable with those of Cheltenham and Leamington, and may be employed in the same kind of diseases. Pitkaithley is by far the weakest of the three; but this constitutes no valid objection against its use; for the purgative salts which constitute the principal ingredients in these waters,—namely, common salt and chloride of calcium, require very considerable dilution before they can be used internally with any advantage to the patient.

VI. Innerleithen.

This water, situated near the Tweed in the classic country of Scottish song, has of late years become rather a fashionable place of resort to the inhabitants of the south of Scotland. This, we believe, is chiefly owing to Sir Walter Scott's romance of St. Roman's Well, the scene of which is understood to be Innerleithen. It was analysed by Dr. Fyfe of Edinburgh about ten years ago. There are two springs situated at a little distance from each other. Dr. Fyfe has not given the specific gravity of the water, nor any description of its characters, but the following table exhibits

the saline contents found by him in an imperial gallon of each spring.

Strongest spring.

Common salt	150·712 grs.
Chloride of calcium	91·320
Carbonate of magnesia	49·107
	291·139

Weakest spring.

Common salt	101·787 grs.
Chloride of calcium	45·612
Carbonate of magnesia	25·447
	172·846

The constituents of these springs are the same as those of Pitkaithley, Dunblane, and Airthrey, with the exception of carbonate of magnesia instead of chloride of magnesium and sulphate of lime. But the Innerleithen water is much weaker than the other three. It is probable that the carbonate of magnesia found in it by Dr. Fyfe is in the state of bicarbonate when the springs issue from the ground. If this be the case, about 55·2 cubic inches of carbonic acid must exist in the strongest spring, and about 28·6 cubic inches in the weakest. It is not unlikely, then, that Innerleithen may be a slightly acidulous water; but this can be determined only on the spot.

Innerleithen water will be found useful in the same kind of complaints for which saline waters in general are recommended.

VII. Sea-water.

As the ocean surrounds Great Britain, and as no part of the island is at any great distance from the sea, we may without impropriety consider sea-water as one of the saline waters of Great Britain. It is a favourite resort, especially for bathers, and is deservedly considered as beneficial to the health as any saline water whatever.

Sea-water is transparent and colourless; it has a disagreeable bitter taste, and a specific gravity which varies from 1·0269 to 1·032. It has been often subjected to analysis, and its constituents vary somewhat in different places. The Mediterranean contains more salt than the Atlantic in the same latitude; the Baltic, the Black Sea, and the Caspian contain much less. The specific gravity of the sea-water surrounding Great Britain may be rated at 1·0285. The following table exhibits the constituents in the imperial gallon of it, according to the best analyses hitherto made.

Common salt	1915·70 grs.
Sulphate of soda	335·50
Chloride of magnesium	371·06
Chloride of calcium	88·70
Sulphate of potash	36·00
Sulphate of lime, trace	
Sal ammoniac, trace	
	2746·96

Doubtless many other salts exist in sea-water, though in quantities too minute to be detected. When the sea-water on the west coast of Scotland is sufficiently concentrated, distinct evidence may be obtained that it contains both bromide and iodide of sodium. The great constituent is common salt or chloride of sodium, which constitutes about two-and-a-half per cent. of the weight of sea-water.

When sea-water is introduced into the stomach, it acts as a purgative; but the administration of it is disagreeable. Common salt, when in a concentrated solution, acts as an emetic, and was much employed in that way by the ancients; but as an emetic it has been long almost laid aside. It is chiefly as a bath that the use of sea-water proves beneficial to the invalid. (See the article Bathing.)

The saline mineral waters hitherto enumerated constitute the most celebrated of those which exist in Great Britain. We think it needless to continue the enumeration, because the constituents and the properties of the remaining saline springs approach very nearly to some one or other of those which have been given. This is our reason for leaving out Epsom, Gilsland, &c. But there are a few foreign saline waters which have acquired so much celebrity that they must be noticed.

VIII. Seidlitz.

Seidlitz is a village in Bohemia in the circle of Elnbogen, about nine miles from Prague. Bohemia abounds in mineral waters, and those of Seidlitz must have been remarked in all ages for the great bitterness of their taste. But they were neglected by the country-people till Hoffmann gave them celebrity about the year 1721.

The springs of Seidlitz are transparent and colourless, destitute of smell, and distinguished by a bitter and saline taste; their temperature is 59°, and their specific gravity, as determined by Hoffmann, 1·016. Like other saline waters they are purgative, and they owe their purgative qualities chiefly to the presence of a notable quantity of sulphate of magnesia. Hence that salt in Germany was frequently termed Seidlitz salt, just as in England it was called Epsom salt. We have no later analysis of this water than that of Bergman. Patissier gives the following as the constituents of an imperial gallon of this water:—

Resinous matter	5.787 grs.
Carbonate of magnesia	9·645
Sulphate of magnesia	2176·200
Sulphate of soda	53·161
Sulphate of lime	40·700
Carbonate of lime	14·971
	2300·464

Carbonic acid ..... 19·507 cubic inches.

Seidlitz is much frequented by invalids, especially those who, from the delicacy of their constitutions, cannot be subjected, though they require evacuations, to a course of more energetic medicines.

IX. Seydschutz.

The town of Seydschutz is situated at a little distance from Seidlitz, and the mineral waters which belong to it possess the same characters, and are considered by Hoffmann as originating from the same source, and as containing the same saline contents, as the former. They are of course applied to the same purposes, and require no particular discussion.

[The saline waters of Balston and Saratoga, in New York, have been subjected to analysis, and have yielded the following constituents:—

Balston Spa, *San Souci Spring:* in a wine gallon, according to Dr. Steel :—

Chloride of sodium	143·733 grs.
Bicarbonate of soda	12·66
——— of magnesia	39·1
Carbonate of lime	43·407
Carbonate of iron	5.95
Iodide of sodium	1·3
Silica	1

Saratoga.—1. *Iodine Spring:* in a wine gallon, according to Prof. Emmons :—

Gaseous Contents.

Carbonic acid	336 cubic inches.
Atmospheric air	4
	340

Solid Contents.

Chloride of sodium	187 grs.
Carbonate of magnesia	75
Carbonate of lime	26
——— of soda	2
——— of iron	1
Iodine	3·5
	294·5

2. *Pavilion Spring:* in a wine gallon, according to Dr. Chilton :—

Gaseous Contents.

Carbonic acid	359·05 cubic inches.
Atmospheric air	5·03
	364·08

Solid Contents.

Chloride of sodium	243·620 grs.
Carbonate of magnesia	84·265
——— of lime	41·600
——— of soda	12·800
——— of iron	5·452
Iodide of sodium or iodine	3·600
Silica and alumina	1·570
Bromide of potassium, a trace.	
	392·907

3. *Congress Spring:* in a wine gallon, according to Dr. Steel :—

Gaseous Contents.

Carbonic acid	311 cubic inches.
Atmospheric air	8
	318

Solid Contents.

Chloride of sodium	385 grs.
Iodide of sodium	3·5
Bicarbonate of soda	8·982
——— of magnesia	95·788
Carbonate of lime	98.098
——— of iron	5.075
Silica	1.5
Bromide of potassium, a trace.	
	597·943]

II.—Of Chalybeate Mineral Waters.

Chalybeate waters are easily recognised by their inky taste, and by the property which they have of striking a black or a purple when mixed with the infusion of nutgalls or an infusion of tea. They are by far the most abundant of all the classes of mineral waters, doubtless because iron is scattered more profusely through the mineral kingdom than any other metal. These kinds of springs are particularly abundant in coal countries, on account of the pyrites balls which so commonly accompany that mineral, and which mostly undergo spontaneous decomposition when exposed to the air, and thus give origin to the formation of sulphate of iron.* Iron in mineral waters is always in the state of oxide, most commonly, though not always, in the state of protoxide. It is held in solution in the water most frequently by carbonic acid, but sometimes also by sulphuric acid. When the water, by simple exposure to the air or by being heated, is found to deposit the whole of the iron which it contains, we may be sure that it has been held in solution by carbonic acid. The sulphate of iron is not decomposed completely either by exposure to the air or by boiling; but the colour of the water impregnated with it becomes gradually yellow or even red, if the quantity held in solution be considerable.

It is but rarely that chalybeates contain a great quantity of salts in solution; though there are examples, which will be given afterwards, of waters containing a very great proportion of sulphate of iron, sulphate of alumina, and persulphate of iron.

Mineral waters impregnated with iron, possess considerable activity as medicines. They are decidedly tonics. A course of them has a tendency to render all the functions more active, especially digestion, circulation, and absorption. They generally produce a feeling of heat upon the surface of the body, and give an activity and energy to the patient which is sometimes very remarkable.

Chalybeates have the tendency to render the stools of those who drink them black. This is of no consequence in itself; but the patient ought to be warned of it beforehand, because it is apt to produce alarm.

When a mineral water has an inky taste, when the infusion of nutgalls occasions, if mixed with it, a purple cloud, which gradually passes into bluish-black, and when a solution of prussiate of potash dropped into it strikes a blue colour, we may be certain that it contains iron.

I. Tunbridge.

Tunbridge Wells, the most celebrated of all the chalybeate waters in England, is situated in Kent, about thirty-six miles south of London, a few miles distant from the village of Tunbridge. It is placed in rather a barren part of the country; but being well wooded, and the surface being hilly, it possesses considerable beauty. The chalybeate rises from the ferruginous sand, which constitutes the lowest of the three beds into which the formation of green sand lying immediately under the chalk is divided. It is well known that the counties of Kent, Sussex, and a portion of Surrey, are

* One of the places most remarkable for these pyrites balls is slate-clay, or shale, which alternates with the only coal-bed wrought at Hurlet, about five miles south-west of Glasgow. The pyrites balls undergo spontaneous decomposition when exposed to the air, and have been employed about eighty years in the manufacture of copperas. They are composed of

4 atoms bisulphurate of iron	30
1 atom sulphuret of iron	5·5
	35·5

nearly surrounded with chalk-hills, and that the central part of these counties constitutes a valley, from which the chalk (supposing it originally deposited) has been removed, and consequently composed of the formations immediately under the chalk.

How long the mineral waters of Tunbridge-Wells have been a fashionable place of resort we do not know; but they are mentioned by the oldest of our writers on mineral waters, and in such terms that it is evident they had been known long before their time.

Many chalybeates exist in this place, but the only one in use rises into a large marble basin; the water overflows through an aperture into a channel connected with a chalybeate cold bath, depositing in its progress a reddish-brown sediment.

The temperature of the water as it issues from the spring is 50°, which is the mean temperature of that part of Kent, showing that the spring issues from a considerable depth below the surface. The supply is not great, and is in some measure dependent on the weather, the smallest supply being about a quart, and the greatest about two gallons and a half per minute, according to the measurement of Sir Charles Scudamore. Its specific gravity, as determined by Dr. Babington in 1792, was 1·0014; but in 1816 it was, according to Sir Charles Scudamore, only 1·0007 at the temperature of 50°.*

The fresh water is perfectly transparent, and does not give out air-bubbles. It has a smell distinctly chalybeate. Its taste is also strongly marked; but it is neither acidulous nor saline. It has an agreeable freshness, and is by no means unpalatable. When heated to 68°, it gives out a few air-bubbles, and in about an hour a delicate white pellicle appears on its surface, which gradually thickens and becomes shining, and by degrees an ochrey precipitate falls, and the water loses its chalybeate taste.

The following table exhibits the constituents of an imperial gallon of Tunbridge-wells water, according to the analysis of Sir Charles Scudamore:

Common salt	1·5 grs.
Sulphate of soda	1·768
Chloride of calcium	1·848
Chloride of magnesium	0·348
Carbonate of lime	0·328
Protoxide of iron	2·748
Manganese, silica, &c.	0·528
	9·068

Carbonic acid gas	9·66 cubic inches.
Oxygen gas	0·60
Azotic acid	5·70
	15·96

The weight of 9·66 cubic inches of carbonic acid gas is 4·585 grains. Now, 2·748 grains of protoxide of iron to keep them in solution would require 3·358 grains, and 0·328 grains of carbonate of lime requires to keep it in solution 0·144 grains of carbonic acid. Thus, the whole carbonic acid necessary to keep the protoxide of iron and the lime in solution, amounts to 3·502 grains. So that there is a surplus of one grain of carbonic acid.

From the preceding analysis it is evident that the only constituent to which Tunbridge Wells owes its activity as a medicine, is the carbonate of iron. The other saline constituents exist in such minute quantity that they must be quite insignificant in a medical point of view. The quantity of iron is also small, not exceeding 0·14 grains in the usual dose of half a wine pint. Yet it has a decidedly stimulant effect, and has been frequently taken with great benefit, especially in dyspepsia, chlorosis, uterine debility, and similar affections. It usually occasions constipation of the bowels, and requires, therefore, to be accompanied by the use of some laxative medicine.

Several of the mineral wells both at Leamington and Cheltenham contain more carbonate of iron than the water of Tunbridge Wells; and as they contain at the same time a notable quantity of purging salts, they are perhaps better adapted for internal use. The analysis of these waters has been already given while treating of saline mineral waters.

Many other chalybeates occur in England; but it seems unnecessary to give a description of these, as they are but little employed, and as their nature approaches very nearly to that of Tunbridge.

II. Hartfell Spa.

This mineral water springs from the base of Hartfell, a mountain distant about five miles from Moffat, and the highest in the south of Scotland, its summit being elevated about three thousand three hundred feet above the level of the sea. The spring rises at the bottom of a deep and narrow ravine, the sides of which are laid bare to the top, so as to exhibit to the view of the geologist the whole structure of the mountain; the country is transition, and the mineral water originates in a species of alum slate, a black soft slaty rock, containing abundance of iron pyrites. Hence, doubtless, the origin of the salts with which the spring is impregnated.

The Hartfell Spa was discovered in 1748, by John Williamson, a farmer in the neighbourhood, and a very eccentric character. He considered it as unlawful to destroy animals for the sake of food, and on that account fed entirely on vegetables. He died in 1769, and was buried in the old churchyard of Moffat.

The Hartfell Spa water is transparent and free from smell. Its taste is sweetish and astringent, and its specific gravity, as determined by Dr. Thomson, 1·0007.

This water was subjected to a chemical analysis by Dr. Garnet, in the year 1797, the result of whose experiment is, that the imperial gallon of it contains the following salts:—

Sulphate of iron	100·8 grs.
Sulphate of alumina	14·4
	115·2

Azotic gas	6 cubic inches

It was subjected to a new analysis by Dr. Thomson, of Glasgow, about the year 1825. He had only a wine-bottle full of the water to examine,

* The specific gravity of the water brought into the village of Tunbridge-Wells for domestic purposes is 1·00023 at 60°.

and could not succeeed in detecting in it any common salt, or any alumina; though Dr. Garnet states sulphate of alumina as one of the constituents. The water contains sulphuric acid and chlorine in very sensible quantities, and exhibits abundant evidence of the presence of protoxide of iron and lime. The result of the examination of Dr. Thomson is, that the imperial gallon of this water contains,—

Protosulphate of iron	36·747 grs.
Chloride of calcium	33·098
	69·845

both of these salts being considered as anhydrous. Had a gallon of the water been concentrated down to a tenth or twentieth of its bulk, it is not unlikely that common salt might have been discovered. But the quantity is certainly small, since it cannot be discovered in the unconcentrated water. The apparent excess of sulphate of iron in Dr. Garnet's analysis, is partly owing to his giving his salts in a crystallized state; 36·747 grains of anhydrous sulphate are equivalent to 67·2 grains of crystallized sulphate. As Dr. Garnet has neglected to state the specific gravity of this water, we have no means of judging whether it has become weaker since 1797.

This water has been found of considerable service as an astringent in all cases where there is relaxation of the solids, and indeed in every disease connected with general debility.

The dose of it is more limited than that of most other mineral springs. It is proper to begin at first with a very small quantity, and it can scarcely ever be increased to more than an English wine-pint in the course of the day; but this quantity may be continued for a considerable time, not only without injury, but with decided benefit.

III. **Strong Moffat Chalybeate.**

This new chalybeate seems to have been discovered about the year 1825. It is said to run down the face of the Hartfell mountain in considerable quantity. It has a red colour and a harsh astringent taste. It reddens vegetable blues. Its specific gravity, as determined by Dr. Thomson, is 1·00965.

Of this water a specimen, amounting only to a wine-bottle full, was sent to Dr. Thomson of Glasgow in 1825, who subjected it to analysis. The saline contents of the imperial gallon, according to this analysis, are as follows:—

Sesquisulphated peroxide of iron	591·025 grs.
Sulphate of alumina	112·726
Uncombined sulphuric acid	5·202
	708·953

This water is much stronger than the preceding, and contains a notable quantity of sulphate of alumina. It is too strong to be administered internally without dilution, but as an external application it answers well in many cases as an astringent.

IV. **Vicar's Brig Chalybeate.**

This extraordinary chalybeate was discovered a few years ago. It occurs in Perthshire on the south side of the Ochil-hills, about two miles east from Dollor, and near Blarngone. It rises in a coal country, and doubtless originates from the decomposition of pyrites balls in the slate clay, which usually accompanies the coal beds. It was accidentally observed running in various little streams near the road. Specimens of it were sent to Dr. Thomson of Glasgow, who subjected it to a chemical analysis. There are different sources of this water, and the probability is that the composition of the water varies in each, though all of them are uncommonly strong.

The specimen sent to Dr. Thomson was transparent, but had a red colour and an exceedingly astringent and harsh taste. Its specific gravity was 1·0100. The saline constituents in the imperial gallon of this water were found to be—

Common salt	5·87 grs.
Sulphate of soda	170·99
Sulphate of alumina	953·18
Bisulphated peroxide of iron	1753·10
Sulphated peroxide of iron	141·55
Silica	58·70
	3083·39

Another specimen of water from Vicar's Brig was found by Mr. Connel to have a specific gravity of 1·04893. He subjected it to analysis, and found the saline contents of the imperial gallon to be—

Sulphated protoxide and peroxide of iron	3037·84 grs.
Sulphate of alumina	580·64
Sulphate of magnesia	277·20
Sulphate of lime	43·68
Common salt and chloride of potassium	2·40
	3941·76

It is obvious, both from the specific gravity and the saline constituents of these two specimens, that they must originate from different sources. Dr. Thomson examined the sample of the water sent to him, in order if possible to detect lime and magnesia in it, but he could discover none; while the sulphate of soda, which exists in a notable quantity in the mineral water examined by Dr. Thomson, is wanting in the water which was analysed by Mr. Connel.

Vicar's Brig water is, perhaps, the strongest chalybeate in existence; at least it is the strongest which we ever met with. It is similar in its nature and properties to the strong Moffat chalybeate, but more than four times as strong. This water might be employed with advantage externally, and indeed is in high reputation with the country people as a remedy for cuts, and even bruises. It could scarcely be taken into the stomach unless it were much diluted. In that way it might be employed for the same purposes as the weaker Moffat chalybeate.

We are of opinion that when iron is used as a medicine, the best possible form is that of protoxide. In this state it exists in all those chalybeates in which the iron is held in solution by carbonic acid. In the strong Moffat chalybeate, and in Vicar's Brig mineral water, the iron is in the state of peroxide. We have some reasons for believing that in the tincture of muriate of iron, which is so

powerful a remedy in ischuria, the iron is in the state of peroxide, or at least of perchloride, which may be considered as equivalent to the peroxide. It might therefore, perhaps, be worth while to try whether the strong Moffat chalybeate and Vicar's Brig water, if it were mixed with alcohol, might not be employed with advantage as a cure for ischuria.

The chalybeates which we have now specified may be considered as exhibiting a pretty fair specimen of all the different varieties of these waters which occur in such great abundance in different parts of Great Britain; for, so far as we have observed, the iron in chalybeates is either in the state of protoxide or peroxide. When in the state of peroxide, we believe it is always held in solution by sulphuric acid; but when in the state of protoxide, it may be held in solution either by carbonic acid, as in the water of Tunbridge Wells, or by sulphuric acid, as in the Hartfell Spa at Moffat. There are some chalybeate waters on the continent which have acquired so much celebrity that we think it right to notice them.

V. Spa Chalybeate.

Spa is a village situated in that mountainous tract of Belgium which constitutes a part of the forest of Ardennes. It is about six leagues from Liege, and seventy-five from Paris. The town is situated in a kind of amphitheatre formed by two mountains. It is well built, and crowded annually with the best company in consequence of the celebrity of its mineral waters.

The wells are seven in number, and are all characterized by holding a quantity of protoxide of iron in solution. The solvent of the iron is carbonic acid gas, of which they contain so much that they might without impropriety be placed among the acidulous mineral waters. But as they probably owe much of their value to the iron which they contain, we have thought it better to describe them here.

The fashionable time for visiting Spa is from May to October. The springs are very numerous; but the most celebrated are the following seven:—the Pouhon, the Geronstere, the Sauveniere, the Groesbeck, the two Tonnelets, and the Watroz.

The Pouhon, which is the most celebrated and the most frequented, rises in the middle of the town from a rock of clay state. In cold dry weather it is transparent and colourless. When first taken out of the well, it scarcely sparkles; but it emits air-bubbles when poured from one vessel to another. Its taste is acidulous and inky, and, like the water of Tunbridge Wells, it gradually lets fall its iron when left exposed to the air. Its specific gravity, according to Bergman, is 1·0010. In 1816 it was analysed by Dr. Godden Jones: according to his analysis, an imperial gallon of this spring contains:—

Sulphate of soda	1·188 grs.
Common salt	1·392
Carbonate of soda	2·700
Carbonate of lime	11·848
Carbonate of magnesia	1·260
Protoxide of iron	6·288
Silica	2·712
Alumina	0·348
	27·736

Carbonic acid gas, 314·4 cubic inches.

As the imperial gallon contains 277·274 cubic inches, it is evident that the Pouhon spring contains 1·13 its volume of carbonic acid. This is rather a larger quantity than water without artificial pressure can dissolve; but the difference is easily accounted for by the quantity of carbonate of lime, carbonate of magnesia, and oxide of iron, which it holds in solution.

The Geronstere is the most celebrated fountain at Spa after the Pouhon. It lies about a mile from the town, on the side of a mountain and in the middle of a wood. The water rises in a circular pit about three feet in diameter, and very shallow. The constituents of the imperial gallon of this water, according to the analysis of Jones, are as follows:—

Sulphate of soda	0·744 grs.
Common salt	0·768
Carbonate of soda	1·716
Carbonate of lime	6·240
Carbonate of magnesia	1·260
Protoxide of iron	1·008
Silica	1·680
Alumina	0·228
	13·644

Carbonic acid gas, 201·6 cubic inches.

This water has been stated to contain a little sulphuretted hydrogen gas; but the presence of this gas has not been confirmed by the analysis of Jones.

The Sauveniere is about a mile and a half from Spa, and springs from the side of the same mountain as the Geronstere. It is situated near the great road to Malmedy, in the midst of a wild thicket of trees. The constituents of an imperial gallon of this water, as determined by Jones, are as follows:—

Sulphate of soda	0.06 grs.
Common salt	0·30
Carbonate of soda	0·72
Carbonate of lime	4·20
Carbonate of magnesia	0·72
Protoxide of iron	2·52
Silica	0·48
Alumina	0·12
	9·12

Carbonic acid gas, 289·2 cubic inches.

Groesbeck bears considerable resemblance to the water of the Sauveniere. Its taste is sharp and agreeable, and it contains less iron than any of the preceding springs. The constituents of an imperial gallon of it, as determined by Jones, are as follows:—

Sulphate of soda	0·06 grs.
Common salt	0·18
Carbonate of soda	0·36
Carbonate of lime	2·88
Carbonate of magnesia	0·24
Protoxide of iron	1·86
Silica	0·72
Alumina	0·12
	6·42

Carbonic acid gas, 318 cubic inches.

This spring contains more carbonic acid than any of the preceding, and being less impregnated with iron, it approaches more nearly to a simple saline spring.

The fountains of Tonnelet are two in number. They both yield a great deal of water, and give out a slight smell of sulphuretted hydrogen gas. The taste of the water is sharp and agreeable, and less ferruginous than most of the other springs. The constituents of the imperial gallon of these two springs, according to the analysis of Godden Jones, are as follows:—

1. *Tonnelet spring.*

Sulphate of soda	0·07 grs.
Common salt	0·18
Carbonate of soda	0·24
Carbonate of lime	1·32
Carbonate of magnesia	0·36
Protoxide of iron	3·34
Silica	0·72
Alumina, a trace.	
	6·13

Carbonic acid gas, 336 cubic inches.

This is the spring which is most impregnated with carbonic acid of all those that occur at Spa.

2. *Tonnelet spring.*

Sulphate of soda, trace.	
Common salt, trace.	
Carbonate of soda	0·12 grs.
Carbonate of lime	1·08
Carbonate of magnesia	0·24
Protoxide of iron	1·80
Silica	0.78
Alumina, trace.	
	4·02

Carbonic acid gas, 314·4 cubic inches.

The Watroz spring furnishes but little water; its taste is decidedly chalybeate; its temperature is various, and it contains but little gas compared with the other springs. The constituents in the imperial gallon, as determined by Jones, are as follows:—

Sulphate of soda, trace.	
Common salt	0·24 grs.
Carbonate of soda	0·12
Carbonate of lime	1·68
Carbonate of magnesia	2·28
Protoxide of iron	3·12
Silica	1·08
Alumina	0·72
	9·24

The proportion of carbonic acid gas has not been determined, but it is small.

The use of the Spa waters is said to produce some degree of vertigo, and a kind of intoxication, which continues about half an hour, and is very similar to that produced by spirituous liquors. This effect is doubtless owing to the carbonic acid gas with which these waters are impregnated. They have a decidedly stimulating property, and may probably promote all the secretions; but their most direct determination is to the kidneys and skin. They are observed to quench thirst better than common water, especially in slight feverish complaints. In short, all the remarks made upon Tunbridge Wells water apply to them in a greater degree, because they contain a greater quantity of iron, and the carbonic acid and carbonate of soda which they contain add both to their agreeable taste and their medicinal properties.

VI. Passy Chalybeate.

Passy is a village near Paris, on the right bank of the Seine, and celebrated for its beautiful situation in the neighbourhood of the *Bois de Boulogne*. There are different mineral springs, which have been divided into two sets, the *old* and the *new*. The old are formed of two springs, which rise very near each other. The new waters are at a small distance from the old, and consist of three springs, which are enclosed in a building. The old springs are limpid, and have a very weak ferruginous taste; the taste of the new is much more decidedly inky and astringent. When these waters are left exposed to the air in an open vessel, they deposit an ochreous sediment, showing that the iron in them is partly held in solution by carbonic acid. These waters have been often analysed. The imperial gallon of the new springs, according to the analysis of Deyeux, contains the following constituents:—

Sulphate of lime	200 grs.
Sulphate of iron	79·84
Sulphate of magnesia	104·63
Common salt	30·55
Alum	34·74
Carbonate of iron	3·70
Bituminous matter, trace.	
	453·46

The carbonic acid gas amounted only to 1·955 cubic inch.

This water approaches somewhat to that of the Hartfell spa, only its ferruginous impregnation is not so strong. It differs also by the sulphate of lime and sulphate of magnesia, the last of which may in some measure serve to counteract the astringent tendency of the sulphate of iron. The quantity of carbonate of iron is so small, that, considering the sulphate present, it cannot have great effect upon the patient.

VII. Bourbon l'Archambault Chalybeate.

Bourbon l'Archambault is a small town in the department of the Allier in France, about six leagues west from Moulins. It lies in a valley surrounded by four hills. The waters are hot, and appear to have been frequented during the time of the Romans. Gaston d'Orleans, brother of Louis XIII., improved the baths, and various ameliorations have been made since, which render these waters the most convenient as bathing-places of any in France.

The waters rise in the middle of the town, and emit a noise resembling that of boiling. This noise is owing to the rapid disengagement of gas. These waters have a slight smell of sulphuretted hydrogen. The taste is slight and not easily described. The temperature of the water as it issues from the earth is 144°; but it cools as it flows. In the basin which serves for the common use of the inhabitants of the town the temperature is 131°. In the basin for the use of the poor it varies from 100° to 120°. It is said that this

water, notwithstanding its heat, is not the least disagreeable when taken into the mouth, nor does it injure the petals of the most delicate rose. The best analysis of these waters has been made by M. Faye. The saline constituents in the imperial gallon, according to his determination, are as follows :—

Chloride of calcium	12·336 grs.
Chloride of magnesium	7·716
Common salt	28·550
Sulphate of soda	10·026
Sulphate of magnesia	14·290
Sulphate of lime	10·803
Carbonate of iron	14·230
Silica	5·031
	103·042

Carbonic acid gas 158·50 cubic inches.
Sulphuretted hydrogen gas, a trace.
Vegetable soap, a trace.

This mineral water contains a greater quantity of iron than either Spa or Tunbridge Wells water; but its impregnation of carbonic acid gas is inferior to that of the Spa Wells, though it greatly exceeds that of Tunbridge Wells. If to this we add the temperature of the waters of Bourbon l'Archambault, we must admit that they constitute a very valuable medicine. When used as a bath, probably they derive their chief value from their temperature. When taken into the stomach, doubtless the carbonate of iron and the carbonic acid impregnation give them considerable efficacy as a chalybeate.

VIII. Rennes Chalybeate.

The mineral waters of Rennes (called formerly the waters of Montferrand) are attached to a small village called *Les Bains*, situated in a narrow valley about seven leagues south from Carcassons, in the south-west of France, not very far from the Pyrenees. As a watering-place, it appears to have been frequented in the time of the Romans.

The mineral springs are five in number, three of which are hot and two cold: these are—

1. *Bain de la Reine*, the least hot of the warm springs, is situated on the left bank of the Salz, about 500 paces from the village. The waters rise directly from the rock, and are received into a large covered basin, from which they are conducted by pipes into the various baths, erected for the use of the invalids. The temperature of this water is 89° 5′ of Fahrenheit.

2. *Bain doux* or *les Ladres*. The spring to which this name is given rises from the same level as the Allet. It is received into three large basins; one destined for women, and the two others for men. Very recently separate bathing-places have been established. The temperature of this spring is 90° 5′.

3. *Bain Fort* is situated in the middle of the village in an ancient inn, which has been lately restored by MM. de Fleury. The water rises from the level of the river Salz, and is received into a small basin. In this place a vapour-bath has been established. The temperature of the Bain Fort is about 106°.

4. *Source du Cercle* is situated about 300 yards above the Salz. It rises from below a huge rock, and winds its way into a reservoir, in which it does not remain. Both this spring and the following one are cold, or have merely the mean temperature of that part of the earth where they rise.

5. *Source du Pont* lies about 100 yards north from the *Bain de la Reine*. It runs above the Salz and upon the left bank of that river. This is the spring most frequently used by the invalids who frequent the place.

These five springs are transparent and colourless, and never freeze. They are hottest during summer, and coldest during winter. The water of the *Cercle* has a strong ferruginous odour; the *Bain doux* exhales an hepatic smell, which is most sensible when the basins are emptied. The other three have no smell. The water of the *Cercle*, when exposed to the air, lets fall some carbonate of lime. They have all a slightly bitter taste.

The saline constituents in the imperial gallon of each of these waters are, according to the analysis of MM. Julier and Rebouhl, as follows:—

1. *Bain de la Reine.*

Chloride of magnesium	53·707 grs.
Chloride of calcium	23·150
Common salt	55·560
Sulphate of lime	67·133
Carbonate of magnesia	41·669
Carbonate of lime	18·520
Carbonate of iron	52·243
	311·982

2. *Bain doux.*

Chloride of calcium	106·49 grs.
Chloride of magnesium	46·30
Common salt	37·04
Sulphate of lime	39·35
Carbonate of lime	10·19
Carbonate of magnesia	3·50
Carbonate of iron	13·89
Silica	0·93
Sulphuretted hydrogen gas, a trace.	
	257·69

3. *Bain Fort.*

Chloride of magnesium	123·15 grs.
Chloride of calcium	23·15
Common salt	11·57
Sulphate of lime	50·93
Carbonate of magnesia	43·98
Carbonate of lime	37·97
Carbonate of iron	20·83
	311·58

Carbonic acid 364½ cubic inches.

4. *Source du Cercle.*

Chloride of magnesium	23·15 grs.
Chloride of calcium	11·57
Common salt	32·41
Sulphate of magnesia	16·21
Sulphate of lime	20·83
Sulphated peroxide of iron	9·26
Carbonate of magnesium	13·89
Carbonate of lime	13·89
Carbonate of iron	13·89
	155·10

5. Source du Pont.

Chloride of calcium	24·54 grs.
Chloride of sodium	12·04
Sulphate of magnesia	18·52
Sulphate of soda	9·26
Carbonate of magnesia	18·52
Carbonate of lime	6·94
Carbonate of iron	11·57
	101·39

The first of these mineral springs is used as a bath in nervous affections, in œdema following acute diseases, in glandular obstructions, chlorosis, and in calculous diseases when they have resisted the Bain Doux. It probably owes its value as a bath to its temperature.

The Bain Doux has received its name from a kind of oily feeling which it communicates to those who are immersed in it. It is said to have the property of preserving the skin soft and flexible. It is employed as a bath in herpetic eruptions, and also in gout. Its efficacy in the former of these diseases is probably owing to the sulphuretted hydrogen which it contains, and in the latter to its temperature.

The waters of the Bain Fort are used in chronic rheumatism, paralysis, and chronic ulcers. Undoubtedly its value as a bath in these diseases is owing to its temperature.

The waters of the Cercle have some resemblance to those of Spa, except that they are cold. They are chiefly used as a drink, and produce the effects of chalybeate waters in general.

The waters of the Pont, besides being chalybeates, are slightly purgative in consequence of the salts with which they are impregnated. Hence they are used in cases of indigestion. It is customary to drink this water for two or three days before beginning to use the waters of the Cercle.

IX. **Tongres Chalybeate.**

Tongres is a town situated on an eminence near the little river Geer, and about a league from Maestricht in the Low Countries. There are several mineral springs in the neighbourhood of this town; but two of these are chiefly distinguished. The first, called the Fountain of St. Giles, and known to the inhabitants by the name of Fountain of Pliny, is situated in a valley surrounded on all sides by low sand-hills. The spring is copious, and is received into a basin composed of large limestones. It is limpid and colourless, has a chalybeate taste, and its temperature is 59°. It deposits on standing some ochre, showing that it contains carbonate of iron.

The second fountain is about eight hundred yards distant from the first, just on the north side of the little hill of Fer. The water of this fountain is always muddy. There is an iridescent pellicle on the surface, and it has a stronger inky taste than the other fountain. Its temperature is $61\frac{1}{4}°$. The saline constituents in the imperial gallon of these fountains, according to the analysis of M. Passé, are as follows:—

First Fountain.

Carbonate of iron	7·957 grs.
Carbonate of magnesia	11·991
	19·948

Second Fountain.

Carbonate of iron	10·254 grs.
Carbonate of magnesia	10·624
	20·878

The presence of iron in water is easily known by the inky taste and by the property which such water has of striking a purple colour with the infusion of nutgalls, or with an infusion of tea. Prussiate of potash strikes a blue, and sulphocyanate of potash strikes a red with peroxide of iron, but produces no sensible action on the protoxide. By means of this reagent we can easily determine whether the iron be in the state of protoxide, or whether the water does not also contain peroxide.

If the whole iron precipitates when the water is exposed to the air, or when it is boiled, we may be sure that it is in the state of carbonate, and therefore all protoxide. If it only precipitates partially on exposure to the air, part of it is in the state of carbonate and part of it in the state of sulphate.

To determine the quantity of iron in a chalybeate, we may have recourse to various processes. One of the easiest is to mix a determinate quantity of the water (previously concentrated if necessary) with sulphohydrate of ammonia. The iron precipitates in the state of sulphuret, and its quantity might be determined by drying and weighing that sulphuret. For the iron constitutes 7-11ths of the weight of the sulphuret, supposing it pure. But it will be more accurate to dissolve the sulphuret in nitra-muriatic acid, and after neutralizing the solution, to throw down the iron by caustic ammonia; when washed and dried, it is in the state of peroxide. Let its weight be a. To reduce it to protoxide, multiply by 4·5 and divide by 5, or the weight of protoxide of iron is $\frac{9}{10}a$.

If the mineral water contains no other constituent which can be thrown down by caustic ammonia but iron, the easiest method of proceeding is to peroxidize the iron by heating a certain portion of the concentrated water with nitric acid. Let the liquid be then neutralized, and the peroxide of iron precipitated by ammonia. Its quantity in the state of peroxide may be estimated as above. Should alumina be also present, as is the case with Moffat Strong Chalybeate and with Vicar Brig water, we must digest the recently precipitated peroxide of iron with a sufficient quantity of caustic potash ley to dissolve out the alumina. The residual peroxide of iron is to be separated, washed, and estimated as above directed. Saturate the potash ley with muriatic acid, and throw down the alumina by means of carbonate of ammonia. When washed, ignited, and weighed, if we deduct its weight from that of the mixture of peroxide of iron and alumina at first thrown down, we have the weight of the peroxide of iron which the given quantity of the mineral water contains.

[The most celebrated chalybeates in the United States are **Balston, Saratoga, Bedford,** and **Brandywine.**

Anderson's spring, Bedford, has been found to

yield on analysis the following constituents in a wine gallon.

Carbonic acid 74 cubic inches.

Solid Contents.

Sulphate of magnesia	80 grs.
Sulphate of lime	14·5
Chloride of sodium	10
Chloride of calcium	3
Carbonate of iron	5
Carbonate of lime	8
	120·5]

III.—Of Sulphureous Mineral Waters.

Sulphureous mineral waters have been so named from the sulphuretted hydrogen gas with which they are impregnated. They are easily distinguished by the peculiar smell which they exhale, similar in some respects to the smell of rotten eggs; by the property which they have of blackening silver and of giving a dark-coloured precipitate when mixed with a solution of acetate of lead. The greater number of sulphureous waters have a kind of unctuous feel, and give a softness to the skin. They lose their peculiar smell and characteristic properties by exposure to the air, or by being heated in an open vessel. All the sulphureous mineral waters in Great Britain are cold; but the greater number of those that occur on the Continent are hot.

Sulphureous mineral waters have been always highly esteemed on account of their medicinal properties. When employed as a bath, they are particularly efficacious in herpetic eruptions on the skin. Indeed, in diseases of the skin in general, and in cases of old, callous, fistulous ulcers, which have resisted medical treatment, they have been frequently found of immense benefit.

When taken internally, they are found to be stimulating. They have been often recommended as useful in cases of want of appetite and heartburn. They have been considered as highly valuable in cases of amenorrhœa, and in diseases of the breast. They have been reckoned capable of even dissipating those tubercles in the lungs which are the usual forerunners of consumption, and many cases are upon record in which they have been of undoubted utility in the early stages of that deplorable disease.

The use of sulphureous waters is considered as injurious to those who labour under plethora, or are affected with inflammatory fever.

The most celebrated of the sulphureous waters in England is Harrowgate in Yorkshire. In Scotland two of these waters have been resorted to by invalids for a considerable time; these are Moffat and Strathpeffer, the former in the south and the latter in the north of Scotland. A new sulphureous water has been lately discovered near Rothesay in the Isle of Bute. We shall, in the first place, give a short account of these four mineral waters, comprehending the principal sulphureous springs in Great Britain. We shall then notice a few of the most celebrated sulphureous waters on the continent.

I. Harrowgate Water.

Harrowgate lies in Yorkshire near the south-west extremity of an extensive plain, about twenty miles from York and fifteen from Leeds. It is situated on a bed of shale, which covers the mountain limestone, and is itself covered by magnesian limestone. It is from this shale that the mineral waters of Harrowgate all rise. It seems to be all the substitute which exists in this part of the country for the coal-beds, so abundant at the distance of fifteen or twenty miles. Harrowgate of late years has increased very much, chiefly on account of the celebrity of its wells.

At present there are no fewer than fourteen different wells at Harrowgate, all of which are more or less resorted to on account of their medicinal properties. The longest known among these is the *Tewit Spa*, so called from the lapwings which still frequent the spot. It was accidentally discovered in the year 1571 by William Slingsby, Esq. Having travelled in Germany and used the celebrated chalybeate waters at Spa, he was struck with its great resemblance to the Sauvenier fountain. He was induced to use it, and to prefer it to the Spa waters as more agreeable and more valuable, and thus brought it into a certain degree of celebrity. This reputation has been ever since augmenting, and has no doubt been promoted by the gradual discovery of the other mineral wells which are now so numerous.

Numerous books have appeared professing to give a medical and chemical account of these waters. The first was by Dr. Deane in 1626; Dr. Stanhope published a work on the subject in 1632; Dr. French gave another treatise on these waters to the public in 1651. The work of Dr. Neal of Leeds, though drawn up in 1656, was not published till 1734, when it was incorporated with the work of Dr. Short, of Sheffield, on Mineral Waters. Dr. Higgins gave an analysis of them in 1780; Dr. Garnet's treatise on them appeared in 1791. Sir Charles Scudamore in 1820 gave a chemical analysis of several of the Harrowgate wells, in his chemical and medical report of the properties of various mineral waters. The last and most complete account of these springs was published by Dr. Adam Hunter, of Leeds, in 1830, under the title of *A Treatise on the Mineral Waters of Harrowgate and its vicinity.*

The springs at Harrowgate are not all of the same class, though it will be most convenient to give an account of them all in this place. Six of them are impregnated with sulphuretted hydrogen gas, and therefore are entitled to the name of sulphureous springs. Five of them are pure chalybeates; one is a saline chalybeate; and two may be considered as simple saline, since they contain little iron, and are destitute of sulphuretted hydrogen. Indeed, besides the fourteen springs which we mean to describe, many others might be added, for the neighbourhood of Harrowgate abounds in mineral impregnations. But the resemblance of those left out to some one or other of those which we mean to introduce is so great, that were we to describe them all, we should be merely lengthening out the article by a needless repetition.

Class I. *Sulphureous Springs.*

1. The *old sulphur* or *drinking well* issues from the base of a considerable ascent inclining to the south-west, and is encircled with rising grounds which are partly covered with buildings. The water rises into a circular stone basin, covered with a large leaded dome, supported by pillars. The

water is transparent and colourless, and very sparkling: its temperature is 49°, which is doubtless the mean temperature of that part of Yorkshire. The smell is strongly hepatic, the taste saline, with an impression of sulphur: it loses its colour by standing or by boiling, and a white matter is deposited: its specific gravity, as determined by Dr. Garnet, was 1·0064; Sir Charles Scudamore found it 1·0101 at 60°, and Dr. A. Hunter found it 1·0110 at 61°.

The saline contents of the imperial gallon, according to the analysis of Dr. A. Hunter, are as follows:—

Chloride of sodium	867 grs.
Chloride of calcium	87
Chloride of magnesium	42·5
Bicarbonate of soda	20
	1016·5

Sulphuretted hydrogen gas	15·64 cubic inches.
Carbonic acid gas	2·72
Carburetted hydrogen	6·80
Azotic gas	8.84
Total	34·00

2. *Thackwray's Garden Spring* or *Crown Spa* is about two hundred yards from the old sulphur well, nearly on a line with it, and in the lowest part of the valley, in the garden at the east end of the Crown hotel. It was discovered in 1810, and was long used as a bath. A small Chinese temple has been placed over this spring, and the garden and some surrounding land has been converted into pleasure-ground. Its properties are so nearly similar to those of the old sulphur well, that a particular description is needless. Its specific gravity at 58° was found by Dr. A. Hunter to be 1·0105.

The saline constituents of the imperial gallon of this water, according to the analysis of the same gentleman, are as follows:—

Chloride of sodium	802 grs.
Chloride of calcium	77·5
Chloride of magnesium	38·6
Bicarbonate of soda	28·0
	946·1

Sulphuretted hydrogen gas	21·6 cubic inches.
Carbonic acid gas	4.32
Carburetted hydrogen	5·76
Azotic gas	4·32
	36·00

3. *The Crescent New Pump* is situated in the garden immediately to the west of the promenade room, and about a hundred yards from the old well. It is more strongly impregnated with salts than any of the springs, except the preceding ones. Its specific gravity, according to Dr. A. Hunter, is 1·0051 at 59°: its constituents, by the analysis of the same gentleman, in the imperial gallon, are as follows:—

Chloride of sodium	462 grs.
Sulphate of soda	14
Chloride of calcium	47·2
Chloride of magnesium	21·8
Bicarbonate of soda	11·0
	556·0

Sulphuretted hydrogen gas	5·75 cubic inches.
Carbonic acid gas	3·35
Carburetted hydrogen	4·80
Azotic gas	10·10
	2·400

4. *The Crescent House Pump* is placed in one of the back-rooms of the Crescent hotel, and had been almost confined to its use as a bath. It was first analysed by Dr. A. Hunter. Its specific gravity at 58° is 1·0029. The saline constituents in an imperial gallon of this water, according to the analysis of Dr. A. Hunter, are as follows:—

Chloride of sodium	280 grs.
Chloride of calcium	23·25
Chloride of magnesium	17.25
Bicarbonate of soda	4·00
	324·5

Sulphuretted hydrogen gas	3 cubic inches.
Carbonic acid gas	3
Carburetted hydrogen	2
Azotic gas	12
	20

5. *Knaresborough* or *Starbeck Spa*, though the weakest, is, however, of considerable importance. It is the only sulphur spring not at or immediately adjoining Low Harrowgate. It is situated in the township of Knaresborough, and at nearly an equal distance from Knaresborough and Harrowgate. It seems to have been the first sulphur well discovered at Harrowgate, but was gradually neglected as the others increased in celebrity. It was at last altogether destroyed, and the ground ploughed over; but it made its way again to the surface; and some individuals, finding it useful as a bath, formed a pond for leading away the water as occasion required. It then became a subject of dispute between Knaresborough and Harrowgate. By the enclosure act, it was awarded to Knaresborough; and in 1822 it was enclosed by subscription in an elegant fabric. A neat cottage, with shrubberies and a garden, with hot and cold baths at a moderate price, together with a chalybeate spring, complete the establishment of the Knaresborough Spa. It is an excellent pure light water, which sits easily on the stomach, and is less disagreeable to the palate than the stronger sulphur waters. It is peculiarly recommended as a bath in cutaneous diseases. Its specific gravity at 58° is 1·0026. The saline constituents in the imperial gallon of this water, according to the analysis of Dr. A. Hunter, are as follows:—

Chloride of sodium	122 grs.
Sulphate of soda	2·5
Chloride of calcium	10
Chloride of magnesium	8·25
Bicarbonate of soda	3
	145·75

Sulphuretted hydrogen gas	5 cubic inches.
Carbonic Acid	8·3
Azotic gas	11·7
	25·0

6. *The Hospital well* is situated in the moss or

bog from which, in the opinion of some, all the sulphureous springs in Harrowgate originate. It is one of the springs which supplies the hospital, built upon the edge of the bog. Its specific gravity at 58°, as determined by Dr. A. Hunter, is 1·0039. The saline constituents in the imperial gallon, according to the analysis of the same gentleman, are as follows :

Chloride of sodium	329	grs.
Sulphate of soda	6	
Chloride of calcium	27·6	
Chloride of magnesium	16·8	
Bicarbonate of soda	3·0	
	382·4	

Sulphuretted hydrogen gas	4·5	cubic inches.
Carbonic acid gas	5.4	
Azotic	8·1	
	18·0	

Class II. *Pure chalybeates.*

These springs are five in number. The following table shows the specific gravity of each according to the determination of Dr. A. Hunter :—

1. Oddy's pure chalybeate ... 1·0007 at 58°
2. Old spa ... 1·0003 at 56°
3. Tewit well ... 1·0003 at 56°
4. St. George's well ... 1·0005 at 59°
5. Starbeck's chalybeate ... 1·0005 at 57°

Oddy's chalybeate was discovered in the year 1818. It was first subjected to analysis by Dr. A. Hunter, who found the saline contents of the imperial gallon as follows :—

Protoxide of iron	1·8	grs.
Common salt	5·0	
Sulphate of soda	3·5	
Chloride of calcium	6·0	
Chloride of magnesium	4·0	
	20·3	

Carbonic acid gas	5	cubic inches.
Azotic gas	8	
Oxygen gas	1	
	14	

The *Old spa* or *sweet spa* was discovered by Dr. Michael Stanhope in 1631. It is situated on the common of High Harrowgate, near the Granby Hotel, and adjoining the Knaresborough road. For many years it has been the principal Harrowgate chalybeate. The saline contents in the imperial gallon of this water, as determined by Dr. A. Hunter, are the following :

Protoxide of iron	2·5	grs.
Carbonate of lime	7·5	
	10	

Carbonic acid gas	5·25	cubic inches.
Azotic gas	6·0	
Oxygen gas	0·5	
	11·75	

The iron is kept in solution by carbonic acid.

The *Tewit well* was the first mineral spring discovered in Harrowgate, and was much frequented almost three centuries ago. Many volumes have been published on its medical virtues, and the most exaggerated accounts have been given of the surprising cures which it performed. To it Harrowgate is indebted for its rise and celebrity ; yet this spring, though possessed of all the virtues which it ever had, is now almost entirely neglected, and even its situation unknown to many of the inhabitants of the place. It is situated at the extreme eastern corner of the common near the Leeds and Harrowgate road, in a rough and swampy piece of ground. Dr. A. Hunter subjected it to an imperfect chemical analysis. From the imperial gallon of the Tewit spring he obtained—

Protoxide of iron	2	grs.
Earthy salts	8	
	10	

Carbonic acid gas	5	cubic inches.
Azotic gas	5·75	
Oxygen gas	0·75	
	11·5	

Hence it would appear not to differ much from the Old spa.

St. George's well is about fifty yards from Oddy's chalybeate, on the outside of the fence and close to the road. It is entirely neglected, and has not even a stone basin to receive the water, which is pure and light, though it contains less iron than any of the preceding chalybeates. The saline constituents in the imperial gallon are, according to Dr. A. Hunter, as follows :—

Protoxide of iron	1	gr.
Earthy salts	9	
	10	

Carbonic acid gas	5·25	cub. in.
Azotic gas	5·5	
Oxygen gas	1	
	11·75	

Starbeck chalybeate is very near the sulphureous spring of the same name. In its general properties it coincides with the other chalybeates; but it is kept with so much neatness, and is so bright and so clear when taken from the well, that it is generally preferred by the visitors, though the weakest of all the chalybeates. The saline constituents in the imperial gallon are, according to Dr. A. Hunter, as follows :—

Protoxide of iron	0·75	grs.
Common salt, with some earthy salts	17·25	
	18·00	

Carbonic acid gas	3	cub. in.
Azotic gas	8	
Oxygen gas	1	
	12	

Class III. *Saline Chalybeates.*

To this class there belongs only one spring, namely, Oddy's saline chalybeate or Cheltenham spring, which is so important in its nature and effects, and differs so much from all the rest, that it is entitled to a place by itself. It is situated

about two hundred yards from the promenade-room, in a field adjoining the Leeds and Ripon road. It was discovered in 1818, while boring in search of sulphur water to supply the increasing demands for the baths. Water was found at the depth of eight yards in the lowest part of the narrow valley, and a few yards from the fence adjoining the road. The alluvial earth being removed, a layer of clay was found, beneath which was a bed of sand covering a dark bluish stratum of shale, from under which the water issued. A cistern was afterwards prepared for its reception, and when the value of the water became known, a neat pump-room was built and other suitable improvements effected. The specific gravity of this water, as determined by Sir Charles Scudamore, is 1·0046 at 60°. Dr. A. Hunter found it 1·0076 at 59°. This last gentleman from the imperial gallon of this water obtained the following quantity of saline constituents:—

Carbonate of iron	5·3 grs.
Common salt	576·5
Chloride of calcium	43·5
Chloride of magnesium	9·65
	634·95

Carbonic acid gas	5·75 cub. in.
Azotic gas	7·75
	13·5

This water is not only impregnated with a considerable proportion of carbonate of iron, but from the quantity of purging salts which it contains, counteracts the binding effect of the iron, and may therefore be persisted in without injury for a longer time than Tunbridge Wells or any pure chalybeate, unless the effects of the iron in these waters on the intestines be counteracted by the administration of purgatives. It may be taken, with proper management, either as a tonic, an alterative, or aperient. It is, therefore, a valuable medicine in derangement of the liver and debility of the stomach. Indeed it may be considered as in some measure uniting together the virtues of the spring at Tunbridge Wells, and some of those at Cheltenham. It is, therefore, a valuable water to Harrowgate, because it saves the invalid from the necessity of being obliged to repair to Cheltenham or Leamington after having exhausted the virtues of the sulphur water.

Class IV. *Saline Springs.*

These waters contain more or less of purgative salts, but they are destitute of iron and of sulphuretted hydrogen. There are two such at Harrowgate, namely, *Crescent old well* and *Knaresborough dropping well.*

The specific gravity of these two wells, as determined by Dr. A. Hunter, is as follows:—

Crescent old well ..... 1·0033 at 52°
Dropping well ..... 1·0032 at 55°

The *Crescent old well* is situated in the garden behind the Crescent Inn, and immediately adjoining the promenade room. It was first analysed by Dr. Garnet, who bestowed very high encomiums on its virtues. But it would appear to have considerably deteriorated since his time. It seems at one time to have contained a notable quantity of sulphuretted hydrogen; but in 1829 no trace of that gas or of iron could be detected. The saline contents in the imperial gallon of this water are, according to the analysis of Dr. A. Hunter, as follows:—

Common salt	107 grs.
Sulphate of soda	27
Chloride of calcium	10·1
Chloride of magnesia	7·4
Carbonate of lime	4·0
	155·5

Carbonic acid gas	6 cub. in.
Azotic gas	8
	14

Knaresborough dropping well has been long famous on account of its petrifying powers. It is mentioned in Leland's Itinerary, who, after describing its properties, adds, "There was once a conduit of stone made to convey water from this well over Nid to the Priory of Knaresborough; but this was decayed afore the dissolution of the house."

The water of the dropping well rises in a deep narrow dell, about fifty yards from a rock, over the projecting ledge of which it trickles and falls from a height of ten feet, giving a good idea of a natural shower bath. It is over against the castle on the south side and near the edge of the river Nid. The saline constituents in the imperial gallon of this water, according to the analysis of Dr. A. Hunter, are as follows:—

Carbonate of soda	6 grs.
Sulphate of lime	132
Sulphate of magnesia	11
Carbonate of lime	23
	172

Carbonic acid gas	7 cubic inches.
Azotic gas	8
Oxygen gas	1
	16

II. Moffat Sulphureous Spring.

This is the most celebrated sulphureous spring in the south of Scotland. The village of Moffat lies at the bottom of a range of transition mountains, which stretch with little interruption from St. Abb's Head, the south-eastern extremity of the frith of Forth, to the western coast of Scotland, where they lose themselves in the sea on the north side of Loch Ryan, in Galloway. The situation is fine, owing chiefly to the contrast between the bleak and green mountains constituting the back-ground, and the finely wooded little hills and fertile fields in the immediate vicinity of the village. There is an extensive view to the south, over the valley of Annandale, bounded only by the distant mountains of Cumberland and Galloway. The mountains behind Moffat are composed of gray-wacke, transition, greenstone, and transition slate: whether alum-slate be present is doubtful. The well is about a mile and a half from the village, and is said by Dr. Garnet to take its rise in a bog; but the writer of this article, after some pains in examining this spot, could not satisfy himself of the accuracy of this statement.

The sulphureous well at Moffat has been resorted to by invalids for many years. An analysis of it was published by Mr. Matthew Mackail, of Edinburgh, in 1659. Sir Robert Sibbald describes it in his Nuncius Scoto-Britannus, published in 1683. A short treatise on it appeared in the first volume of the Edinburgh Medical Essays in 1746, written by Mr. George Milligan, at that time a surgeon in Moffat. Dr. Johnston, who long practised medicine at Moffat, drew up an account of it, which was published by Dr. Garnet, in his tour through Scotland, about the end of the last century. Dr. Garnet spent a summer at Moffat during the year 1797. He made an analysis of the water, and obtained from a wine gallon of it the following constituents:—

Common salt	36 grains.
Sulphuretted hydrogen gas	10 cub. in.
Azotic gas	4
Carbonic acid gas	5
	19

Dr. Thomson of Glasgow analysed it in the year 1823. He found its specific gravity 1·00255. The water as it issues from the pipe is transparent and colourless; but when kept for some time, it becomes opal-coloured, as is the case with water impregnated with sulphuretted hydrogen gas. It has the well-known odour of this gas, and a slightly sweetish taste. The constituents in the imperial gallon of this water, according to the analysis of Dr. Thomson, are as follows:—

Common salt	176·569 grs.
Sulphate of soda	16·562
Sulphate of lime	11·579
Sulphate of magnesia	5·474
	210·184

Sulphuretted hydrogen gas, 21·29 cub. in.

The quantity of this gas was determined by a small quantity of sulphate of copper having been put into a bottle of the water upon the spot at the instant of filling it. The precipitate (sulphuret of copper) was dissolved in nitric acid, and the sulphuric acid formed was precipitated by chloride of barium. 4·27ths of the precipitate gives the amount of the sulphur in the quantity of water employed. Two grains of sulphur are equivalent to 5·841 cubic inches of sulphuretted hydrogen gas. Hence, to find the quantity of this gas in cubic inches in the volume of water analysed, multiply the weight of sulphur found by 2·92; the product will be the number of cubic inches required. This is a much more accurate method than extricating the gaseous contents of the water by boiling and analysing them by absorption; because sulphuretted hydrogen gas is so soluble in water, that a portion of it must always disappear during the process; whereas sulphate of copper throws down the whole sulphur present in the water, and this sulphur is wholly converted into sulphuric acid when the sulphuret is dissolved in nitric acid. Acetate of lead cannot be used, because the lead would be thrown down not only by the sulphur, but also by the sulphuric acid contained in the water.

III. Strathpeffer Sulphuretted Water.

This mineral water is situated in the valley of Strathpeffer, a few miles west from Dingwall, the county-town of Ross-shire, in the north of Scotland. The situation is romantic, and the neighbouring country fertile and exceedingly beautiful. The wells seem to rise in the new red sandstone of which the country is composed, and are at no great distance from the lofty mountains of Ben Nevis, so conspicuous in the north of Scotland. These wells had been long known as medicinal, and an imperfect analysis of them was published by Dr. Donald Monro in the Philosophical Transactions for 1772. They were brought into considerable celebrity by Dr. Morris, an Aberdeenshire gentleman, who built a pump-room, and was enthusiastically attached to these waters, which he affirmed to be the strongest and most salubrious in Great Britain. This gentleman died in 1824, and thus the wells were deprived of his valuable patronage.

There are two wells at a little distance from each other. Their temperature was found by Dr. Thomson, on the 24th of June, 1824, to be 39°·75′, that of the air at the time being 60°. The day happened to be rainy. The specific gravity of these wells was found at the same time to be as follows:—

Upper well	1·00193
Lower well	1.00091*

It is the lower well which is supplied with a pump-room. It is obviously the weaker of the two.

An imperial gallon of the lower spring, according to the analysis of Dr. Thomson of Glasgow, contains the following constituents.

Sulphate of soda	52·710 grs.
Sulphate of lime	30·686
Common salt	19·233
Sulphate of magnesia	4·855
	107·484

Sulphuretted hydrogen gas, 13·659 cub. in.

An imperial gallon of the upper spring was found to contain—

Sulphate of soda	67·770
Sulphate of lime	39·454
Common salt	24·728
Sulphate of magnesia	6·242
	138·194

Sulphuretted hydrogen gas, 26·167 cub. in.

IV. Rothsay Sulphuretted Water.

This spring was discovered in 1831 by Mr. Richmond. It lies about half a mile east from Rothsay, the county town of Bute. The situation is magnificent. The town forms a kind of amphitheatre, lining as it were a semicircular bay. From this bay the sea, divided by the point of Towart, the southernmost extremity of Cowal, forms what appears to the eye two magnificent rivers. The first of these, constituting the Kyles

* The specific gravity of two other specimens was found in 1828 as follows:—

Upper well	1·0022
Lower well	1·0015

Hence their strength obviously varies with the weather.

of Bute, about a mile wide, and gradually narrowing to little more than half a mile, separates the island of Bute from Argyleshire to the north-west of Rothsay. The other, about six miles wide, passes to the north, dividing the county of Argyle from Ayrshire and Renfrew, and gradually narrowing into the river Clyde. This division proceeds southwards, and after passing by Bute and Arran with its beautiful mountains, gradually widens to at least 80 miles. The banks on both sides of this frith are of the boldest and most romantic description, and want nothing capable of constituting one of the most splendid pieces of sea scenery that Great Britain can anywhere exhibit.

This water, as it rises from the sand, (for it is situated very near the shore,) is transparent and colourless. Its taste is disagreeably salt, and its smell that of sulphuretted hydrogen gas. Its specific gravity, as determined by Dr. Thomson, is 1·0228.

This spring rose a few feet distant from an old quarry-hole filled with stagnant water, which contained no sulphuretted hydrogen gas, and its specific gravity was considerably less than that of the spring. The Marquis of Bute, to whom this part of the island belongs, employed a number of workmen, during the summer of 1831, to drain the quarry, in order to trace the source of this mineral spring; but before they had completed their object, a high tide made its way to the quarry-hole, and filling up the cavity with water, destroyed the undertaking, and it was not again renewed. In consequence of this injudicious attempt, the sulphureous spring ceased to flow; but it has again broken out a few feet nearer the sea, and probably were the quarry drained and deepened, and a wall built to keep off the sea, a regular sulphur spring might be obtained, from which the sea-water would be excluded.

The saline constituents in the imperial gallon of this water, as determined in the winter of 1830–1 by Dr. Thomson, are as follows:—

Common salt	1860·73 grs.
Sulphate of lime	125·20
Sulphate of soda	129·77
Chloride of magnesium	32·80
Silica	14·39
	2162·89

Sulphuretted hydrogen gas, 17·4 cub. in.

From the nature of these constituents, we think there can be little doubt that the sulphur spring had been contaminated with sea-water. Indeed it was situated so near the sea that it must have been overflowed at high spring-tides. Of course, before the real nature of this water (with the exception of the sulphuretted hydrogen gas which it contains) could be accurately known, it would be necessary to exclude the sea completely, and then to analyse it again, after all the sea-water had been removed.

V. Enghien Mineral Water.

Enghien, or Montmorency, is a small town, not far from the right bank of the Seine, about four miles from St. Denis, and twelve miles from Paris. The mineral water of this place has been known for about a century, and has not been much frequented on account of the want of the requisite accommodations for visitors. Its taste is bitter and sulphureous. Its specific gravity is 1·00069; its temperature 59°, and it reddens paper rendered blue by litmus. When boiled, it lets sulphuretted hydrogen gas escape for a long time. It becomes first greenish, then milky, and deposits flocks of a vegeto-animal matter.

Its constituents in the imperial gallon, as determined by M. Henry, junior, are as follows:—

Common salt	3·54 grs.
Chloride of magnesium	7·08
Sulphate of magnesia	7·43
Sulphate of lime	3·54
Subcarbonate of magnesia	2·69
Carbonate of lime	2·33
Silica	0.28
Sulpho-hydrate of lime and magnesia	3·94
Vegeto-animal matter, trace.	
	30·83
Azotic gas	3·88 cub. in.
Carbonic acid gas	33·94
Sulphuretted hydrogen gas	5·00

From this it appears that Enghien water is very weak, so far as the impregnation of sulphuretted hydrogen gas communicates medical virtue.

VI. Bareges Sulphureous Water.

Barèges lies in the department of the *Hautes Pyrénées*. It is situated in a small valley surrounded with high mountains. Formerly it was nearly inaccessible, but of late years a good road has been made to it. It is covered with snow during a considerable part of the year, and is only a pleasant residence during a few months in summer.

The mineral waters of Barèges were known to Cæsar and Sertorius. Marguerite, sister of Francis I. and queen of Navarre, in some measure restored them to the splendour which they exhibited in ancient times. Henry IV. frequented them a great deal during his youth. They were visited by Montaigne, and their celebrity was much increased in consequence of a visit paid them by Madame Maintenon in company with the Duc de Maine. Louis XV. built a military hospital at Barèges, which became celebrated for the numerous cures which were wrought in it by the use of the waters.

There are three springs: 1. the hot spring, which is very abundant; 2. the temperate spring, which is colder and not so copious; 3. the lukewarm, which is still colder and more scanty than either of the other two. There are five baths.

The waters are clear and limpid; they give out the smell of sulphuretted hydrogen: their taste is sweet and rather unpleasant. Their surface is covered with a pellicle, which gives them an oily appearance. The temperature of these waters, according to Lomet, is as follows:—

First spring	113 degrees.
Second spring	100
Third spring	88¼

They are always colder in spring and summer than during winter. This is owing to the infiltration of melted snow. The specific gravity of these waters has not been stated, but it exceeds

that of distilled water very little. Their saline contents are very small in quantity, not exceeding, according to Longchamp, 1-3400th part of the weight of the water. They have been analysed by M. Poumier, who obtained from the imperial gallon of the royal spring, the oldest and most renowned, the following saline constituents:—

Chloride of magnesium	2·26 grs.
Common salt	2·46
Sulphate of magnesia	5·90
Sulphate of lime	9·52
Carbonate of lime	4·08
Sulphur	10·68
Silica	0·90
Vegeto-animal matter, trace.	
	25.80

Sulphuretted hydrogen gas 1·615 cubic inch.

If this analysis be near the truth, the water of Baréges is one of the weakest of the whole class of sulphureous waters. We have an account of this water by M. Longchamp, who informs us that it leaves 1-3400th of its weight of saline residue composed of the subcarbonate, muriate, sulphate and hyposulphate of soda, of a little subcarbonate of lime and magnesia, of a small quantity of silica, and of an animal matter to which he gives the name of *barégin*. He says that the sulphuretted hydrogen gas does not exceed 28-1000000 of the bulk of the water, which is a still smaller quantity than that deduced from the analysis of M. Poumier.

VII. Aix.

Aix is a small town, about twelve leagues from Geneva, and two and a half from Chambery. Its hot baths were frequented during the time of the Romans. They were repaired at the expense of the emperor Gratian; they are frequented from the month of May to the middle of September, when the season breaks up. The months of July and August are the most fashionable.

There are two wells; one called the *alum well*, or the *well of St. Paul*; the other called the *sulphur well*. These two springs are distant from each other about one hundred paces. They pass into leaden pipes, and are conducted into very large receivers. The principal building encloses the sulphur spring. It is called *Batiment Royal*. It is divided into a series of baths of different kinds.

The temperature of these waters is the same all the year round, except during the melting of the snow and during the equinoxial rains, when it is slightly diminished. The usual heat is 113°; that of the air in the baths is about 83°.75. The water is transparent, has an unctuous feel and a strong smell of sulphuretted hydrogen, which is dissipated by exposure to the air. The taste is sweetish and earthy. The *alum water* has a slightly bitter styptic taste, which the sulphureous water wants.

According to the analysis of M. Socquet, the imperial gallon of the sulphur spring contains the following saline ingredients:—

Animal extract	0·135 grs.
Sulphate of soda	2·24
Sulphate of magnesia	1·97
Sulphate of lime	4·88
Common salt	0·61
Chloride of magnesium	2·10
Carbonate of lime	7·32
Carbonate of magnesia	4·00
	23·255

Sulphuretted hydrogen gas	2·22 cubic inches.
Carbonic acid gas	3·14
	5·36

From this analysis it appears that the sulphureous spring at Aix is very slightly impregnated with sulphuretted hydrogen, and that it contains but an insignificant quantity of salts. The *alum spring* is stronger, though also very weak. It does not contain a particle of alum notwithstanding its name, but minute quantities of the following salts, according to the analysis of M. Socquet, —sulphate of soda, sulphate of lime, sulphate of magnesia, common salt, chloride of magnesium, carbonate of lime, carbonate of magnesia, and animal matter. The sulphuretted hydrogen gas is about two-fifths of that contained in the sulphur well, while the carbonic acid is about one-and-a-half times as much.

VIII. Aix-la-Chapelle.

Aix-la-Chapelle is a considerable town about twelve leagues west from Cologne and seven from Spa. It is situated in a beautiful and fertile valley, surrounded by well-wooded hills, and has been long celebrated for the salubrity of its air. The hot springs which it possesses were frequented by the Romans, and after having been long abandoned and forgotten, they were again restored by Charlemagne, who was so delighted with the baths of this place that he made it his residence, and was in the habit of holding his court in them.

The fundamental rock in the neighbourhood of Aix-la-Chapelle is calcareous. Over this lies a bed of micaceous sandstone, seemingly connected with the coal-beds, being often replaced by coal or slate clay. Three principal springs have been observed. The first, called the great spring, is situated on the east side of the town-house. The second is placed in the principal street of the town, called the *Grande Rue*, where we find the fountain set apart for the drinkers. The third spring is situated south-east from the first. These springs, which are copious, unite together, and are enclosed in vaulted reservoirs; the waters run out of different aqueducts of stone, wood, or lead, in the houses where there are baths. These exist to the number of four in the old town, namely, the emperor's bath, the little bath, St. Quirinus's bath, and the new bath. There are six in the new town, namely, Charles's bath, the bath of St. Corneille, two large baths called bains des seigneurs, the bath of the rose, and the bath of the poor.

The waters are clear and transparent; they have the smell of sulphuretted hydrogen gas, and an alkaline, saline, and hepatic taste. When allowed to cool, they lose their smell, taste, and transparency, and become milky. The temperature of the emperor's bath is 135½°; but as it issues from the ground, it is as high as 144°. The heat of Quirinus's bath is 120°; that of Cornelius's bath 119°. The specific gravity, before

boiling, is 1·012; after boiling, it becomes as high as 1·016.

The saline constituents of the imperial gallon of the water of the emperor's bath, according to the analysis of MM. Reumont and Monheim, are as follows:—

Carbonate of soda	35·343 grs.
Common salt	210·520
Sulphate of soda	18·694
Carbonate of lime	9·244
Carbonate of magnesia	3·119
Silica	4·997
	281·917

From the experiments of Monheim in 1812, it appears that 100 cubic inches of the gases disengaged from this water are composed of

Azotic gas	51·25 cubic inch.
Carbonic acid gas	28·26
Sulphuretted hydrogen gas	20·49
	100·00

But he does not determine the absolute quantity of these gases, which is the most interesting point. If any confidence can be put in the analysis of Kortum, the imperial gallon contains about 133 cubic inches of sulphuretted hydrogen gas. It is therefore much more strongly impregnated with this gas than any of the other sulphuretted springs which we have hitherto noticed.

The waters of Aix-la-Chapelle are more celebrated in a medicinal point of view than any other sulphuretted water whatever. They act with considerable energy, and are particularly valuable in all chronic diseases of the skin, in scrofulous sores, and in chronic rheumatism and gout. They have been recommended also in diseases of the liver, in diseases of the bones, in colics from metallic poisons—in short, in diseases to which sulphur or its compounds are considered applicable. When taken internally, the patient should drink them cautiously, and should scarcely take more than a couple of glasses at a time. When taken to the extent of a couple of quarts, they become purgative. They are at first disagreeable on account of the smell; but the patient soon becomes reconciled to their use. As a bath, they are particularly valuable in all cutaneous affections, and indeed in chronic ulcers in general.

IX. Loeche or Leuk.

Leuk is a small town in the Valais, six leagues distant from Sion, built upon the right bank of the Rhone, in a valley, the bottom of which has been channelled by torrents. The waters of Leuk are celebrated for the energy with which they act, and are not a little frequented, although the place does not afford all the conveniences to strangers that could be wished. These waters are known in the Valais by the name of *Baden*, (the baths). Within a circuit of about half a league there are eleven or twelve hot springs, most of which flow into the Dala. They issue from the bottom of a mountain covered at the summit with perpetual snow. The great spring issues from a place situated between the inn and the buildings of the baths. It constitutes a considerable rivulet, and furnishes water to various baths. It is unnecessary to describe the particular situations of the other springs.

The temperature of the great spring is 125¼°, and that of the coldest of the whole is 115¼°. About two hundred paces from the baths there rises a spring, which is always very cold, and which flows only from May to September.

The water exhales a slight odour of sulphuretted hydrogen gas. It is perfectly limpid, and has no peculiar taste. Pieces of silver left in it for a few days acquire a yellow colour, which is permanent. We are not in possession of any recent analysis of this water; but from the analysis of Morell it follows that an imperial gallon of it contains the following saline constituents:—

Common salt, with a little sulphate of magnesia	13·33 grs.
Sulphate of lime	175·00
Carbonate of magnesia	13·88
Carbonic acid gas	8·53
Protoxide of iron	4·28
	215·02

But no great confidence can be put in this analysis.

[The warm sulphureo-saline waters in this country, are the **White Sulphur, Red Sulphur, Salt Sulphur, &c. of Virginia.** The water of the White Sulphur was analysed by Prof. W. Rogers, of the University of Virginia. The wine gallon was found to contain the following ingredients:—

Gaseous Contents.

Sulphuretted hydrogen	2·5	cubic inches.
Carbonic acid	2	
Oxygen	1·448	
Nitrogen	3·552	
	9·5	

Solid Contents in a Pint.

Sulphate of magnesia	5·588 grs.
——— of lime	7·744
Carbonate of lime	1·150
Chloride of calcium	0·204
——— of sodium	0·180
Oxide of iron, a trace.	
Loss	0·410
	15·276]

IV.—Of Acidulous Waters.

The mineral waters of this class are characterized by the notable quantity of carbonic acid gas which they contain, and which gives them an acidulous and sharp taste, somewhat resembling that of brisk beer, which they lose when left for some time exposed to the atmosphere. Air-bubbles are continually rising through them and breaking at the surface of the liquid, which gives it the appearance of boiling. By exposure to the air or to a gentle heat, they lose the carbonic acid upon which their principal peculiarities depend.

These acidulous waters are easily known by their taste and briskness and by the property which they have of reddening (slightly but sensibly) paper stained blue by litmus. When the litmus paper is exposed to the air, the red tinge is gradually destroyed by the evaporation of the carbonic acid, and the original blue colour restored. Lime-water occasions a precipitate when mixed with a

portion of acidulous water; this precipitate is carbonate of lime. Should the quantity of carbonic acid present be great, and the quantity of lime-water used small, it might happen that the original precipitate produced by the addition of lime-water might be again dissolved. But should this take place, we have only to leave the mixture for some time exposed to the atmosphere, and the precipitate will again appear.

These springs have always attracted a great deal of attention. The cold acidulous waters are much used in bilious affections, and in fevers, whether putrid or malignant, as an agreeable drink. Even in chronic cases they are not without utility. They are considered as having a peculiar action on the stomach and intestines. Probably their virtues depend in some measure on the mechanical action of the carbonic acid which they contain. When strongly impregnated with carbonic acid gas, they sometimes affect the head of those that use them too liberally, producing a species of temporary intoxication, similar to that occasioned by the use of brisk beer or champagne wine. It is obvious that they must be injurious to those who are troubled with habitual flatulence, indicating a bad tone of the stomach or an imperfect digestion. In such cases considerable quantities of carbonic acid are apt to be generated in the stomach, and the addition of liquids charged with that gas would be only increasing the quantity of a substance which is already producing inconvenience.

[Most of them contain either carbonate of soda or iron, or both; and their efficacy is, of course, partly dependent upon the amount of these ingredients. The carbonic acid always, however, communicates decided qualities to them. It gives them a piquant taste, their excitant agency upon the stomach, and their exhilarating effect upon the system. The Pyrmont water is said to be drunk by the country people, partly as a medicine, and partly on account of the kind of intoxication it induces. The Congress, and other waters of Saratoga, are mainly indebted for their agreeable qualities to the carbonic acid which they contain. It is the pleasant ingredient in the effervescing draught in soda powders, and in the soda water from the fountain; and it is to it that these preparations owe their power of arresting vomiting, and that soda water and Seltzer water aid digestion, when taken during a repast.]

The easiest method of determining the quantity of carbonic acid gas in a mineral water, is to put a certain portion of it into a flask, from the mouth of which there passes a glass tube which plunges into a Wolfe's bottle filled with lime-water, or, what is better, with barytes water. The Wolfe's bottle should be filled with the liquid in question, and a bent tube from one of the mouths of the phial passes into a pneumatic trough to collect the other gases which the water may contain. The carbonic acid gas is absorbed by the barytes or lime-water, and precipitated in the state of carbonate of barytes or of lime. This carbonate, when the process is finished, is to be separated from the liquid, and after being carefully washed and dried, is to be weighed. 1·225 grains of carbonate of barytes indicate 2·75 grains of carbonic acid. Hence, if we multiply the weight of carbonate of barytes obtained by 0·2245, the product will be the weight of carbonic acid gas contained in the volume of the acidulous water subjected to examination. And as 100 cubic inches of carbonic acid gas under the mean pressure and temperature weigh 47.4691 grains, it is easy from the weight thus found to deduce the number of cubic inches of the gas.

When we use lime-water, 6·25 grains of the precipitated carbonate of lime contain 2·75 grains of carbonic acid. Hence, if we multiply the weight of carbonate of lime which we get by 0·44, the product is the weight of carbonic acid gas in the portion of the water which we have subjected to examination.

We have only one acidulous water in Great Britain. On the continent there occur more than one variety of these waters, some of which have acquired considerable celebrity. On that account we shall notice a few of the most remarkable in this place.

I. Ilkeston Water.

This water, situated near the old market-town of Ilkeston, in Derbyshire, about eight miles from Nottingham, has lately acquired considerable celebrity, and deserves on that account, and because it is the only acidulous water at present known to exist in Great Britain, to be noticed in this article.

The history of its discovery, as it has been stated to us by a Nottingham gentleman, is as follows:—The Rutland colliery being very much annoyed by an immense body of water accumulated in the waste workings of the old Ilkeston coal-field, an engine was erected on one of the level pits of the latter, to assist in draining the works. Close to the engine was made a reservoir, partly to supply the boiler, and partly to be used as a warm-bath. The water had been observed to have the smell of sulphuretted hydrogen, and it irritated the hands of the workmen who put down the pumping apparatus and kept it in order. These circumstances led to the suspicion that it contained ingredients different from those in common water, and the engineer was ordered, when he next emptied the boiler, to put it into a tub, from an expectation that the concentrated water might deposit its contents, and thus betray their nature. The consequence of this was the deposition of a crop of beautiful crystals, which were found to act as aperients. This discovery led to the extensive use of the water, both as a bath or external application, and as an internal remedy, both in its natural and concentrated state.

The beds in this part of the country consist of the usual coal metals which dip to the north-east. The grand subterranean reservoir is formed by the excavations made in getting the bed of hard coal, and the water doubtless acquires its mineral impregnation as it soaks through the different coal metals from the surface.

The Ilkeston water was analysed by Dr. Fyfe, of Edinburgh, Dr. Calvert, of Derby, and Mr. Greeves, of Nottingham. But we have not seen the results obtained by any of these gentlemen, except the last. He obtained from the wine pint of this water the following constituents:—

Carbonic acid	0·4189 grs.
Sulphuric acid	1·3
Muriatic acid	1·1678
Lime	1·3323
Magnesia	0·5700
Soda	0·5860
	5·3750

These he considered as existing in the water under the form of the following crystallized salts:

Carbonate of lime	0·34375 grs.
Carbonate of soda	2·0000
Muriate of lime	4·8000
Sulphate of magnesia	2·5900
Sulphate of soda	0·5905
	10·32425

Mr. Greeves informs us that he found also in the water a large quantity of uncombined carbonic acid gas, a considerable portion of sulphuretted hydrogen gas, and a little iron. If we abstract the water of crystallization from the preceding salts, they will be reduced to the following quantities:—

Carbonate of lime	0·34375 grs.
Carbonate of soda	0·7500
Muriate of lime	2·2590
Sulphate of magnesia	1·2630
Sulphate of soda	0·2624
	4·87815

Now, as 4·87815 grains is much less than 5·375 grains, the weight of the constituents stated by Mr. Greeves to have been extracted by him from a pint of the Ilkeston water, it is obvious that he has committed some mistake in his calculations.

In the month of November, 1832, a young Nottingham gentleman, a student of medicine in the college of Glasgow, brought to Dr. Thomson, professor of chemistry in that university, two wine bottles of the Ilkeston water, and a wine bottle of the concentrated water. It was subjected to a chemical examination, as minute as was consistent with the small quantity of water to be operated upon. We shall now relate the result of that examination.

The water was transparent and colourless, destitute of smell, and without any sensible saline taste. Its specific gravity was 1·00049. It rendered cudbear paper violet, and therefore contained an alkali. 9726 grains of it being evaporated to dryness, with the requisite care to avoid loss, left a saline residue weighing 4·85 grains.

From some previous trials on another portion of the water, it was found to contain sulphuric acid, chlorine, and carbonic acid, together with soda, lime, and a little magnesia. It was the knowledge of these circumstances which regulated the analysis of the 4.85 grains of saline residue.

Being digested in water, it left undissolved 1·65 grains of sulphate of lime. The portion dissolved yielded the following substances, when minutely analysed:—

Sulphuric acid	0·71 grs.
Chlorine	0·74
Lime	0·311
Magnesia	0·035
Soda	1·11
Silica	0·059

The 1·65 grains of sulphate of lime were composed of,

Sulphuric acid	0·97 grs.
Lime	0·68
	1·65

Hence, the whole sulphuric acid	1·68 grs.
Lime	0·991

A portion of the soda was in the state of carbonate, and the carbonic acid with which this portion was united was found by calculation to be 0·207 grains. Thus the whole constituents extracted from the 4·85 grains of saline residue were 4·763 grains. There was, therefore, a loss of 0·087 grains. There was found beside a trace of oxide of iron and a little silica. But both of these certainly did not exceed 0·02 grains. The loss, 0·067 grains, therefore, was probably owing to the presence of a minute quantity of something not discovered, for the analysis was so conducted that there could scarcely be any loss. These constituents were probably combined in the mineral water so as to constitute the following salts:—

Sulphate of lime	1·650 grs.
Sulphate of magnesia	0·105
Sulphate of soda	1·280
Chloride of calcium	0·722
Common salt	0·568
Carbonate of soda	0·4008
	4·7258

Hence the imperial gallon must contain—

Sulphate of lime	11·883 grs.
Sulphate of soda	10·704
Sulphate of magnesia	0·756
Chloride of calcium	5·200
Common salt	4·091
Carbonate of soda	3·355*
Silica	0·455
	36·444

The sulphuretted hydrogen and carbonic acid gas had made their escape during the conveyance of the water to Glasgow, and could not therefore be ascertained.

The bottle marked concentrated Ilkeston water had a pretty deep reddish brown colour, a saline and bitter taste, and gave a deep violet colour to cudbear paper. When an acid was dropped into it, a pretty brisk effervescence took place, showing clearly the presence of an alkaline carbonate. The specific gravity was 1·04107. This liquid was not precipitated by oxalate of ammonia, nor did prussiate of potash produce any alteration in its colour. The colouring matter was found to be a vegetable substance; but it was present in too small quantity to permit its nature to be determined.

* This is made up by supposing the loss to have been carbonate of soda, as it undoubtedly was.

Five hundred grains of this water being evaporated to dryness, left 24·6 grains of saline residue in two different trials. These 24·6 grains being subjected to analysis, were found to consist of,

Sulphate of soda	8·676 grs.
Common salt	2·483
Carbonate of soda	13·855
	25·014

Besides a trace of lime, oxide of iron, and oxide of copper. There is an excess in this analysis amounting to 0·414 grains. It is owing, we believe, to the sulphate of soda, into which the whole salt was ultimately converted, not having been long enough heated to drive off every trace of moisture.

The constituents of the imperial gallon, according to this analysis, are,

Sulphate of soda	1264·80 grs.
Common salt	361·96
Carbonate of soda	2015·80
	3642·56

The difference between the saline constituents of the concentrated and unconcentrated water is so great, that it cannot be explained on any other supposition than that various kinds of springs exist at Ilkeston, and that a very different water has been concentrated from that which was brought under the name of unconcentrated water. Even the supposition that carbonate of soda had been added on purpose to the concentrated water, would not account for the anomaly, as the sulphuric acid and chlorine bear very different ratios to each other in the unconcentrated and concentrated water.

II. Pyrmont Water.

Pyrmont is situated near the river Weser, about four leagues from Hamelet, in Westphalia. The springs rise in a beautiful and fertile valley, and amount to about six. These are—1. The *sacred fountain*, which issues from the ground with a remarkable noise. It supplies the water which the patients drink. 2. The bathing spring, distinguished by the name of the *boiling fountain*. 3. The *augenbrunnen*,* (*eye fountain*,) which, like the preceding spring, contains carbonate of iron. 4. The *new spring*, only recently brought into notice, and situated about a mile from Pyrmont; the other two springs are called the *salt well* and the *new salt well*.

The characters of these springs vary somewhat. The waters of the *sacred fountain* are limpid and colourless. They are covered as they issue from the ground with an atmosphere of carbonic acid gas, which is much more perceptible in winter than in summer. The temperature is always about 58½°. The specific gravity has been stated to be 1·0024. The *boiling spring* is not so clear and transparent as the preceding one, and it is constantly emitting numerous bubbles of carbonic acid gas. The *new spring* is remarkable for its agreeable flavour. It is the fashion to drink it mixed with wine. The *augenbrunnen* is weaker than the others, but possesses the same characters.

We have no modern analysis of these springs; but Westrumb, who was remarkable for his accuracy, has left us an analysis of them all which is probably very nearly correct. According to him, an imperial gallon of the *sacred fountain* contains the following saline constituents:—

Sulphate of soda	28·9 grs.
Common salt	12·2
Sulphate of lime	83·4
Carbonate of lime	34·8
Sulphate of magnesia	54·7
Chloride of magnesium	13·4
Carbonate of magnesia	38·9
Resinous matter	0·9
Protoxide of iron	10·5
	277·7

Carbonic acid gas 300 cubic inches.

He states the saline contents of the imperial gallon of the *boiling fountain* as follows:—

Sulphate of soda	37 grs.
Common salt	17·5
Sulphate of lime	97·5
Carbonate of lime	68·0
Sulphate of magnesia	60·1
Chloride of magnesium	15·0
Carbonate of magnesia	12·5
Silica	3·0
Resin	1·0
Protoxide of iron	9·0
	320·6

Carbonic acid gas 225 cubic inches.

This fountain is richer in saline constituents than the former, but contains less carbonic acid gas. The constituents of the *augenbrunnen* are as follows:—

Sulphate of soda	11 grs.
Common salt	5·5
Sulphate of lime	61·2
Carbonate of lime	38·0
Sulphate of magnesia	18·0
Carbonate of magnesia	11·0
Resin	1·0
Protoxide of iron	4·0
	149·7

Carbonic acid gas 135 cubic inches.

The saline contents of the imperial gallon of the *new spring* are as follows:—

Common salt	76·36 grs.
Carbonate of lime	72·73
Sulphate of magnesia	33·63
Chloride of magnesium	45·45
Carbonate of magnesia	23·63
Silica	2·73
Resin and extractive	5·45
Sulphate of iron	8·18
Protoxide of iron	7·26
	275·42

Carbonic acid gas 200 cubic inches.

The saline contents of the imperial gallon of the *salt spring* are as follows:—

Sulphate of soda	170 grs.
Common salt	704·4

* So called because it is used as an application to the eyes.

Sulphate of lime	69·6
Chloride of calcium	28·4
Carbonate of lime	36·4
Chloride of magnesium	32·4
Carbonate of magnesia	59·2
Alumina	7·6
Resin	2·0
	1110·0

Carbonic acid gas 236 cubic inches.

We perceive that this well is much more impregnated with common salt than any of the preceding.

The saline contents of the imperial gallon of the *new salt well*, according to the analysis of the same chemist, is as follows:—

Sulphate of soda	63 grs.
Common salt	532·4
Sulphate of lime	37·3
Carbonate of lime	64·8
Sulphate of magnesia	5·2
Chloride of magnesium	113·5
Carbonate of magnesia	3·0
Alumina	9·5
Resin	8.0
	836·7

Carbonic acid gas 230 cubic inches.

It is rather weaker than the preceding, though it differs but little in the proportion of carbonic acid gas.

III. Seltzer Water.

Seltzer, (or, as the Germans write it, *Selter*,) is a small town on the Rhine, about ten miles from Frankfort and thirty-six from Coblentz. This part of the country has been long known for its beauty, and it abounds in mineral springs. Those of Seltzer issue out of the earth about two hundred paces from the town, in a long narrow valley. The place is frequented by visitors during the summer season, and the water is sent in stone bottles, closely corked and sealed, to different parts of Europe.

Seltzer water is transparent and colourless, and sparkles much when poured into a glass. Its taste is slightly pungent, with a saline and decidedly alkaline flavour. If left exposed to the air, it soon loses its pungency, and its saline and alkaline taste becomes stronger.

As a medicine, this water has been in high repute ever since the days of Hoffmann, who recommended it as aperient and highly diuretic. It has been found useful in all those diseases for which acidulous waters are recommended, and at one time it was considered as almost a specific in calculous diseases, whether in the kidney or the bladder.

The most accurate analysis is probably that of Westrumb, who found the saline constituents of the imperial gallon of this water as follows:—

Common salt	185·5 grs.
Crystals of carbonate of soda	167·7*
Carbonate of lime	27·2
Carbonate of magnesia	15·7
Carbonate of iron	1.2
Silica	2·4
	399·7

* Equivalent to 62·88 grains of anhydrous carbonate of soda.

Carbonic acid gas 343·8 cubic inches.

So that 100 cubic inches of this water contain 124 cubic inches of carbonic acid gas. It is obvious from this that it has been saturated with gas under a certain degree of pressure. It is the richest in carbonic acid of any mineral water with which we are acquainted, excepting the waters of Guilenau, to be noticed afterwards.

IV. Pougues.

Pougues is a town situated on the great road from Paris to Lyons, distant about nine miles from Nevers. The country is fertile, and exhibits numerous little hills which add considerably to the beauty of the district. The principal mineral spring acquired great celebrity during the sixteenth century, having been visited by the prince of Mantua, Henry III. of France, Catharine de Medicis, Henry IV., Louis XIV. and many other eminent personages. The prince de Conti embellished the environs of the spring by planting trees around it. It lies in a limestone country, and is situated in a meadow about four hundred paces from the town and six hundred from the nearest limestone hill. The water is abundant at all seasons of the year. It is limpid and colourless. Its taste is pungent, and it is destitute of smell. When left in an open vessel, it deposits a small quantity of oxide of iron.

We are not aware that any later analysis of this water has been made than that of Hessenfratz in 1789, at a time when chemists were not in possession of such accurate methods as at present. The saline constituents of the imperial gallon, according to his experiments, are as follows:—

Carbonate of lime	112·96 grs.
Carbonate of soda	96·30
Common salt	20·37
Carbonate of magnesia	11·11
Alumina	3·24
Silica with protoxide of iron	29·63
	273·63

Carbonic acid gas 325.9 cubic inches.

If any confidence can be put in this analysis, the quantity of carbonic acid in the waters of Pougues does not fall short of that which exists in Seltzer water. It must answer all the purposes of Seltzer water, and be equally applicable to all the diseases for which that water is considered as a remedy.

V. Mont d'Or.

Auvergne, in which the small village of Mont d'Or is situated, abounds in acidulous waters. The hot mineral springs of Mont d'Or were known and frequented by the Romans, who have left monuments of their residence, several of which still remain. The village is situated in an elevated country about twenty-four miles from Clermont. The Monts d'Or, as they are called, are covered with snow during seven months of the year. It is only from May to September that they afford an agreeable residence. Indeed the accommodations are not very good.

The springs are four in number, which all rise

at the bottom of the mountain L'Angle. They are very near each other, and situated in a straight line, and traverse the village from north to south-west. The highest of these springs is distinguished by the name of St. Marguerite. Its waters are received in an open basin composed of cut stones. Near this basin, and a little to the right of it, is another spring, whose waters are of the same nature as those of St. Marguerite. The noise which it makes in issuing out of the ground has induced the inhabitants to give it the name of *the drum*. The second spring is called *Cæsar's bath* or *balneum cryptæ*. It is about fifty feet below St. Marguerite's spring. Its waters are enclosed in a very ancient edifice. There are two holes in the floor, through which the waters issue as if they were boiling. The third spring is called the *great bath*, or the *bath of St. John*, and is about twenty feet below the second. It is enclosed in a square gothic building. Within it is a rectangular basin divided into four parts, and three baths of tinned copper. The fourth spring, called the *Magdeline fountain*, is situated at the foot of Mount L'Angle: its waters flow into a square building in the centre of the *Pantheon Place*.

The waters of these four springs possess different properties. Those of the Magdeline are transparent and free from smell, and have an acidulous and saline taste. Their temperature is 107° 5. The surface is covered with a very thin iridescent pellicle. The specific gravity is 1·0015.

The properties of *Cæsar's bath* are analogous; but its temperature is 113°. It furnishes 2441 cubic inches of water per minute, which is not much less than nine imperial gallons.

The waters of the *great bath* have a slight taste. The temperature is about 108°. The waters of St. Marguerite are clear and limpid, and let fall no deposite in their channel. Their taste is acidulous and slightly styptic. Their temperature is about 40° or 42°. They are much used to dilute wine for drinking.

For the best analysis of these waters we are indebted to M. Bertrand, who published an excellent treatise on them. According to him the saline contents of the imperial gallon of these waters are as follows:—

Carbonate of soda	33·07 grs.
Sulphate of soda	9·97
Common salt	25·37
Alumina	10·85
Carbonate of lime	20·30
Protoxide of iron	1·92
Carbonate of magnesia	6·65
	108·13

Carbonic acid gas .... 4·79 cubic inches.

The waters of *Cæsar's bath*, according to M. Bertrand, are similar in their constitution to those of the Magdeline.

The saline constituents in the imperial gallon of the waters of the *great bath* are, according to the same physician, as follows:—

Carbonate of soda	35·00 grs.
Common salt	25·72
Sulphate of soda	8·50
Carbonate of lime	24·15
Carbonate of magnesia	8·22
Protoxide of iron	0·70
Alumina	6·82
Silica	5·25
	114·36

Carbonic acid gas .... 23·95 cubic inches.

These springs are considerably weaker in carbonic acid than some of the preceding, owing, probably, to their temperature.

V. Vichi.

Vichi is a small and very old town on the right bank of the Allier, situated nearly in the centre of France, in what was formerly the Bourbonnois. It lies in a valley from which the hills rise in an amphitheatre, and being covered with vineyards and orchards present a rich and agreeable landscape. The town is but poorly built, and the streets are narrow and disagreeable; but the springs are detached from it, and there are several excellent hotels and walks in their immediate neighbourhood. These springs amount to seven. 1. The *great grille*, so called because it is surrounded by a railing of iron. 2. The *little puit-carré*, which is enclosed. 3. The *great puitcarré*. Both of these are used only to supply water for the baths. 4. The *little boulet*, distant about one hundred paces from the *great grille*. 5. *Lucas's* spring, situated very near the *little boulet*. 6. The *great boulet*, which is in the neighbourhood of the hospital. These three last springs are inclosed in a cylindrical reservoir and surrounded with a wall, through which passes a tube to allow the waste water to escape. The advantage of this is, that the drinkers get the water before any of its gaseous contents have escaped. 7. The fountain of the *Celestines*, or of *the rock*, is at the bottom of a hill situated at the end of the town, and its approach is not very good.

The waters of the *great grille* and of the *puit-carré*, as they issue out of the ground, give out great bubbles of gas, which break upon the surface and exhibit the appearance of ebullition. The taste of the six first springs is acidulous and alkaline. They have a slightly sulphureous taste, and the waters of the great boulet and of Lucas's spring seem to be most impregnated with sulphuretted hydrogen gas. The water of the *Celestines* is pungent, and its surface is covered with small bubbles of gas.

These waters deposit a sediment consisting of carbonates of lime and magnesia and a little oxide of iron.

Cattle are particularly fond of these waters, and after having drunk them once, they endeavour to get at them if possible, and even cross the river Allier to reach them. The temperature of these different springs is as follows:—

Great grille	91½°
Great puitcarré	97
Little puitcarré	97½
Great boulet	86
Little boulet	73½
Fountain of the Celestines	63½

For the most recent analysis of these waters we are indebted to M. Mossier. The following tables exhibit the saline contents of the imperial gallon of these waters, according to the analysis of this gentleman:—

1. *Great Grille.*

Carbonate of lime	14·91 grs.
Carbonate of magnesia	2·78
Carbonate of iron	0·74
Carbonate of soda	320·46
Sulphate of soda	51·57
Common salt	21·17
	411·63

Carbonic acid gas .. 132·84 cubic inches.

2. *Great Puitcarré.*

Carbonate of lime	15·74 grs.
Carbonate of magnesia	2·78
Carbonate of iron	1·39
Carbonate of soda	300·00
Sulphate of soda	63·98
Common salt	35·93
	419·82

3. *Little Puitcarré.*

Carbonate of lime	21·29 grs.
Carbonate of magnesia	2·78
Carbonate of iron, trace	
Carbonate of soda	336·11
Sulphate of soda	65·28
Common salt	24·44
	449·90

4. *Great Boulet.*

Carbonate of lime	22·68 grs.
Carbonate of magnesia	2·50
Carbonate of iron	3·33
Carbonate of soda	310·37
Sulphate of soda	58·05
Common salt	10·18
	407·11

5. *Little Boulet.*

Carbonate of lime	30·46 grs.
Carbonate of magnesia	3·24
Carbonate of iron	3·24
Carbonate of soda	395·37
Sulphate of soda	28.12
Common salt	4·35
	464·78

6. *Fountain of Lucas.*

Carbonate of lime	31·57 grs.
Carbonate of magnesia	3·79
Carbonate of iron	1·57
Carbonate of soda	264·44
Sulphate of soda	60·09
Common salt	67·68
	429·14

VII. **Geilenau.**

The village of Geilenau is situated in the grand duchy of Nassau, at no great distance from the city of Frankfort. Its waters are acidulous, and have been long and deservedly held in high estimation; for they are perhaps the most strongly impregnated with that gas of any mineral waters in Europe. The water is clear and transparent, and sparkling. Its taste is pungent and acidulous, without any saline flavour. According to the analysis of Dr. Bischoff of Bonn, who published a treatise on the mineral waters of Germany and France in 1826, the saline contents of the imperial gallon of this water are as follows:—

Carbonate of soda	56 grs.
Sulphate of soda	0.84
Phosphate of soda	2·52
Common salt	2·73
Carbonate of lime	18·10
Carbonate of magnesia	20·37
Carbonate of iron	1·47
Silica	0·98
	103·01

Carbonic acid gas.....452·51 cubic inches.

Here the carbonic acid gas amounts to 1·6322 times its volume.

The mineral spring of Fachungen lies likewise in the duchy of Nassau, and at no great distance from that of Geilenau. It has also been analysed by Bischoff, who found the saline constituents in the imperial gallon of this water as follows:—

Carbonate of soda	149·89 grs.
Sulphate of soda	1·54
Phosphate of soda	0·007
Common salt	39·28
Carbonate of lime	22·75
Carbonate of magnesia	15·77
Carbonate of iron	0·84
Silica	0·77
	230·847

Carbonic acid gas.....373·86 cubic inches.

This water, though not so strongly impregnated with carbonic acid as the preceding, is yet well charged with it. It contains 1·3485 times its bulk of it.

VIII. **Eger.**

Egerland constitutes a wide valley at the western extremity of Bohemia, surrounded on all sides by eminences. It seems originally to have been a lake which burst its barriers between Culm and Konigsberg, and nothing of which remains but the river Eger, which flows through the valley, passes through a gorge between Culm and Konigsberg, and makes its way to the Elbe. The principal town in this district is Eger. In this valley there are several acidulous springs, which have acquired considerable celebrity. The spring which has been longest known, and which is most frequented, has received the name of *Franzensbrunnen*, from the name of one of the emperors of Austria, to whom it is indebted for much of the accommodations which it possesses. It was analysed by Reuss in 1792, by Trommsdorf in 1820, and by Berzelius in 1825. According to this last chemist, the constituents in the imperial gallon are as follows:

Sulphate of soda	222·44 grs.
Common salt	84·15
Carbonate of soda	47·29
Carbonate of lithia	0·34
Carbonate of lime	16·41
Carbonate of strontian	0·028
Carbonate of magnesia	6·125
Carbonate of manganese	0·392
Carbonate of iron	2·142
Phosphate of lime	0·210

Subphosphate of alumina	0·112
Silica	4·312
	383·931

According to Reuss, the imperial gallon of this water contains 446·17 cubic inches of carbonic acid gas. If this statement be correct, 100 cubic inches of the water must contain 160 cubic inches of this gas.

Berzelius has given us the fixed constituents of three other mineral springs in this district. They are all acidulous; but as the water which he analysed, was concentrated on the spot, and sent to a distance to be analysed, the gaseous contents could not be determined. It will be sufficient if we give, in the following table, the constituents obtained by Berzelius from the imperial gallon of each of these springs.

	Salt Spring.	Ferdinand's Spring.	The cross Spring.
	Grains.	Grains.	Grains.
Sulphate of soda	196·154	205·408	347·410
Common salt	79·933	81·998	123·627
Carbonate of soda	47·467	55·874	65·016
Carbonate of lithia	0·245	0·616	1·043
Carbonate of lime	12·936	36·561	35·861
Carbonate of strontian	trace	0·049	0·035
Carbonate of magnesia	7·273	27·790	24·780
Carbonate of manganese	0·112	0·960	0·350
Carbonate of iron	0·644	3·640	1·603
Phosphate of lime ..... } Subphosphate of alumina ..... }	0·224	0·049	0·028
Silica	4·473	6·104	3·535
Fluoric acid	—	trace	trace
Iodine	—	trace ?	—
	349·461	419·049	603·288

Specific gravity of Franzensbrunn ..... 1·005387
" " salt springs ..... 1·004883
That of the other two springs is not stated.

IX. Ems.

The celebrated mineral waters of Ems are situated on the north bank of the river Lahn, not far from Darmstadt and Nassau Dietz, in the duchy of Nassau, and about two hours' journey from Coblentz on the Rhine.

The mineral waters of this place have a temperature of 90°. Their taste is saline and bitter. They are considered by medical men as possessing virtues similar to those of Bath-water in England. They have been frequented for nearly three centuries, and employed both for bathing and internal use. Two springs have been set apart for baths, and two for drinking. We are not aware of any modern analysis of these springs. Many years ago, they were examined by Cartheuser, who detected in them soda, lime, and iron: but when he lived, the art of chemical analysis had made so little progress that it was not in his power to determine the weight of these constituents.

[The *Sweet Springs*, of Monroe county, Virginia, are the best specimen of simple carbonated waters in the United States. The temperature of the water is 73°.]

V. Of Hot Springs.

This division, though not natural, is at least convenient. It is obvious, from the preceding part of this article, that both sulphureous and acidulous and chalybeate waters may be hot as well as cold; for we have described several of each of these in the preceding sections. The saline springs are frequently hot also, as well as cold. We have reserved several of these for this section. The reason which induced us to give a separate section to the consideration of hot springs, is that there are several of them in this country which are possessed of a high reputation, and which have been long celebrated for the numerous cures which they perform, and frequented accordingly. Thus Buxton enjoys a high reputation for curing chronic rheumatism, while Bristol hot-well is equally celebrated for its salutary effects on consumptive patients. Now these waters contain so little saline matter, or indeed foreign matter of any kind, that we cannot avoid ascribing their medicinal properties chiefly at least to their temperature. Hence, considered in a medicinal point of view, such waters ought not to be overlooked, as they point out the particular temperature at which waters, when used as a bath, are most beneficial in removing certain complaints.

[The simple thermal waters have the same effect upon the economy as warm water and hot water baths. (See Bathing.) They have the great advantage, however, in rheumatic and other diseases, that their temperature continues the same, whatever may be the duration of the immersion.]

I. Matlock Water.

The situation of the village of Matlock is perhaps the finest in England. It lies in a mountainous part of Derbyshire, half-way down a pretty steep limestone hill, at the foot of which flows the clear and rapid stream of the Derwent, the steep banks of which are covered with a thick clothing of woods. The view is not extensive, but it is rich and picturesque in the highest degree. A number of springs issue from the limestone rock, all of them possessing the clearness and purity which characterize mountain streams. Many of them are of the mean temperature of that part of England, while there are others whose temperature is always steadily above that point. All the tepid springs arise from fifteen to thirty yards above the level of the Derwent, while those situated either above or below that level are cold. The supply of tepid water is very copious, and the temperature, as determined by Dr. Percival, is always very nearly 66°; according to Scudamore, 68°.

In its sensible properties, this water scarcely differs from common good spring-water. It is beautifully clear, and has no peculiar taste or smell by which it can be distinguished. When it first issues from the ground, it is said to curdle soap, owing, probably, to its containing carbonate of lime in solution; but this property it loses when left for a few days standing exposed to the air. Its specific gravity, as determined by Sir Charles Scudamore, is 1·0003.

This water has not been subjected to a regular analysis; but from the effects of tests upon it, we learn that it contains some carbonic acid gas and some carbonate of lime. There are present, also, sulphuric and muriatic acids in minute proportions. It contains also a little magnesia, and, probably, common salt; but from the specific gravity and sensible properties of this water, it is obvious that the saline constituents must be very minute in quantity.

As an internal remedy, it may doubtless be used with advantage in all cases where water as a di-

luent is advantageous. On this account, its internal use use may doubtless be advisable in dyspepsia and gravel. But it is as a bath that it is chiefly useful. Its temperature being 66°, it occasions but little shock on immersion, and is therefore peculiarly fitted for those delicate habits that cannot exert sufficient reaction to overcome the effects of the ordinary cold bath, and on which the benefits which it produces chiefly depend.

II. Bristol Hot Well.

This spring, formerly one of the most celebrated in England, is situate at the bottom and southern extremity of St. Vincent rock, a lofty cliff on the banks of the Avon, on the Gloucestershire side, about a mile below the city of Bristol, and four from the Bristol Channel, where the Avon flows into the sea. The country is exceedingly beautiful, and this beauty is owing in a considerable degree to the bold banks of the Avon, the hilly nature of the country, and the rich clothing of wood with which it is adorned. St. Vincent rock is composed of limestone, employed both as a building stone, and to be converted into quicklime.

The Hot well spring is a very fine clear water, discharging at the rate of about forty gallons in a minute. It has no smell, but is limpid and sparkling, and gives out air-bubbles when poured into a glass. It is very agreeable to the palate, and is, in fact, without any peculiar taste, and so pure, that it is employed by the inhabitants in preference for making tea or coffee. Its specific gravity is 1·00077. Its average temperature is 74°. It is slightly affected by the spring tides, which rise to an immense height in the Severn and Avon. It becomes somewhat turbid, and during these periods it is not used till by two hours' pumping the water returns to its original purity.

It has been repeatedly analysed, though not by modern chemists. The latest analysis which we have seen is by Dr. Carrick, published in the year 1797. The saline constituents in the imperial gallon of this water, according to his analysis, are as follows:—

Chloride of magnesium	8·7 grs.
Common salt	4·8
Sulphate of soda	13·5
Sulphate of lime	14·1
Carbonate of lime	16·2
	57·3
Carbonic acid gas	36 cubic inches.
Oxygen and azotic gases	3·6
	39·6

These salts are purgative; but their quantity is so trifling, not exceeding six grains in the wine-pint, that they can scarcely be supposed to produce any sensible effect. The carbonic acid gas rather exceeds one-ninth of the bulk. Its medicinal virtues, therefore, must be ascribed to its temperature chiefly.

When taken warm and fresh from the spring, it is said to produce a gentle glow in the stomach, sometimes succeeded by slight headach and giddiness. A continued use of it usually produces an increased flow of urine, while the skin is kept moist and perspirable; and the appetite and general health are usually improved by a residence at the Hot wells. These effects, we doubt not, would be equally derived from the use of any other pure water raised to the same temperature.

III. Buxton Water.

The tepid springs of Buxton have been long known and resorted to; indeed, it is probable that they were frequented during the time of the Romans. In the year 1572, a treatise on their virtues was written by Dr. Jones of Derby, from which we learn that at that time they were crowded with visitors from the neighbouring counties. They were examined in 1784 by Dr Pearson, and in 1820 they were subjected to a chemical analysis by Sir Charles Scudamore and Mr. Garden.

Buxton is situated at the north-western extremity of the county of Derby, on the borders of Cheshire, in a narrow valley surrounded on all sides by hills. The whole of this part of Derbyshire is mountainous and thinly inhabited. The hills are composed of mountain limestone, a well-known rock lying immediately under the coal-beds. Some of the hills at a little distance, as Mam Tor, are composed of sandstone, perhaps belonging to the coal formation. The mountain limestone of this district is distinguished for the numerous caverns which it contains, the most remarkable of which are Pool's Hole and the Peak Cavern.

The climate of this part of Derbyshire is cold and rainy; but the soil is of so dry a nature, that the moisture immediately runs off. Hence it happens that the shortest interval of good weather may be taken advantage of by the invalid. The high winds, though too often bleak and unpleasant, yet obviate all the inconveniences which attend stagnation. Much has been done by the Duke of Devonshire to embellish the place. The crescent in particular has a grand effect, when we descend towards it from the neighbouring hills.

The warm springs of Buxton rise into day through numerous small fissures in the limestone rock, and the supply of water is amply sufficient for the numerous baths and other purposes to which it is applied. The original and most ancient fountain is St. Anne's well, which is enclosed in an elegant stone building. It is appropriated for drinking. The other springs are employed for the baths.

Buxton water is clear and transparent, and does not sparkle. It has no smell and no taste by which it can be distinguished from common water of the same temperature. Its temperature as it issues from the earth is 82°, but in the basin its temperature is no higher than 77°. It gives out, soon after it issues to the day, no inconsiderable proportion of azotic gas, as was first ascertained by Dr. Pearson. Its specific gravity, when cooled down to 60° of Fahrenheit, is 1·0006.

Dr. Pearson was the first who attempted to analyse this water. From a wine-gallon of it he extracted the following salts:

Carbonate of lime	11.5 grs.
Sulphate of lime	2·5
Common salt	1·75
	15·75

The analysis of Scudamore and Garden in 1820 gives us the following as the saline constituents in the imperial gallon of Buxton water.

Sulphate of soda	0·76 grs.
Chloride of calcium	0·62
Common salt	2·16
Chloride of magnesium	0·70
Carbonate of lime	12·48
Extractive, &c.	1·44
	18·16

Carbonic acid gas	1·8 cubic inches.
Azotic gas	5·57
	7·37

The existence of azotic gas in this water, without any trace of oxygen, is not easily accounted for. In general, the azotic gas contained in mineral waters is merely what is imbibed from the atmosphere. It is accordingly mixed with oxygen gas; and as oxygen gas is more absorbable than azotic gas, the gas extricated from water by boiling is richer in oxygen gas than common air. When a water contains an impregnation of sulphuretted hydrogen gas, all the oxygen gas which it may have absorbed is of necessity abstracted. Water in such a case may contain carbonic acid gas, and it may also contain azotic gas; but here we have a water deprived of all its oxygen gas, without containing a trace of sulphuretted hydrogen gas. The quantity of azotic gas present is precisely what ought to be contained in Buxton water, on the supposition that it was imbibed from the atmosphere. But what has become of the oxygen gas? The imperial gallon should contain $1\frac{1}{3}$ cubic inch of it. We suspect strongly that it would be found were the water properly examined. For example, if a drop or two of newly dissolved sulphate of iron were dropped into a glass of Buxton water, and afterwards a drop of caustic potash added, it would be easy to see whether the water contained oxygen gas. If it did, the iron would be precipitated yellow; if it did not, it would be thrown down of a dirty green, which would not alter its appearance.

The great reputation of Buxton water depends upon its use as a bath. St. Anne's spring, however, is taken internally by invalids while enjoying the benefit of the baths. When taken internally, it is said to be inconveniently stimulating to some persons of a sanguineous temperament and full habit of body. It is said to produce headach, giddiness, and flushing of the face. It is not easy to account for these effects from its saline constituents. We are disposed to ascribe them, so far as they are not fanciful, to the temperature of the water. Nor have we any doubts that temperature enters as a most important ingredient in the effects which water produces when taken into the stomach.

But it is as a bath that the value of Buxton water is to be chiefly appreciated. It is to persons labouring under chronic rheumatism that it is most useful. The baths are highly convenient, and provided with every thing requisite for the convenience and accommodation of the bather. It is said in the first place to aggravate the symptoms; so that a patient is congratulated, when, upon first having recourse to it, his pains are augmented. Gouty patients are also benefited by the use of these baths; but they are considered as injurious to those who are labouring under a gouty paroxysm.

The best time for bathing is before breakfast, and it is better to plunge in at once than to step slowly in. At the instant of immersion a slight sense of chilliness is perceived; but this is speedily followed by a moderate degree of warmth and an agreeable sensation, which the patient compares to immersion in cream. At first he should not remain more than a few minutes in the bath. The proof that it agrees with the patient is that he derives an agreeable refreshment and a general increase of elasticity. It acts unfavourably when it occasions feelings of chilliness, lassitude, and a languid appetite.

Besides the tepid springs, Buxton possesses also a chalybeate spring, which rises (according to Sir C. Scudamore) from a bed of shale, on the north side of the river, near the George Inn. It is weakly impregnated with carbonate of iron, and contains very little saline matter. Its specific gravity is only 1·0003, and its temperature as determined by Scudamore is 54°.

IV. Bath Waters.

The city of Bath undoubtedly owes its existence, as it does its name, to the use of the warm springs in which it abounds. From the remains of Roman baths which have been discovered in it, we cannot doubt that these springs were noticed by the Romans, and employed by them to supply the luxury of a warm-bath. It continued to be more or less frequented during every period of English history; but it was not till the reign of Charles II. that it became a fashionable resort to the gay and the idle, as well as the invalid.

Bath is situated in a deep narrow valley in the county of Somerset, distant one hundred and seven miles from London, and twelve from Bristol. It was originally confined to the valley, and occupied a space amounting to about fifty acres. But the celebrity which it acquired induced the inhabitants to extend it in all directions, and it has gradually creeped up the hills with which it was originally surrounded. The elegant magnificence of its circuses and crescents is too well known to be dwelt on here. The view is not extensive, but it is rich and beautiful, while the city itself has no parallel for splendour in any part of England. It is situated in the great oolite formation, and the oolitic limestone of the neighbourhood is used as a building-stone. It is this circumstance chiefly which has given Bath such a superiority of appearance over the brick-built houses of the other towns of England.

The climate is mild but rainy; and the new town from its exposed situation is open to the west and south-west winds, which are the most frequent and most violent.

The hot springs in Bath are three in number, namely, the King's-bath, the Cross-bath, and the Hot-bath. These springs all rise at a short distance from each other at the lower part of the town, and not far from the Avon, into which the hot water flows after having supplied the several baths. The water is so abundant that all the reservoirs used for bathing are filled every evening with water fresh from the respective fountains.

According to Mr. Phillips, the temperature of the three springs is as follows:

Hot-bath	117°
King's-bath	114°
Cross-bath	109°*

Their specific gravities at 60°, as determined by Scudamore and Children, are as follows:—

Hot-bath	1·00245
King's-bath	1·00238
Cross-bath	1·00231

The water when first drawn is quite clear and colourless, and not the least brisk or sparkling. When left for some hours exposed to the air, it becomes muddy and lets fall a pale yellow ochre. The taste of the water while hot is chalybeate without any flavour distinctly saline; but if it be allowed to cool, the chalybeate taste vanishes, and you can hardly distinguish Bath-water from any other common water.

Bath-water has been frequently analysed. Dr. Lucas, Dr. Charlton, Dr. Falconer, and Dr. Gibbs, published experiments on it in succession; but by far the best and most satisfactory analysis is that of Mr. Phillips, published in 1806. (Phil. Mag. vol. xxiv. p. 342.) According to his experiments, the saline contents of an imperial gallon of this water are as follows:—

Sulphate of lime	86·41 grs.
Common salt	31·68
Sulphate of soda	14·40
Carbonate of lime	7·68
Silica	1·92
Protoxide of iron	0·02
	142·11

Carbonic acid gas	11·52 cub. in.

Through the water in the King's-bath, bubbles of gas are perpetually rising in considerable numbers. Mr. Phillips collected a portion of this gas and examined it: he found it a mixture of

5 volumes carbonic acid gas
95 volumes azotic gas
100

We have here, therefore, the same phenomenon as at Buxton, namely, azotic gas escaping from the water without any mixture of oxygen gas whatever. Is this absence of oxygen gas to be ascribed to anything connected with the temperature of the water? or is it connected with the small proportion of iron which it contains?

When Bath-water is newly drawn from the spring, it strikes a purple with the infusion of nut-galls, and a blue with a solution of prussiate of potash; but after remaining sometime exposed to the air, neither of these re-agents is capable of indicating the presence of iron. Mr. Phillips has shown that this alteration is owing to the presence of carbonate of lime in the water, and to the conversion of the iron by the action of the air from protoxide to peroxide. Carbonate of lime promotes the action of these two reagents on solutions of protoxide of iron, but it almost destroys their action in peroxide of iron.

* According to Dr. Falconer the temperature of the King's-bath is 116° and that of the Cross-bath 112°.

Sir Charles Scudamore made a set of experiments upon Bath-water in 1820. From these experiments compared with those of Mr. Phillips, he considers the saline constituents in the imperial gallon to be as follows:—

Chloride of calcium	11·52 grs.
Chloride of magnesium	15·36
Sulphate of lime	91·24
Sulphate of soda	8·64
Silica	1·92
Protoxide of iron	0·02
	128·70

The differences between these two results are owing chiefly to the mode of considering the constituents. Mr. Phillips evaporated the water to dryness and analysed the residue. Scudamore determined the weight of the constituents by precipitation, and then supposed them combined so as to constitute the most soluble salts. Both of these modes of proceeding are liable to objections; but we have made some remarks on the subject in a previous part of this article. The presence of magnesia in Bath-water was discovered by Scudamore.

So much has been written upon the medical properties of the Bath-water, that it may seem superfluous to touch upon the subject. As a bath, its value doubtless depends in a great measure on its temperature. It contains (if the last view of its saline constituents be taken) several salts which possess purgative qualities; and although the impregnation be not considerable, there can be no doubt that if a person continue the use of the water, they will at last produce a certain effect, especially the chlorides of calcium and magnesium, which act with considerable energy upon the living body.

The proportion of iron is small, and it exists in the water in the state of carbonate. But iron is so active a medicine even when administered in small quantities, that the iron in Bath-water cannot be without its effect upon the system.

Bath-water has been recommended by medical men as a remedy of no small efficacy in chlorosis, visceral obstruction, palsy, gout, rheumatism, colica pictonum, hypochondriasis, St. Vitus's dance, and lepra. These diseases are of so opposite a character, and require so very different treatment, that it is difficult to understand how Bath-water can be applicable to them all. As a bath, its temperature may render it valuable in gout, rheumatism, and lepra, and even in St. Vitus's dance. The ferruginous constituent might give it some value when taken internally as a remedy in chlorosis, while the saline constituents, joined to the temperature, might be conceived to give it some value as an internal medium in visceral obstructions, hypochondriasis, colica pictonum, and even palsy. But if we consider the very small quantity of iron present, and even of purgative salts, we can scarcely doubt that the principal benefits derived from the use of this water arise from its temperature.

The internal use of this water in cases of inflammation has been interdicted by medical men; and this prohibition is founded upon its stimulating qualities. We cannot avoid thinking that

much of the benefit resulting from the use of mineral waters is owing to the mode of living with which the employment of such waters is accompanied. If a person who has been in the habit of living fully, and indulging in the pleasures of the table without restraint, be suddenly removed from the centre of the metropolis, and placed in one of the parades or crescents of Bath, and if he be prevailed upon to enter upon a course of Bath-water, and to take the air and exercise with which such a course is accompanied, it is obvious that his general health will be greatly improved, and that improvement will be ascribed to the use of the waters, whereas in reality it is owing to the alteration in the mode of living — to the additional air and exercise, and the substitution, in part at least, of water for wine.

In gout the greatest benefit is derived from Bath-water in those cases where it produces anomalous affections of the head, stomach, and bowels. The principal advantage here is to be able to bring by warmth that active local inflammation in any limb which relieves all the other troublesome and dangerous symptoms. Hence it is commonly said that Bath-water produces the gout; by which is meant that when persons have a gouty affection shifting from place to place, and thereby disordering the system, the use of Bath-water will soon bring on a general increase of action, indicated by a flushing of the face, fulness in the circulating vessels, and relief of the dyspeptic symptoms; and the whole disorder will terminate in a regular fit of the gout in the extremities, which is the crisis always to be wished for. (Saunders on Mineral Waters, p. 187.) Scudamore considers their use as inadmissible when an active state of gouty diathesis is present, and likewise when the constitution is undermined by the long continuance of gout accompanied by irregularity of living. The reason of this restriction is too obvious to require any illustration. We refer the reader to Dr. Saunders's Treatise on Mineral Waters for some very judicious remarks on the use of Bath-waters.

V. Carlsbad Waters.

The village of Carlsbad (Bath of the Emperor Charles) lies at the south-west side of the kingdom of Bohemia in a narrow and dark valley, very near the hollow through which the river Eger runs. A brook, called the *Tepel*, flows through the middle of this small valley, and numerous hot springs rise on both sides of this brook at a little distance from each other. The number of these springs is very great; but five or six of them have been distinguished by names and chiefly used for the baths. These are the *sprudel* or furious spring, the muhlbrunnen or millspring, the neubrunnen or new spring, Theresienbrunnen or Theresa's spring, and Bernardsbrunnen or Bernard's spring. The springs rise through openings in a limestone-bed, over which conduits are erected, up which the waters are forced a certain way by the internal pressure, so as to suit the purposes of the bathers. This limestone-bed has been deposited by the waters themselves. It was broken through by the waters in 1713 and 1727, and the hot stream flowed directly into the Tepel. This induced the proprietors to pierce the limestone-bed in order to dicover the cause of this alteration and to prevent it from happening again. As soon as they made a hole in the upper bed, the water issued with violence, and various cavities of different sizes were observed filled with the water. The bottom of these cavities consisted of another bed of limestone, which was also pierced, and below it other cavities were observed from which the water rushed with still greater force. The bottom of these cavities consisted of a third bed of limestone. This being also pierced, a great reservoir of water was discovered which received the name of *sprudelkessel*, or cauldron of the sprudel. The thickness of each of the beds of limestone thus pierced was between one and two feet, and consisted of a white stone with brown bands, to which the name of *sprudelstein* (sprudel stone) has been given. These three beds are not concentric with each other. They constitute unequal spaces separated by partitions, as if hemispheric vases were placed reversed upon each other. The water in this reservoir was boiling with violence: its depth varied from three to four yards, and in one direction no bottom could be found with poles tied to each other to the length of thirty fathoms. It was from this place that the waters seemed to flow. This reservoir is of vast extent. We come upon the calcareous crust that covers it, if we dig down in almost any part of the village of Carlsbad, and when this crust is pierced, the hot-water rushes through it with violence.

Carbonic acid gas issues in such quantities from the crevices in this crust, that the cellars of the houses are filled with it, and from that part of the Tepel which is near the sprudel, we see bubbles of carbonic acid gas rise in great numbers.

The opening thus artificially made was shut up with mason-work, the joints of which soon became covered with sprudelstein. Thus the water was kept in its basin and obliged to rise by the ordinary openings, and to flow out from their mouths. These openings are gradually filled with sprudelstein deposited from the water, and this deposition takes place so rapidly that they require to be cleared out four times a year.

What is called the sprudel is an opening in the basin through which the water is driven out at intervals; for the water and gas rush out alternately. The upper parts of the basin become filled with carbonic acid disengaged from the hot-water, in consequence of the diminution of pressure as the water rises towards the surface of the earth. This gas, accumulating in the upper part of the basin, presses upon the surface of the water, and at last issues out instead of it at the opening. In this way the water and gas alternate about eighteen or nineteen times per minute.

The quantity of hot-water is immense. According to the measurements of Reuss, Fuhrmann, Damm, and Mitterbacher, the sprudel alone gives 192¾ millions of cubic feet of hot-water per day.

All the springs at Carlsbad have the same specific gravity, namely, 1·004975 at the temperature of 64½°. While under the earth they are all boiling hot; but their temperatures as they issue out of the ground are different, depending upon the degree that they have been cooled while passing from the sprudelkessel to the surface. The

temperatures of the principal springs have been stated by Becher, a physician, who resided on the spot and paid particular attention to Carlsbad water, as follows :—

Sprudel	164°·75
Neubrunnen	144.5
Muhlbrunnen	133·7
Theresienbrunnen	133·7
Schlossbrunnen	122·6

It was analysed with much accuracy by Becher in 1771, who obtained from 1000 parts of the water 5·55 of saline constituents, consisting of the following salts :—

Sulphate of soda	2·52
Carbonate of soda	1·54
Common salt	0·87
Carbonate of lime	0·56
Protoxide of iron	0·06
	5·55

He found that the water of the sprudel contained 0·39 of its volume of carbonic acid gas.

Klaproth analysed it in 1789, and obtained nearly the same results as Becher. From a thousand parts of the water he extracted the following constituents :—

Sulphate of soda	2·431 grs.
Carbonate of soda	1·345
Common salt	1·198
Carbonate of lime	0·414
Silica	0·086
Protoxide of iron	0·004
	5·478

Dr. Reuss examined them again in the year 1812. 1000 parts of the sprudel water contain, according to his analysis—

Sulphate of soda	2·405 grs.
Carbonate of soda	1·302
Common salt	1·163
Carbonate of lime	0·447
Carbonate of iron	0·004
Silica	0·080
	5·401

Berzelius subjected them to another examination in 1822, and discovered in it some magnesia, which preceding chemists had overlooked. From 625·4 grammes (9651·8 grains) of the water he obtained—

Sulphate of soda	1·618 grammes.
Carbonate of soda	0·790
Common salt	0·649
Carbonate of lime	0·195
Magnesia	0·054
Protoxide of iron	0·004
Silica	0·046
	3·356

During his analysis of the water, he met with several substances in minute quantities which had not hitherto been discovered in mineral waters; but he was able to determine their nature by analysing the calcareous deposit from the water, which yielded these new substances in appreciable quantities. The following table exhibits the saline constituents in the imperial gallon of Carlsbad water, according to his analysis :—

Sulphate of soda	182·00 grs.
Carbonate of soda	88·81
Common salt	73·06
Carbonate of lime	21·71
Fluate of lime	0·225
Phosphate of lime	0·015
Carbonate of strontian	0·067
Magnesia	12·540
Subphosphate of alumina	0·022
Protoxide of iron	0·254
Protoxide of manganese	0·059
Silica	5·286
	384·048

The carbonic acid gas in the imperial gallon, according to Dr. Reuss, amounts to 124·06 cubic inches. Doubtless the waters, before they issue from the earth, contain their own volume of carbonic acid at the temperature of 212°.

The waters of Carlsbad were accidentally discovered in 1358 by the emperor Charles IV. while hunting. The country all around would appear to be of volcanic origin. This may, perhaps, in some measure account for the heat of the water. With respect to its saline impregnation it is not possible to form any rational conjecture. From Berzelius's examination, the gas which this water contains is mixed with about one per cent. in volume of azotic gas without any trace of oxygen gas; so that we have the difficulty to account for the absence of this gas which occurred in the case of Buxton and Bath waters.

These waters, besides their high temperature, which fits them admirably for a bath when sufficiently cooled down, possess a notable quantity of purgative salts, sulphate of soda, carbonate of soda, common salt, and carbonate of magnesia. Hence they act upon the bowels when taken to a considerable extent. The secretions of urine, perspiration, and saliva, are also increased by the internal use of these waters. It is said to exhibit the effects of a general stimulant by increasing the pulse and heat, and even sometimes by inducing headach in plethoric and irritable habits. It is said also occasionally to bring on a kind of œdema in the feet, which continues for a day or two after using it as a bath. Some other symptoms are enumerated, rather proceeding from the too high temperature of the water than from any thing else.

The diseases for which these celebrated hot springs have been recommended are of the most various and opposite kind. It has been found of great use in dyspepsia and other derangements of the healthy action of the stomach. It is no less noted for its services in obstructions of the abdominal viscera, not connected with great organic disease, and in defect or depravation of the biliary secretions. They have been long celebrated for their efficacy in those calculous diseases in which the patient is in the habit of passing gravel. No doubt the carbonate of soda is the ingredient which renders them useful in these cases, when there is an excess of uric acid, and a disposition to deposit it from the urine.

The small quantity of carbonate of iron which

these waters contain, is probably the cause of their being recommended in derangements of the uterine system, and particularly in cases of sterility, which they are said to have a tendency to remove. In short these waters may be considered as in some measure combining the virtues of saline, chalybeate, acidulous, and hot springs.

VI. Plombieres Hot Spring.

The village of Plombieres lies in the department of the Vosges, in the ancient province of Lorrain. It is situated to the west of the Vosges mountains, in a deep valley, through which runs the small rivulet called Eau Gronne. The village is small, containing about 1200 inhabitants, but well-built, and the neighbourhood is beautiful and furnishes many delightful walks.

The hot springs for which this village is celebrated were known to the Romans, and for many years they have been frequented by invalids from different countries. The course prescribed to the patients is to continue the use of the waters for three weeks. If, at the end of this period, the patient is not cured, he gives up the use of the waters for a fortnight, and then begins another course, which continues as long as the first. The country is sandy and quite destitute of limestone.

The baths are four in number, supplied by different springs. 1. The *great bath* situated in the middle of the principal street, just behind the Arcades. It is divided into three parts, which are supplied from two different springs. 2. The *new bath*, supplied by three springs. 3. The *bath of the Capuchins*, immediately behind the new bath. 4. The *ladies' bath*, situated at the eastern extremity of the principal street of Plombieres.

The waters of Plombieres are limpid and colourless, and have no peculiar taste. They emit an odour slightly fetid and sulphureous. Their specific gravity, according to Vauquelin, does not differ from that of river water in general. The temperature of the different springs, as determined by M. Martinet, is as follows:—

1st spring of the great bath	144.° 5	
2d spring of the great bath	131	
Poor's bath	99· 5	
New bath	90· 5	
Capuchins' bath	104·	to 95°
Ladies' bath	99· 5	to 95
Spring of the crucifix	122	

The constituents of these waters were determined by Vauquelin. From his analysis it appears that the saline contents of the imperial gallon are as follows:—

Carbonate of soda	10·03 grs.
Sulphate of soda	10·80
Common salt	5·79
Silica	6.17
Carbonate of lime	2·31
Animal matter	5·01
	40·11

The gaseous contents have not been determined.

These waters contain so little saline matter that their efficacy in all probability depends upon their temperature. The carbonate of soda may give them some diuretic powers, and may render them useful in some cases of calculous diseases.

VII. Wiesbaden.

Wiesbaden is situated in Germany, about two leagues from Mayence and seven from Frankfort. It lies in a hollow, surrounded on all sides with mountains, except to the north, where there is an opening through which the Sulzbach finds a passage to the Rhine. The temperature, owing to the sheltered situation of the place, is very mild. Snow seldom lies, and even frost is, comparatively speaking, rare.

This place has been long celebrated for its hot springs, and has been very much frequented by the Germans for ages. It constitutes another of the numerous examples of mineral waters in the neighbourhood of Frankfort, which have been already given in this article.

There are fourteen springs employed by those who frequent the place. Two of these are open to the day; the rest are built over. These springs are of two kinds, namely, hot and cold. The hot are saline and acidulous; the cold contain sulphuretted hydrogen gas. The temperature of the hot springs varies from 117° to 151° in different springs: that of the sulphureous spring, which is called Wielbach, is 65° 75.

The constituents of the hot springs, according to the analysis made of them, are as follows, for the imperial gallon:

Sulphate of soda	6·56 grs.
Common salt	441·51
Sulphate of lime	4·18
Chloride of calcium	49·31
Carbonate of lime	11·40
Chloride of magnesium	6·86
Carbonate of magnesia	4·56
Alumina	6·86
Extractive matter	23·43
Protoxide of iron	1·02
	555·69

Carbonic acid gas 50·67 cubic inches.

The saline constituents of the Weilbach spring, as determined by Dr. Creve, are as follows for the imperial gallon:—

Carbonate of lime	32·00 grs.
Magnesia	11·81
Carbonate of soda	42·75
Chloride of magnesium	8·89
Common salt	7·13
Sulphate of soda	10·68
Sulphur resin	3·56
	116·89

Sulphuretted hydrogen gas 85·51 cubic inches.
Carbonic acid gas 38·00
123·51

VIII. Baden in Switzerland.

Baden lies on the banks of the Limmat, about twelve miles from Zurich in Switzerland, and is one of the most ancient towns in Switzerland. The hot springs are five in number, and rise in a plain to the north of the town. Three of these are employed in furnishing water to the public baths. The other two supply about thirty private baths with the requisite quantity of warm water.

The most abundant and interesting of these springs is called *Sainte Verenne*. It rises out of a reservoir situated in the *Place Publique*. These baths were used during the time of the Romans, and Tacitus informs us that it was to them that the town was indebted for its celebrity.

These waters as they issue from the springs are nearly at the boiling temperature. The bath requires to be prepared seven or eight hours before it is used, that it may have time to cool sufficiently. When this water is put into a glass, it is transparent and colourless, but viewed in the reservoir it appears opal. It has a slight smell of sulphuretted hydrogen, and a slightly disagreeable taste. According to the analysis of Morell, the saline contents of the imperial gallon of this water are as follows:—

Sulphate of soda	98·34 grs.
Sulphate of magnesia	6·97
Sulphate of lime	90·27
Chloride of magnesium	24·43
Carbonate of magnesia	29·18
Carbonate of lime	8·36
Protoxide of iron	0·36
	257·91

Carbonic acid gas 3257 cubic inches.
Sulphuretted hydrogen gas, a small quantity.

The reputation of the hot waters of Baden is so great, that they are had recourse to by the inhabitants of the country as a remedy for almost every kind of disease. It is chiefly upon their qualities as a hot bath that their real value depends. In chronic rheumatism, and in some other chronic diseases of an analogous nature, they are very useful. They are not much employed as an internal remedy. The principal salts which they contain are of the purgative kind; but the impregnation is not strong. Their chalybeate ingredient is very small, though it considerably exceeds the iron in Bath water, which gets credit for performing many remarkable cures.

IX. St. Nectaire Hot Wells.

St. Nectaire is a large village built upon a rock at the bottom of a barren glen, on the left bank of the Couze. It lies on the south side of the great plain which constitutes the boundary of Limagne on the west. It is situated in Auvergne, and is at the foot of the enormous volcanic mass called Mont D'Or. The whole of this country is primary, but covered in a great measure with extinct volcanic rocks. The hot springs of St. Nectaire were known to the ancients and employed by the Romans as baths. The remains of Roman baths have actually been found upon the spot; but after the destruction of the western empire, they had been covered over with rubbish and forgotten, till they were accidentally discovered in 1812, while digging round a small spring in the neighbourhood. The neighbouring peasants repaired thither and used the newly-discovered spring as a bath. This induced the French government to appoint a commission to repair to the place and examine the merits of the water. The report being favourable, Dr. Marcon was appointed as medical inspector of the waters. He applied himself to the examination of the different waters, carried M. Berthier to the spot, and prevailed on him to make an accurate analysis of them. Berthier found the specific gravity and saline contents of all the different springs the same.

There are a great many springs at St. Nectaire, but six only of these deserve particular notice. These are,

1. The *great spring* or *Gros Bouillon*, which was discovered in 1812, while digging a cellar. It seems to have been obstructed by the calcareous deposits which it had gradually formed. Its temperature is 104°. A kind of basin has been dug in the calcareous deposits, which all those that frequent these waters use promiscuously as a bath.

2. The *old spring*, distant about ten paces from the preceding, and rising from the centre of a small basin which appears to be very old. Its temperature is 97½°.

3. The *spring of the vault*. It lies very near, but a little higher up than the old spring. It is covered by a small building open to all the world. Its temperature is only 74° 75.

4. The *road spring* was discovered by M. Marcon during the formation of the great road to Mont D'Or. It is a few hundred yards from the great spring. Its temperature, like that of the preceding, is only 74° 75.

5. The *border spring* (*source de la Côté*) is situated about half-way between the bath-house and the village of St. Nectaire, on the right bank of the rivulet. Its temperature is 92° 75.

6. The *village spring* lies at the bottom of the road which rises from St. Nectaire, a little way above the rivulet. Its temperature is scarcely above that of the cold springs in the neighbourhood. It is very scanty in its supply.

The saline contents of the imperial gallon of this water, according to the result of M. Berthier's analysis, are as follows:—

Bicarbonate of soda	198·30 grs.
Common salt	169·40
Sulphate of soda	10·91
Carbonate of lime	30·80
Carbonate of magnesia	16·80
Silica	7·00
Protoxide of iron	0·98
	434·19

Carbonic acid gas ..... 108·51 cubic inches.

From the large quantity of the bicarbonate of soda contained in these waters, it is evident that they must act with considerable energy when taken into the stomach. To a certain extent they may be considered as analogous to soda water, and might doubtless be of considerable service in those calculous habits in which there is a tendency to deposit uric acid.

If we reckon the soda in the state of carbonate instead of bicarbonate, as has been done with the carbonates of lime and magnesia, then the carbonic acid gas in the imperial gallon of this water will amount to 229·43 cubic inches or 101·91 grains. Of this, the quantity required by the different bases to bring them into the state of bicarbonates, is as follows:—

Carbonate of soda	57·4 grs.
Carbonate of lime	13·55
Carbonate of magnesia	8·80
Carbonate of iron	1·10
	80·85

There is, therefore, an excess of 28·06 grains of carbonic acid gas more than is requisite to keep the carbonates in solution. This amounts to 59·11 cubic inches.

It would be easy to extend the list of hot springs almost indefinitely; but those which we have described include almost every variety at present known to exist. Were we to continue our descriptions, we should be only repeating and applying to other springs the remarks which have been already made.

[The chief thermal springs of the United States are the **Warm Springs** and the **Hot Springs of Virginia**; the temperatures of which are 97° and 107°, respectively; the Warm Springs of Buncombe county, North Carolina, (94° to 104°,) and the Hot Springs of Arkansas, (167° to 210).]

THOMAS THOMSON.

WORMS.—It seems to be a principle of nature, says a distinguished physiologist, that every situation capable of supporting living organized bodies should be peopled with them. All animals seem destined to be preyed on by others, not only after their dissolution, but even during their life. The latter part of this assertion is exemplified, at least in a limited sense, in the relation which exists between intestinal worms and many of the other classes of creation.

The frequency of worms in the bodies of men, as well as of the lower animals; their obviousness to the senses; their situation, in most instances, in those portions of the body opening externally, and permitting their occasional expulsion by the efforts of nature alone, and thus, as it were, forcing them on the observation, together with their very common connection with debilitated and morbid states of the animal economy, all tended to render them an object of interest from the remotest periods. Yet, though so long and so frequently investigated, there is perhaps no subject in the whole range of medical science around which a greater number of errors, whether of observation or theory, were till very lately accumulated; and though within the last half century an immense progress has been made in the study of helminthology, this, it must be confessed, bears reference rather to the anatomy and physiology, or, in general, to the natural history of worms, than to those questions in human pathology and therapeutics to which they give rise.

The history of helminthology, and that of the various opinions entertained of the influence of worms in the production of diseases and in the exasperation of their symptoms — opinions which maintained their ground even through the greater part of the seventeenth century, would require more space than could be assigned to them in the present article, consistently with a due attention to the more practical parts of the subject. There is scarcely any disease which has not at one time or another been attributed to worms; and any one who will take the trouble cautiously to weigh the opinions of some of the most distinguished practical writers, or, what is better, to examine the various well-authenticated facts on record, cannot fail to be convinced that worms do occasionally induce most serious symptoms, and, in some cases, extremely rare it is true, even fatal consequences. We proceed, however, without dwelling on this part of the subject at present, to the

CLASSIFICATION OF THE ENTOZOA.

The term entozoa (from the Greek ἐντος, *within*, and ζωον, *an animal*) was introduced into the language of natural history by Rudolphi, now many years ago, and is already very generally adopted both by the French and German physiologists. It includes all those creatures which naturally and permanently inhabit the intestines or any other internal part of animal bodies. By this definition the larvæ of insects, as they exist only accidentally in the alimentary canal, or at most only for a limited period, and evidently originate in all cases from without, are excluded; as likewise those animalculæ, or microscopic zoophytes, which have been detected in certain of the fluids of animal bodies, and the structure of which is so simple or so minute, that no internal organization has yet been detected in them. The entozoa, on the contrary, though likewise occupying a very humble place in the scale of being, yet possess, in general, obvious vessels, serving for the purposes of nutrition and generation, and in many instances have also evident muscular fibres. The distinguished physiologist mentioned above, originally introduced into his definition of the entozoa the negative character of wanting nerves; but as this is a disputed point, it is better omitted.

These parasites are found in all classes of animals, even in the invertebrate, and may exist either in the cavities of the body or in the parenchymatous substance of the organs. Hence they have been divided by some naturalists into "vermes intestinales" and "vermes viscerales;" whilst others have, with greater propriety, preferred an arrangement founded on their external form, or on their internal structure: thus Bloch, from their form, divided them into the long and the broad; and on this division Lamarck, adopting the same principle, has since improved. Linnæus, without separating them from other worms, arranged some of them under the head of *animalia intestina*, embracing the gordius, ascaris, and fasciola; and the remainder, hydatids and tænia, under *zoophyta*. Goeze was satisfied with dividing them into genera, as were likewise Müller and Schrank. Zeder laid the first foundation of a good classification of these animals, dividing them into five classes, subsequently called families, at Rudolphi's suggestion; and these were again subdivided into genera and species. Duméril, separating them altogether from the class Vermes of other naturalists, which comprised along with them those occurring on the earth and in the water, has made of them, under the title *helminthes*, a separate family or group of the class Zoophytes, and afterwards, somewhat after the manner of Lamarck, he divides them into the flat, the round, and the vesicular. Brera has formed, out of the intestinal worms of man alone, five orders, which contain, in all, twelve genera and twenty-six species; just double the number

recognised by Bremser as genuine intestinal worms. In the "Systéme des Animaux sans Vertèbres" of Lamarck, the intestinal worms all fall under the fifth class, of which they constitute the two first orders, under the names of "vers molasses" and "vers rigidules;" the first of which are subdivided into the "vésiculaires," "planulaires," and "hétéromorphes," and the second into interior worms (such as the strongle, ascaris, filaria, &c.) and the exterior (dragonneau or dracunculus, &c.). In Cuvier's arrangement, these animals constitute the second class of zoophytes, and have many external species mixed up with them. Availing himself of a difference in their internal organization, Cuvier has divided them into the "cavitaires," or those which have an abdominal cavity and a distinct intestinal canal within it, and the "parenchymateux," or those in which no proper intestinal tube is traceable, and which, for the most part, consist throughout of an homogeneous structure. The former of these divisions is equivalent to the Nematoidea of Rudolphi, and includes filaria, hamularia, trichocephalus, oxyuris, ascaris, strongylus, &c.; and the latter coincides in extent with Rudolphi's four last orders, and includes tænia, ligula, hydatids, &c. This classification of Cuvier's is, however, any thing but a natural one, as worms the most dissimilar in their general appearance, round, flat, and globular, are here promiscuously congregated together. M. de Blainville, recognising in intestinal worms very dissimilar degrees of organization, has consequently located them in very different situations in his general system of zoology.

Rudolphi doubts the possibility of ever reducing all the species of entozoa to absolutely natural and well-defined families; but as Zeder's system (of which the first hint was furnished by Goeze) makes the nearest approximation to a perfect natural classification, he has adopted it as his own, with the substitution of classical names for the original German ones. According to this arrangement, the entozoa are divided into five orders or families, viz. the nematoidea, acanthocephala, trematoda, cestoidea, and cystica.

I. Nematoidea (*νημα, a thread*, and *εἰδος, form*); vermes teretes; rundwürmer of Zeder. They constitute a very natural order, having a cylindrical and elastic body, a very complicated structure, a digestive apparatus with its two orifices, of which the mouth, by its varieties, affords generic characters. The sexes are distinct; the females, which are longer than the males, being for the most part oviparous. This family is divided into eleven genera.

1. Genus *Filaria:* of nearly an equal thickness throughout their whole length, mouth orbicular, male organ a single or double spicula, occurs not only in all parts of the *vertebrata*, (chiefly in the cellular membrane,) but even in insects and their larvæ. The filaria *Medinensis* occurs in the cellular membrane of man.

2. *Trichosoma:* on its anterior extremity, which is very thin, is the mouth, resembling a minute point. It occurs only in the lower animals, mammalia, birds, and amphibia, between the coats of the stomach, in the intestines, or urinary bladder.

3. *Trichocephalus:* capillary in front and swelling out suddenly behind, mouth orbicular, penis simple and contained in a sheath; occurs in the cœcum of the mammalia. Trichocephalus *dispar* in man; trichocephalus *depressiusculus* in the dog.

4. *Oxyuris:* subulate posteriorly, mouth orbicular, penis in a sheath. Oxyuris *vermicularis*, placed in Ascaris by Rudolphi; occurs in the large intestines of man.

5. *Cucullanus:* attenuated posteriorly, head with an orbicular mouth and striated hood, penis simple; occurs in the intestines and abdomen of reptiles and fishes.

6. *Spiroptera:* attenuated at each end, orbicular mouth, penis comes out between the lateral alæ of the spiral tail; occurs under the nictitating membrane of birds, in the œsophagus and in the stomach of fish, or in tubercles in this organ, in their intestines and swimming-bladder; said to have been also found in the urinary bladder of man.

7. *Physaloptera:* attenuated at both extremities, mouth orbicular; tail of the male bent downwards, winged and furnished below with a sort of bladder, penis coming out of a tubercle; occurs in the stomach of mammalia, birds, and reptiles.

8. *Strongylus:* attenuated at both ends, mouth orbicular or angular, the tail of the male terminates in what Rudolphi calls a bursa, and through this the penis passes out; it occurs frequently in the three first classes of vertebrate animals, in the tympanum, trachea, bronchi, œsophagus, lungs, heart, intestines, liver, kidneys, and in aneurismal tumours of the mesenteric and other great arteries. Strongylus *gigas* in the kidneys of man, the dog, horse, &c.; strongylus *filaria* in the trachea and bronchia of sheep.

9. *Ascaris:* attenuated at the extremities, mouth with three valves, penis double. The most numerous genus of the intestinal worms; occurs in almost every part of the bodies of vertebrate animals, the œsophagus, bronchi, lungs, stomach, but especially in the intestines, in their membranes, and in tubercles therein; in the abdomen, liver, spleen, mesentery, &c. Eighty species have already been determined. Ascaris *lumbricoïdes* in the intestines of man and many of the mammiferæ. (Ascaris *vermicularis*, head with lateral floating processes or alæ, found in the large intestines of man, is placed in this genus by Rudolphi; with Bremser it forms a separate genus—*oxyuris*.)

10. *Ophiostoma:* attenuated at extremities, mouth with two lips, a superior and inferior; occurs in the intestines of mammalia and fishes.

11. *Liorhynchus:* mouth at the end of a sort of erectile and polished tube; occurs in the stomach or intestines of some of the mammalia and of many fishes.

II. Acanthocephala, (*ακανθα, a thorn*, and *κεφαλη, the head*); vermes uncinanti; hakenwürmer of Zeder. This is also a natural order. The body is roundish, utricular, terminated anteriorly by a retractile proboscis furnished with hooks, or spiculæ, arranged in rows; no intestinal canal; they have distinct genital organs and a separation of sexes. There is but one genus—the *echynorhynchus*.

12. *Echynorhynchus:* generic definition same as that of the order. Numerous species; occurs in all classes of vertebrate animals, in the hog,

various birds and fishes, &c., generally in the intestinal canal infixed between its membranes, and occasionally found even in the peritoneal cavity; has also been found in the neck under the skin.

III. Trematoda (τρημα, *a foramen*); vermes suctorii; saugwürmer of Zeder. Body flattish, soft, of various forms, often tending to oval; one or more pores on its under surface, and these furnish the grounds of their subdivision into genera. They have no intestinal canal, and the organs of generation of the two sexes coexist in the same individual.

13. *Monostoma;* a single anterior pore; it occurs in mammalia, birds, reptiles, and fishes, between the muscles, in the thorax, the lungs, the intestines, and the abdomen.

14. *Amphistoma:* two pores, one anterior and one posterior; found in the stomach, intestines, and abdomen, and in the hydatids of the viscera of mammalia, birds, and reptiles.

15. *Distoma:* two pores, an anterior and a ventral. Above one hundred and forty species known; occurs in mammalia, birds, fishes, &c. Distoma *hepaticum* in man; in several of the rodentia; also in the horse, hog, and almost all ruminant animals.

16. *Tristoma:* three pores, the anterior simple, the posterior radiated; found fixed in the gills of a species of fish.

17. *Pentastoma:* the mouth between two pores on each side, through which a spicular process comes out; occurs in the frontal sinuses, lungs, and surface of the liver of the mammalia (dog, horse, wolf,) and in reptiles.

18. *Polystoma:* six anterior pores, besides a ventral and posterior one; occurs in the throat and in the branchiæ of fishes and bladder of frogs. Polystoma *pinguicola* found once attached to the ovary of a woman.

IV. Cestoidea (κεστος, *a band*, and ειδος, *form*); vermes teniæformes; bandwürmer of Zeder. Body elongated, soft, and flat like a riband; in some continuous, in others articulated; has lateral or marginal pores and erectile papillæ passing through them (*lemnisci*), supposed to be the male organ of generation. The head is generally marked by two or four depressions, or suckers; but the head is so dissimilar in different genera, and their form varies so much, that they do not constitute a very natural family. There is no trace of intestinal canal, unless the vessels proceeding from the suckers be considered as such. In some, nutrient vessels and ovaries are to be seen (*teniæ*). Like the third order, they are all androgynous; but the sexual organs are not well understood.

19. *Caryophyllæus:* body flat, continuous, head dilated, divided into flattish processes, furnished with an upper and under lip; occurs in the intestines of fishes (carp, &c.)

20. *Scolex:* body flat, continuous, head has four fossæ on it; occurs in the intestines and abdomen of fishes, sepiæ, &c.

21. *Gymnorhynchus*: body flat, continuous, very long, with a globular receptacle at the neck; head with two opposite fossæ, and four naked retractile probosces; occurs in the muscular substance of many fish.

22. *Tetrarhynchus:* body flat, continuous, head with four fossæ and four retractile probosces, furnished with recurvated spicular processes; occurs in reptiles, fishes, molluscæ—in the muscles, branchiæ, stomach and its membranes, the liver and peritoneum.

23. *Ligula: in its first stage of development*, body elongated with a longitudinal fissure, without any appearance of head or of organs of generation. *In its perfect state*, a simple fossa on each side of the head, the ovaries and processes (*lemnisci*) forming a single or double row along the median line; occurs very frequently in birds and fishes, very rarely in the mammalia.

24. *Trixænophorus:* body elongated, flat, subarticulated, mouth bilibiate and furnished on each side with two tricuspid acicular processes; occurs in the intestines of fishes, in cysts of the mesentery and liver (perch, pike, salmon, &c.)

25. *Bothriocephalus:* body long, flat, articulated, head subtetragonal and furnished with two or four opposite fossæ; occurs very frequently in fishes and birds, in the branchiæ, œsophagus, pyloric appendices, intestines, and abdominal cavity; they occur also, but more rarely, in the mammalia. Bothriocephalus *latus*, vel *tænia lata*, in the intestines of man in Switzerland, Russia, parts of France, &c.

26. *Tænia:* body flat, long, articulated, four suckers on the head; occurs in the intestines, biliary ducts, gall-bladder, and liver of vertebrate animals. Tænia *solium* vel *cucurbitina*, occurs in the human intestines in Great Britain, Germany, the north of Europe, Holland, part of France, and in Egypt, &c.

V. Cystica (κυστις, *a bladder*); vermes vesiculaires; blasenwürmer of Zeder. Body flattish or rounded, and terminating posteriorly in a transparent bladder-like cyst filled with a pellucid fluid, and appropriated in some genera to a single individual, whilst in others it is the joint property of several. The head, which is retractile, exhibits two or four fossæ, or depressions, or four suckers with a coronet of humular processes, and four probosces. The organs of generation and nutrition are almost, or entirely unknown. The worms are in some instances extremely small, and occupy the inner surface of the cyst or bladder, and in others again they float at large in the fluid in its interior. They are for the most part encysted in the organ in which they occur. This is not a natural order; thus the ecchinococcus, or granular hydatid, though referred to it, is not hollow.

27. *Anthocephalus:* body long, flat, terminated behind by a caudal vesicle, and in front by a head with two or four fossæ and four probosces furnished with spicular processes. Each exists solitarily in a double bladder, of which the outer layer is hard and elastic, the inner more thin and delicate; it occurs in fish, in the liver, mesentery, and peritoneum, and within hydatids in the viscera.

28. *Cysticercus:* body roundish or flat, terminated by a caudal vesicle, the head with four suckers and a rostrum furnished with recurved processes or hooks. Exists solitarily within a simple bladder; occurs between the muscles, in the fat, the brain, thorax, pleuræ, heart, liver, mesentery, and peritoneum, in fishes. Cysticercus *cellulosus* in man, the monkey, hog, &c.

29. *Cœnurus:* body elongated, flattish, wrin-

kled, head furnished with a rostrum on which there are hooks and suckers, adhering in greater or less number to the internal surface of a bladder filled with fluid. Cœnurus *cerebralis* in the brain of sheep, oxen, &c.

The above brief view of the orders and genera of intestinal worms, disposed according to the scientific arrangement at present most in repute, will suffice to enable the physician to refer any species he may chance to meet with in man to its true place in the system. For practical purposes it will be advantageous to follow a somewhat different order; dividing intestinal worms into those strictly so called, as occurring in the intestinal tube, and into those whose natural situation is in other parts of the body, and out of this canal: arranging them also somewhat in the order of the frequency with which they present themselves to us in practice, and prefixing those appellations which are as yet most familiar to the great body of the profession in this country.

The order in which we mean to treat of them is adapted, with some very trifling variations, from Bremser, and is as follows :—

Worms belonging to the Intestinal Canal.

1. *Ascaris lumbricoïdes*, or "common round worm" of the intestines, very generally, but improperly, called the *lumbricus;* a term appropriated by Linnæus and other naturalists to the earth-worm.

2. *Ascaris vermicularis:* this species of worm is commonly called "the *ascarides*," "thread-worms," or "maw-worms."

3. *Trichocephalus dispar*, or "the long thread-worm."

4. *Tænia solium*, or common tape-worm of these countries.

5. *Tænia lata*, or *bothriocephalus* of Bremser: broad tape-worm.

Worms occurring in other parts of the body than the Intestinal Canal.

6. *Filaria Medinensis*, or Guinea-worm.

[6¹. *Filaria oculi.*

[6². *Filaria bronchialis.*]

7. *Hamularia.*

8. *Strongylus gigas.*

9. *Distoma hepaticum*, or liver-fluke.

10. *Polystoma pinguiculum*, or *hexathrydium* of Treutler and Brera.

11. *Cysticercus cellulosæ:* hydatid of the cellular membrane of the hog, &c.

12. *Ecchinococcus hominis*, or many-headed hydatid of the Germans.

[13. *Diplosoma crenata.*

14. *Spiroptera Hominis.*

15. *Dactylius aculeatus.*

16. *Trichina spiralis.*]

The Pseudo-Helminthes or Spurious Worms.

1. *Ditrachyceras rudis.*

2. *Ascaris stephanostoma.*

3. *Ascaris conosoma.*

4. *Cercosoma.*

5. *Hexathyridium venarum.*

6. *Diacanthos polycephalus.*

7. Larvæ of insects in various animals introduced from without.

8. Fictitious worms of the teeth.

1. **Ascaris Lumbricoides.** Syn. *Lumbricus teres* or "*common round-worm* of the intestines." *Ascaride lumbricoide* of the French. *Rundwurm* or *Spulwurm* of the Germans. *Lombrico* of the Italians.

General character.—Body cylindrical, elastic, attenuated at both extremities: head trivalvular; the male organ a double spiculum.

Specific character.—The head without alæ or floating processes.

The length of this worm is from five or six inches to about a foot, and its thickness about two lines; but young ones of about only one inch and a half long are occasionally met with. The colour is of a reddish brown with somewhat of a yellow tinge. A shallow groove or darkish line runs down along each side of the body, a white and smaller line being also visible all along the upper and under surface. The animal is moreover encompassed from the head to the tail with close-set transverse circular striæ.

The male is smaller and much rarer than the female, and is readily distinguishable by the end of the tail being somewhat more curved, as well as by the double penis occasionally seen projecting. For some time after they are voided, they are sufficiently transparent to enable us to see the internal organs. The valves or tubercles about the mouth are visible to the naked eye.

The lumbricoïdes, when examined anatomically, is found to consist of integuments, muscles, digestive apparatus, and genital organs, in addition to which some have thought they could discover traces of a nervous and circulatory system. The organs of digestion and generation are bathed in a kind of mucous fluid secreted by the interior of the great containing cavity, in which in the greater part of their extent they float free, or only very slightly supported by delicate cellular adhesions. In the upper third of its extent, however, the digestive tube is enveloped in a closer cellular, or somewhat parenchymatous structure. On the lower portions a very delicate membrane analogous to the peritoneum is discoverable. The muscular system forms two layers of fibres; the one circular or transverse, the other longitudinal and adhering closely to the integument. The digestive tube is straight, and from its contents generally of a greenish brown colour. The upper orifice or mouth is triangular, surrounded by three tubercles, and lined internally with minute granulations, probably glands. The anterior part of the canal, or the œsophagus, is succeeded by a rather wider portion, which may be called the stomach, and this narrows slightly into the intestine, which, after running a straight course, terminates about a line from the tail in a transverse fissure or anus. From the external surface of the intestinal tube come off numerous filaments, which soon swell out into culs-de-sac, of which the use is not certainly known: in all probability they serve for the distribution of the nutritive fluid elaborated in the alimentary canal.

The genital apparatus fills a great part of the animal, especially in the female, and consists of an intricate interlacement of apparently innumerable whitish filaments, which are easily seen through the integuments, or escape on making an incision into the great abdominal cavity. In the male a

penis, vas deferens, seminal reservoir, and a portion of the seminal tube, analogous to a testicle, are discoverable. The male organ, which is double, about a line in length and close to the anus, is occasionally found protruded. A canal leads from it to what is considered to be the testicle, namely, a tube of extreme tenuity, about three feet long, very flexuous, forming a set of entangled meshes, and finally terminating in a cul-de-sac, which floats unattached in the abdomen. The female organs commence externally by a fissure, at the distance of about the third of the animal's length from the head, where there is a slight contraction of the worm, as if a string had been tied tightly around it. The vagina leads to the uterus, which soon divides into two long horns, each of which forms a convoluted canal of extreme delicacy and great length, which may be supposed to represent the ovary. This minute tube of each side is found, on being unravelled, to be continuous with its fellow of the opposite side, their combined length being variously stated at from eight to twelve feet. The uterus and its two prolongations are usually found full of eggs, the worm being oviparous.

M. Jules Cloquet supposes that the two whitish lines running, the one along the abdominal, and the other along the dorsal surface of the worm, consisting of knotted and variously interwoven filaments, are rudiments of a nervous system; and he conceives, moreover, as well as Laennec, that the two lateral lines distinguishable by being somewhat coloured, are vessels in which the sanguineous fluid oscillates. The latter were by Hooper thought to be ligaments for the attachment of the transverse or circular muscles. For a fuller account of the anatomy of this worm, the reader is referred to the works of Werner and Rudolphi, Hooper, Laennec, and Jules Cloquet.

The ascaris lumbricoïdes, if accurately examined, is found to differ very much from the common earth-worm or lumbricus, with which it was long confounded. Tyson pointed out, a century and a half ago, many remarkable grounds of distinction between them; but his observations seem to have been unknown to, or undervalued by, many subsequent writers. Externally the lumbricoïdes, as mentioned by Dr. Bailey, is more pointed at both extremities; its triangular and terminal mouth surrounded by three tubercles is very different from that of the earth-worm, which consists of a small longitudinal fissure, situated on the under surface of the small rounded head. Upon the under surface of the earth-worm there is a semilunar fold of skin, into which the head can be retracted, which is wanting in the intestinal worm. The anus of the lumbricoïdes opens upon the under surface of the worm nearest its extremity, by a transverse curved fissure; that of the earth-worm is an oval terminal aperture. The transverse wrinkles in the integuments of the former are less strongly marked, and the broad yellowish elevated band generally seen to encircle the body of the earth-worm is wanting; whilst in place of it we have, on the contrary, a depressed one, as we have already seen.

The lumbricoïdes is marked by four parallel longitudinal lines, the two lateral ones, as mentioned above, being very obvious from their brownish colour. The earth-worm has three very faint lines on its upper surface. The lumbricoïdes has nothing corresponding to feet; the earth-worm has on each side a quadruple row of bristle-like processes on its under surface, serving apparently the purposes of locomotion. The large and complex stomach of the earth-worm consisting of two cavities, the sacculated intestines, the coexistence of the male and female organs of generation in the same individual, and the appearance of these organs, form additional marks of distinction; as do likewise its more decidedly red colour, the nature of its food, (for it seems to live upon earth,) its power of alternate elongation and contraction, and finally, its mode of progression, in which the motion is propagated continuously from ring to ring; whereas the ascaris lumbricoïdes moves in a serpentine manner, the head being sent forward by the worm curling itself into circles, and then suddenly protruding it with considerable force to some distance.

This worm has been supposed to feed on the chyle or mucus in the intestines, and the three tubercles around the mouth are thought to be muscular, and to serve in the suction of their food, or in their attempts to adhere to the intestines; though of such adhesion, or at least of its frequency, the best writers express considerable doubts. Thus Bresmer has invariably found them involved in mucus, and unattached. M. Fortassin, however, is said to have once found one adhering so strongly to the inside of a phial, that its forcible detachment caused an audible noise. At all events they do not appear to possess any organs capable of doing injury to the tunics of the bowels, so that the stories of their perforating them are worthy of little credit, and are perhaps all attributable to the existence of ulceration or gangrene, and to these animals having subsequently made their escape through the apertures so caused.

Their natural place of abode is the small intestines. When they either ascend into the stomach, or descend into the great intestines, they are for the most part speedily expelled. They have been known to make their way into the œsophagus, exciting cough, or to creep into the posterior nares, or even into the larynx, trachea, or bronchi. We have seen the biliary ducts of the liver stuffed full of them, and they are said to have been found in the gall-bladder, pancreatic ducts, appendix cœci, &c. Laennec says he once found in a child, whose stomach contained a great number of lumbricoïdes, the biliary pores distended and the tissue of the liver gnawed, as it were, in several points by them. In such a case it is conceivable that the parietes of the biliary vessels may have been burst by the distension produced by the worms, and that the soft hepatic tissue thus denuded may have easily yielded to the influence of their organs of suction, as the narrator suggests. They have been known to pass through ulcerated or fistulous openings into the abdominal cavity, the bladder, or vagina, and to make their appearance through the parietes of the abdomen, where an inflamed and grangrenous incarcerated hernia opened them a passage.

The number of these worms which may coexist is very considerable. Dall' Olio tells us that he threw up in the course of a fortnight four hundred and fifty of them, and Marteau de Grandvilliers

knew a soldier of twenty-three years of age who passed three hundred and sixty-seven within six days. Dr. Hooper speaks of a girl of eight years old who voided upwards of two hundred in one week. Frank knew of a case where eighty of them rolled up into a mass were expelled in a fever, and alludes to another in which the whole intestinal tract, both great and small guts, was stuffed full of them. Guersent has found above fifty or sixty in one subject on dissection. Sometimes, however, only one or two exist, so that even the passing of a lumbricoïdes is not by any means a demonstrative proof of the patient being still infested by worms.

2. **Ascaris Vermicularis.** — Syn. *Oxyuris vermicularis* of Lamarck and Bremser. *Ascaride vermiculaire* of Cuvier. *Pfriemenschwanz, mast darnwurm* or *maden-wurm* of the Germans. The *maw-worm*, thread-worm, or *ascarides*.

The body is round and elastic, the mouth orbicular, the male organ in a sheath. The anterior extremity is rather obtuse, with a bladder-like transparent membrane on both sides; the tail of the male spiral and obtuse; that of the female tubulate and straight.

Bremser has separated them from the genus Ascaris, and placed them under Oxyuris, because they want the three tubercles around the mouth, and differ in other respects, which he has pointed out. The male is about a line and a half in length, very thin, and of a white colour. Its internal structure bears a considerable resemblance to that of the A. lumbricoïdes. The female is much the larger of the two, being about half an inch long, and its tail is extremely attenuated. The body is sufficiently transparent to enable us to see the convoluted organs of generation. The vulva, according to Goeze, is found about one third of the length of the animal from the head. The author just named, as well as Hooper, thought them viviparous, but probably mistook the filiform ovaries or the oscillatory motion of the ova for their young, as both Rudolphi and Bremser are, on the contrary, satisfied that they are oviparous. The minuteness of these worms has thrown a great difficulty in the way of examining their internal structure. Their head is in constant motion. From their restlessness and activity, they get their name (from *ασκαριζειν*, to leap). They are supposed to have been named *maw* worms from the uneasiness of stomach which they seem sometimes to occasion. Their abode is the large intestines, and especially the rectum, where they occur often in great quantities, particularly in young children, though they are not absolutely confined to any period of life. Bloch speaks of finding them in a cyst in the walls of the stomach, and Brera asserts that he met with them in considerable number in the œsophagus of a woman who died of a slow nervous fever. They sometimes make their way into the vagina, where they cause intolerable itching; and Frank has found them in the urethra. In the intestines they often exist in very great numbers, thousands perhaps, and are sometimes expelled matted together in the form of balls.

Lister says that he had seen this species of worm in a well; and Dr. Barry (Trans. of the King and Queen's Coll. of Phys. in Ireland, vol. ii.) has related a case where a whole family with their servants and guests became affected with them, and where, upon examination, they were thought to have been traced to a well from which the inmates of the house, which was situate in the country, were supplied with water, as there was discovered therein an immense multitude of minute worms resembling ascarides in all but their colour, which was somewhat darkish. On changing their abode, the sufferers became in the lapse of a few years in some degree freed from their tormentors, though not entirely; the observation is, however, we think, very far from being conclusive in regard to the identity of the worms, or the reality of their external origin, as it does not appear that any very satisfactory microcospical examination of their internal structure was made.

3. **Trichocephalus Dispar.** — *Trichuris* of Rœderer and Wagler, and of Lamarck. *Ascaris trichuris* of Werner. *Trichocéphale* of most French writers, (from *θριξ*, a hair, and *κεφαλη*, the head.) *Peitschen wurm*, or *haarkopf* of the Germans. *The long thread-worm*, Bradley.

This genus is characterized by the cylindrical and elastic body, which is capillary in front, and enlarges suddenly behind; the mouth is orbicular; the male organ simple and contained in a sheath. In this particular species the capillary portion is very long, the head attenuated and indistinct; the body of the male rolled up into a spiral form; that of the female approaches to straight. It is from an inch and a half to two inches long, the delicate capillary portion, which dilates abruptly into the comparatively thick body, constituting two-thirds of the whole length; it is white, unless coloured by the food which it happens to contain. The male is the smallest, and so thin towards the head that the mouth is seen with difficulty. The alimentary canal runs in a straight line down through the anterior capillary portion, which is striated; and thence it extends into the posterior and thicker part of the worm, which, as just stated, is somewhat spiral. In the latter portion, likewise, are seen the contorted spermatic vessels terminating near the end of the tail in a small transparent tube, through which the penis passes out. The female is distinguishable from the male by the greater length of the anterior capillary portion, and by the posterior end being only very slightly curved. In the latter are situated the oviducts with their elliptic shaped ova, and at the extremity is a small opening answering at once for anus and vulva.

It is one of the commonest species of worm, being discoverable in the bodies of almost all individuals. The large intestines, and especially the cœcum, are their natural situation, where they often exist in great numbers, and yet do not seem to produce any inconvenience. Both Werner and Rudolphi have occasionally found them in the small intestines. The same genus of worms occurs in the dog, the fox, the ape, and many other mammiferous animals.

These worms were at one time erroneously supposed to be a distinguished symptom of the morbus macosus, a species of low fever, described by Rœderer and Wagler, and characterized by inflammation of the follicular glands of the intestines, and a superabundant secretion of mucus

into the digestive tube; but Wrisberg, who subsequently described them, asserts with truth that they occur in almost every individual, even when there is no trace of this disease. They were observed in the winter of 1760 for the first time in Germany, in the cœcum of a girl of five years old, by one of the students in the anatomical theatre at Göttingen, and shown to Wagler, the prosector, who mistook them for ascarides of a larger size than ordinary; but on being submitted to Rœderer, and subsequently to Buttner, they agreed in considering them a new species of worm, and the latter bestowed on them the name *Trichurides* (from θριξ, a hair, and ουρα, the tail) on account of the thread-like prolongation which he erroneously conceived to be the tail. About the same time the mucous epidemic happening to take place, the intestines of all the subjects who had died of it were carefully examined, and these worms being always found in great numbers, Rœderer was very naturally betrayed into the error of ascribing them to the prevailing epidemic, on which in all probability they exerted little or no influence. Their abundance may, however, have been connected with the excessive quantity of mucus present, which formed so favourable a nidus for them. Wrisberg was aware that they are not confined to the cœcum, for though most frequently met with there, he had himself seen them in every part of the intestinal tract from the duodenum down, but never in the stomach. He twice found them adherent to the villous surface of the ileum, and to the mucous follicles of Peyer, some by their thick end, and some by both extremities at once. Pallas was one of the first authors who correctly spoke of the long filiform portion as the head of the animal: it is commonly found implanted in the walls of the intestines, whilst the other end, or the tail, moves freely through the fæces. But this view was rejected by Werner, and though its truth was convincingly proved by Goeze and Müller, even Dr. Baillie, and Mason Good, in the second edition of his Study of Medicine, have repeated the error of describing the long attenuated and transparent part as the tail; and Brera still affects to have doubts on the subject.

Though Rœderer and Wagler are generally named as the original discoverers of this species of worm, it was certainly known previously to Morgagni. (See his Epist. Anat. xiv. art. 42.) Wrisberg, as well as Rœderer and Wagler, mistook the male and female for two different species, in consequence of the latter wanting the tube near the extremity of the body.

4. **Tænia Solium.**—*Tænia cucurbitina*, Pallas. *Halysis solium*, Zeder. Lumbricus latus, of the old writers. Lumbricus *cucurbitinus*, Heberden. Tænia *osculis marginalibus*. *Tænia à longs anneaux*, Cuvier. Tænia *cucurbitain*, Lamarck. *Le solitaire, ou tænia sans épines*, of other French writers. Tænia *armata umana*, Brera. *Der kurbiswurm*, Bloch. *Langgleidrichte bandwurm* of Joerdens. *Kettenwurm* of other Germans. *Gourd-wurm, long tape-worm.* —The Tape-worm.

The genus tape-worm is characterized by its elongated, flat, articulated body, and the four suckers on the head. This particular species is distinguished by the somewhat hemispherical head, flattened laterally, and having an obtuse prominence in front. The most anterior joints of the neck are very short, the immediately subsequent ones being nearly square, and the remaining ones oblong from before backwards. All have marginal foramina irregularly alternate.

The tape-worm is of a whitish colour, and towards the anterior extremity becomes very small and thin. The depression in front, by some called the mouth, is so minute as occasionally not to be visible without the aid of a microscope. The interior of the animal is made up of amorphous cellular tissue without any abdominal cavity, and with but indistinct traces of internal organs. The delicacy of their structure, and their so seldom being obtained entire, have thrown great obstacles in the way of its investigation.

The tænia solium, at its broadest part, is from three to six lines in width, but near the head it diminishes to the third or fourth part of a line, or even less. These measurements are, however, little to be depended on, as the animal has so great a power of changing its form by rendering its joints thick, flat, or elongated. The marginal foramina are placed for the most part alternately, that is, on the opposite edges of the two contiguous joints; thus, of the two free margins of each articulation, commonly one only is pierced with a pore. But this is by no means invariable. In some rare cases there are two pores on one joint. The shape of the joints, and their relative breadth and length, depend much on the voluntary motions of the animal, and if suddenly killed, as by plunging it into cold water or spirits of wine, the irregularities which existed at the moment of death are permanent in the preparation. Their surface looks rough and irregular to the eye, and exudes a tenacious fluid. The first articulation is received into the base of the neck, and each subsequent joint is let into the one in front of it. The posterior edge is distinguished by its being larger and fringed, the other being plain and slightly rounded. In each articulation may be detected a portion of the nutrient vessel running along the margin, and the arborescent ovary in the centre communicating with the marginal pore. Blumenbach at one time considered the separate articulations as so many animals connected together—an opinion now sufficiently disproved by the well-known fact that the tape-worm has a distinct head, as well as by the anterior parts of the body differing from the posterior,—by the continuity and pretty firm connection of all the parts, and, finally, by the nutrient vessel being prolonged throughout the chain. The margin of each succeeding joint is embraced in some degree by the one anterior to it, but less strongly the older the animal, and the more posterior the joint. Hence the caudal joints are easily separated, and pass off with the stools. Sir Anthony Carlisle conceived that the detached joints were capable of becoming distinct animals, but later investigations give no countenance to such an opinion.

The head, which is a minute tubercle, or pisiform body terminating the threadlike neck, has on its most prominent and anterior part a circular aperture or depression, surrounded by sharp curved processes or hooks, and supposed by some to be the rudiment of an alimentary canal. These pro-

cesses are, however, not constantly found, being supposed by Bremser to disappear by age. On the somewhat angular projections on the sides of the head are situated four equidistant apertures or suckers, which seem to be the true mouths, as from each of them proceeds a vessel running along the whole length of the animal, near the margins of the joints; and each of these is connected with its fellow by a transverse canal at each joint, and they terminate finally, according to Rudolphi, in a common aperture on the last joint. These suckers and canals seem to be their only apparatus of nutrition, except that possibly a certain degree of absorption may take place by the cutaneous surface. The vessels just mentioned, of which two pass down along each margin, are of a whitish colour; the upper one is easily visible, whilst the other runs parallel to and beneath it, so as to be concealed by it. Bremser possesses a singular specimen, in which, instead of four, there is but a single canal, and it passes down the middle of the worm. With regard to the marginal orifices, each of which is seated in the apex of a minute papillary projection, they were formerly supposed to be the organs by means of which these animals adhere to the mucous membrane, but are now thought to be subservient to the continuation of the species. It is by the suckers on their head that they stick to the walls of the intestines so firmly, that if force be applied, they break rather than lose their hold.

Concerning the organs of reproduction in the tænia, much obscurity still prevails. Werner and Rudolphi, by removing the external covering of a joint, have observed that the canal leading from the marginal orifice soon gives off two branches, the larger of which running transversely is lost deep in the middle of the joint amongst the ramifications of the ovary, to the flexuous vessels of which it is altogether similar; and ova have been seen in it: the smaller runs obliquely to the middle of the surface of the joint, where it terminates in a shut sac, supposed by Werner, who thought that the act of impregnation takes place within the interior of the body, to be the male apparatus of generation. According to Rudolphi, however, who asserts that from the marginal orifices a minute filament (lemniscus), supposed to be the penis, has been seen projecting, the generative act takes place externally. He conceives the larger canal to be the oviduct, the lesser the spermatic vessel; and that the canal common to the two is destined to fulfil at different periods a double office, at one time transmitting the semen, and at another giving exit to the ova. He conceives that Sir A. Carlisle was in error in supposing a communication to exist between the central apparatus of vessels or the ovary, and the great longitudinal or nutrient canal. All the joints except the anterior smaller ones contain ovaries, and in the tænia lata the pores on the flat surface led to them. The tænia seems to be at once androgynous and hermaphrodite, impregnation appearing to take place indifferently either by means of the approximation of two individuals, or by that of two joints of the same animal; and as commonly only one tape worm is present, the latter is probably the more frequent occurrence of the two. The joints containing the mature ova very generally in the process of time become separated from the animal, and accordingly the larger tænia are found almost always torn across and deprived of the final articulations, which, being scattered about, constitute the *vermes cucurbitini* of the older writers, and were by Aristotle, and after him by Andry, mistaken for the ova. Coulet took them to be identical with ascarides, and conceived that it was by their mutual adhesion that the tænia was made up, the separate portions becoming concatenated and confounded together so as to form eventually but a single animal. The integument covering the ova, which are situated in the centre of each joint, is extremely thin, yellowish, raised up, or even burst, so that the ova easily get effused into the surrounding mucus. Occasionally, moreover, the ovaries of such joints as are not yet ready to separate, burst, and pour out their ova, and the central part of these joints being destroyed, leaves nothing but their margins, and causes them to present a perforated appearance. Such is Rudolphi's opinion as to the common mode of escape of the ova. Werner and Goeze, on the contrary, think that they are always projected through the oviduct already described.

It has been disputed whether the tænia, as it increases in size and age, gets new joints to supply the place of those which it is perpetually losing. Rudolphi thinks it does not, believing merely that the articulations, and especially the anterior ones, which are at first very minute, become gradually but extremely developed. On the other hand, authors who were ignorant of the animal possessing a head, or who thought that it was made up of mutually adhering cucurbitine worms, asserted that new joints were formed at each end to replace those passed by stool. From the time that the head was detected, Andry and others began to believe that it was only to the hinder extremity of the body that such addition was made. At length Pallas and Müller showed that the increase did not take place at either extremity, but that the elongation occurred chiefly in the filiform portion of the animal next the head. The joints of the young tape-worm are so very close and small as to give it the appearance of being merely wrinkled rather than articulated; but on inspection through the microscope it is found to consist of innumerable articulations; and even at this early period the head and tail are found to have their characteristic form already well marked. Thus the received opinion at present is, that the animal really gets no new joints whether anteriorly or posteriorly, but only developes those which existed from the first in a rudimentary state, and so is constantly preparing substitutes for the gradual impairment and loss of the posterior and more mature articulations. Brera has supposed that the supplementary replacement of lost parts takes place by means of the formation of entirely new inter-articular joints, but Bremser has entirely refuted this very improbable opinion.

The length to which the tænia solium is capable of attaining is very considerable, but quite indefinite. Those passed now-a-days rarely much exceed twenty feet; but in the olden time we read of far more gigantic specimens: thus, Pliny speaks of one three hundred cubits long; but his

computation, like that of many later writers, may have been made from measurements of a number of portions successively evacuated, and all ascribed to one individual worm, though, in all probability, they came from several; or the length assigned may, in those days when accuracy in matters of natural history was not very strictly attended to, have been the result of a mere random guess. In the Copenhagen Transactions, there is mention made of one eight hundred ells long! Reinlein estimates their length at from forty to fifty ells. Hufeland speaks of a child of six months old, who had passed at successive periods thirty ells of tape-worm, and that, too, without any impairment of its health. Van Doeveren tells us of one a hundred and fifty feet long, and Rosenstein of another of three hundred! Whatever may be thought of some of these accounts, it is indubitable that it has occasionally attained to a very great length, as in the case mentioned by Robin, where, upon dissection, it was found to extend from the pylorus to within seven inches of the anus, and was firmly adherent to the villous coat of the intestines. Now, as the length of the bowels may be estimated at nearly thirty feet, and as the worm does not keep itself by any means at full stretch, its length was in this instance probably at least sixty feet. Such cases are, however, certainly rare; for even in the extensive museum of Vienna, there is no preparation exceeding twenty-four feet in length. They are sometimes, on the other hand, found remarkably short. Thus, Rudolphi has seen some specimens of young ones only a very few feet in length, the animal being yet entire, as was evident from the tail; for the last joint, as usual in the perfect state, was rounded off, and destitute of any lateral form. In the lower animals, tæniæ often acquire a very great magnitude: Goeze met with one fifty-one ells in length in a sucking lamb.

The motions of the tape-worm, whether whole or divided into joints, are often, says Rudolphi, most active and various; and people who are infested with it are sometimes conscious of its undulatory and disagreeable movements; and it occasionally continues capable of lively action even for some time after its expulsion, if it be received in tepid water. Portions of many feet in length have protruded from the anus, and been again drawn in by the animal; and Pallas even talks of one creeping a few feet up a wall, though about this fact we may be permitted to be somewhat sceptical. Slightly marked longitudinal and transverse fibres are said to have been observed in the tape-worm, if we recollect rightly, by Werner; and in the tænia lata in particular, longitudinal fibres are seen passing from one joint to another, and explain the fact of their firmer adhesion, in consequence of which minute fragments of the species are less frequently found in the stools. From the single joints of the tape-worm retaining, even after having been excreted, the power of independent motion, they came in former times to be considered as so many distinct animals, and were called cucurbitine worms, from their resemblance to the seeds of the gourd. Bremser, who has seen the tape-worm live for some time after it was passed from the bowels, says that the head and neck were in continual movement, and that the body was alternately elongated and contracted.

As to the age which the tænia is capable of reaching, nothing very satisfactory is known, though it is supposed to be very much longer-lived than the small species of worms. Carlisle, from a case communicated to him by Hunter, conceived it might attain at least to eight years if undisturbed, that period having elapsed in this instance from the commencement of the affection up to the time of the expulsion of the head. But as one head, or even more, might, in consequence of the extreme minuteness of this part, have been previously passed unobserved, this is not very conclusive. The ancients, with Hippocrates at their head, thought that the tape-worm was born and died with us. It has certainly been found, in one or more well-authenticated instances, in the fœtal state; yet this, it must be admitted, is an extremely rare occurrence; and it is, generally speaking, much more infrequent in children than in adults.

The term *solium* or solitary worm, is not strictly applicable to it, as it is now well known that it may coexist with several others, either of its own or other species, lumbricoïdes, ascarides, vermiculares, &c. De Haen saw eighteen tæniæ expelled by a woman of thirty years of age within the course of a few days. Bremser has frequently known two or three to be passed simultaneously by the same individual; and in Mr. Breton's paper on the use of the pomegranate, to which we shall subsequently refer more in length, the case of a boy is given who passed both a tænia solium and a tænia lata in one day. In dogs, so many as sixty or eighty tape-worms have been detected on dissection. Their natural situation is the small intestines, though sometimes they have been found extending into the larger ones also. It would seem that they may occasionally get into the stomach likewise: thus, Wendelstadt has given a case in Hufeland's journal of a man who vomited at one time no less than four tæniæ; and Van Doeveren mentions a peasant who, after having taken an emetic, vomited up forty Dutch ells of tape-worm, and might have got clear of more of it, "if he had not been afraid of puking out all his guts, and for that reason bit the worm off."

The tænia solium does not occur with equal frequency in all countries, though its distribution seems to be much more extensive than that of the tænia lata; yet it is to the latter (but for what reason we know not) that Linnæus gave the epithet of *vulgaris*. The tænia solium is met with in England and Holland, Germany, Sweden, Italy, Greece, and most countries in Europe, and also in Egypt and the East; and in all of these situations the other species is comparatively rare. In France, the two kinds occur with nearly equal frequency, or the preponderance is perhaps in favour of the tænia lata. Hasselquist, in his Travels to Palestine, &c., mentions that the tape-worm is very common in Egypt, and that the fourth part of the inhabitants of Cairo are affected with it, and especially the Jews and common people, who are miserably fed.

Whether the tænia originates from without has long been debated. Unzer, amongst others, was, at one period of his life, a firm believer in their

external origin; having, as he thought, found one in a fountain, from which a woman affected with the disease was in the habit of drinking. He subsequently, however, came to doubt the accuracy of his former observation. Their existence in the fœtus is a great stumbling-block in the way of those who advocate the affirmative side of the question. Underwood mentions, on the authority of travellers, that the tape-worm has often been found in the waters about Constantinople, where the complaint is very common; but he does not give the details. An examination into the origin of the tæniæ which infest the lower animals, has sometimes been thought to favour the notion of their coming from without. In the Transactions of the Society of Natural History of Dantzig, MM. Baer and Eisenhardt are said to have found in the waters of the Pregel, near Kœnigsberg, a considerable number of the bothriocephalus solidus, of which they caught four. This, which might have been taken by superficial observers as confirmation of Linnæus's opinion of the external origin of intestinal worms, assumes quite a different aspect when we learn from these naturalists that there existed in the same spot a great number of the gasterosteus pungitivus, in the intestines of each of which one or more of these worms were, upon examination, usually found. Analogy would lead us to believe that they had originated in the fish, and been by them communicated to the water, in which they were ascertained to be capable of supporting life for several days. Dr. Elliotson, though he admits that they may be in some instances innate or hereditary, and that they require a particular habit of body for their development, yet seems to incline to the belief of their external origin in the great majority of cases, and says, in support of this view, that they are peculiarly prevalent in marshy situations, and have even been detected alive in the water of such localities, though of smaller dimensions than they assume in the intestinal canal. Other physiologists, however, such as Müller, Rudolphi, Bremser, &c., who have made helminthology their peculiar study, and who may therefore perhaps be considered the most competent judges of the question, are almost unanimously opposed to this view.

It is often extremely difficult to detect the head of the tape-worm even when it has been actually passed, and this is especially the case if it has broken off short with a very little of the cervical portion attached to it. Bremser says the best method of finding it is, first, to pour tepid water in small quantities on the stools to soften them, and afterwards cautiously to drain off the more liquid portion, repeating the operation till nothing but the worm or its fragments remain at the bottom of the vessel. He mentions, however, an important practical fact, namely, that of the many hundred persons cured by him of tape-worm, not a single individual has seen the head come away. In the collection at Vienna there is an example of monstrosity in the tænia, two of these animals being substantially connected together by the edges of one joint of each; and another taken from a cat has six suckers on the head and a prismatic-shaped body, and seems to have originated in the consolidation of two or perhaps three individuals.

One of the first tolerable descriptions of tape-worm was that by Spigelius in 1618, in which he has distinguished the two species now called solium and lata. The head of the latter was observed for the first time by Fehr in 1667. Tyson, as we have already mentioned, was acquainted with many particulars in the anatomy of these worms. In 1750, Bonnet published an account of the tænia, accurately discriminating the two species. In a later work, however, he speaks incorrectly of their possessing a bifid head or a mouth with two lips, deceived probably by some accidental laceration or monstrosity. He was in error, likewise, in supposing that we derive them from the lower animals; an hypothesis, moreover, by which the difficulty of their first source is thrown back a step without being in any respect explained. Sir A. Carlisle has written a paper on tape-worm, in the second volume of the Linnæan Transactions, where he expresses an opinion already held by Gandolphi, who wrote so long ago as the year 1711, as well as by Postel de Francière in 1763, and now adopted by some of the best authorities, namely, that these animals are generally to be considered rather as an accompaniment than as a cause of disease, believing it absurd to suppose that they were created merely to do injury. He is less satisfactory where he speaks of the possibility of the head being regenerated, and is in error in rejecting Goeze's account of their having ova and ovaries. Coition, he thinks, takes place by the contact of two joints of the same individual. In the exploration of their structure by means of injections he has been anticipated, and perhaps excelled by Werner, who is considered one of the best writers on their anatomy. On several points connected with their natural history and treatment, Pallas may still be consulted with advantage. Amongst the older writers the best are Plater, Le Clerc, Andry, and Vallisnieri.

5. **Tænia Lata.** — *Bothriocephalus latus* of Bremser and all the later writers. *Tænia vulgaris* of Linnæus and Joerden; *Tænia articulos demittens*, Dionis; *Halysis lata*, Zeder; *Tænia inerme umana*, Brera; *Tænia large*, Cuvier; *le ver plat; Tænia à épines; Tænia à anneaux courts*, (Bonnet,) *ou à mamelons, ou stigmates ombilicaux*, of some of the French writers; *Bothriocéphale de l'homme*, Lamarck; *der kurzgleidrichte bandwurm; the broad tape-worm*, Bradley, &c.

The tænia lata, or bothriocephalus, as it is more properly called, has an elongated flat, articulated body, and a subtetragonal head, with two or four lateral and opposite fossæ or depressions, from which it takes its name (derived from *βοθριον*, a trench, and *κεφαλη*, the head.) This particular species is distinguished by the oblong shape of the head and of the lateral depressions on it, by its having little or no distinct neck, by the anteroir joints presenting the appearance of wrinkles, by the subsequent ones being shorter than they are broad, but approaching to square, and getting longer the nearer we come to the tail. It bears a sufficiently great general resemblance to the tænia solium on a superficial examination, to have caused them long to be confounded together. A careful inspection, however, leads to the discovery of such important differences as to show that they belong not only to distinct species, but even to

different genera. Thus the articulations of the bothriocephalus are shorter and broader in proportion to their length and to the size of the animal than those of the tænia solium. The pore leading to the radiated ovary is situated, not upon the edge of the joint, but in the centre of the flattened surface; and what is the most characteristic of all, the form of the head as seen through the microscope is totally dissimilar, being of an elongated and somewhat elliptical shape, with an extensive depression on each side of it. In the middle between these and quite anteriorly, a very minute aperture, supposed to be the mouth, may be detected. It is not surrounded by hook-like processes, as in the tænia solium, and hence the bothriocephalus has been designated by some of the French writers by the title of tænia non armé. The appellation of tænia à épines, by which it is also sometimes known in France, refers to the languinous filaments observable on its neck. For an accurate knowledge of the form of the head, and the reference of this species of tape-worm to a distinct genus, we are indebted to Bremser. It is thinner than the tænia solium, and its length likewise is generally rather less, and as a medium may be stated at about fifteen feet. They are occasionally, however, met with of a much greater size. Goeze possessed one of sixty ells in length; and Boerhaave says he effected the expulsion of one three hundred ells long from a Russian. Its usual breadth is about half an inch at the broadest part, which is near the middle of the animal. In the museum at Berlin there are some an inch in breadth. It diminishes in width towards each extremity, and very remarkably so towards the head. The joints are generally much broader than they are long, and this is more especially obvious towards the ends. In very young specimens the contraction is so great that they commonly appear to be wrinkled rather than articulated. The neck, or part immediately behind the head, occasionally appears even in a good microscope to be without articulations, which is probably attributable to the great contraction and intimate approximation of the divisions. The anterior portion of the worm is often perfectly threadlike for so many as twenty inches or upwards from the head, when at length it begins to broaden itself out. This narrow portion is not, however, admitted by Bremser to be a true neck, but rather a portion of the body elongated, perhaps by the weight of the worm as it hangs from the intestines, for the same appearance is not observed in those which are expelled at once and rolled up into a ball.

Through the depression and pore in the flat surface of each joint, a minute stigma is occasionally projected, as was observed by Bonnet; and this is supposed to be the male organ. On the surface of the impregnated joints minute yellowish protuberances are seen, which, on being opened with a pin, give exit to the subjacent ova. In some instances two pores have been observed on a joint, the one behind the other, or more rarely placed side by side; and sometimes even so many as four on several joints in succession; but such must be looked upon as examples of monstrosity, produced probably while the worms are in embryo by the unnatural adhesion and consolidation of two or more joints. A similar explanation might be given of some of those cases where the tail is cleft or divided into two narrow processes, instead of ending by a rounded joint, as in the natural condition. Perhaps, however, it more frequently depends, as well as the perforated state of single joints, on the rupture of the ovaries, which leads to the destruction of the central portion of the articulations, and thus facilitates their laceration in a longitudinal direction. By Tulpius such an accidentally fissured portion seems to have been mistaken for a head with two lips; and similar misrepresentations are to be found in the works of other old writers.

The tænia lata is not so easily broken across, and is much less apt to part with single joints than the other species of tape-worm; and hence the epithet by which Dionis distinguishes it, as mentioned in the list of synonyms above. To the cause of this peculiarity we have already alluded.

When first passed, its colour is whitish, but not so white as that of the tænia solium; and on being put into alcohol, it acquires a decidedly greyish tinge, and from this circumstance it has been called the tænia *grisea* by Pallas. It inhabits the small intestines, in which frequently so many as three or four are found to coexist. The countries in which they occur most frequently are Switzerland, Russia, and Poland. In France, also, they are by no means rare; in some parts of it, indeed, considerably commoner than the other kind. In England they are very seldom met with.

Worms existing in other parts of the body than the Intestinal Canal.

6. **Filaria Medinensis, or Guinea-worm.**—*Filaria dracunculus*, Bremser; *Dracunculus Persarum* or *vermis Medinensis*, Kæmpfer; *Gordius Medinensis*, Linnæus; *Ver*, ou *filaire de Médina*, ou *de Guinée*, Lamarck, Cuvier, De Blainville, &c.; *Le dragonneau*, *la veine de Medine* of other French authors; *Der faden wurm*, *der hautwurm* of the Germans; *the Guinea or hair-worm*.

In this genus the body is round, elastic, elongated, and of nearly equal thickness throughout; the mouth orbicular, and the male organ simple. The species is distinguished by its great length, the margin of the mouth being tumid, and the point of the tail bent.

The structure of this worm, which occurs for the most part in the cellular membrane beneath the skin, is extremely simple. It is of a white colour, about the thickness of the string of a violin, and of various length from eight or nine inches to three or four feet, or even more. It is of nearly equal diameter from one end to the other, except just towards the tail, which is somewhat attenuated and curved, displaying the male organ in the form of a simple spiculum at its extremity, whilst at the other end may be observed a round orifice with swollen edges, which is the mouth. It is elastic and transparent, and is said to contain a gelatinous substance without any well-marked internal organization. A whitish fluid has been seen to escape from it when wounded. Ovaries are spoken of by Zeder; but Rudolphi was not able to discover them. The latter, though he had not actually seen either their ova or young ones in any of the preparations

submitted to his examination, was yet inclined to believe the sexes distinct.

It seems to be capable of slowly shifting its position in the cellular membrane. According to Rudolphi, its coming out through the skin is to be attributed not to any process of perforation, for which it has no adequate organs, but to the irritation and inflammation which, like any other foreign body, it excites in approaching the integuments. The lower extremities are the parts which it the most frequently infests, winding itself around the foot and toes, or appearing higher up about the ankle or leg. It has been met with, however, in almost all the superficial situations in the body, —in the thighs, scrotum, and testicle; in the walls of the abdomen and chest; in the arms and hands; about the neck and head, and even under the conjunctivæ, or deep in the socket of the eye; from all of which situations it has been successfully extracted. In a certain species of ape a similar worm has been found within the peritoneal cavity, and in another between the coats of the stomach. It has been discovered in the abdomen of the horse also, and even in the globe of the eye itself, where it has been clearly seen through the transparent humours. Many of the insect tribe are infested by worms of this genus.

Several dracunculi have been known to coexist in the same patient. Bosman speaks of nine or ten being occasionally met with; and Desportes saw one case in which there were fifty. M. Clot is one of the latest writers on the disease, and by him it is stated that from ten to twelve is not by any means an uncommon number. He adds, moreover, that Dr. Marrudri, a friend of his own, who had been with the Egyptian army throughout the whole campaign of Cordofan, had suffered from twenty-eight of these worms in succession.

The disease seems to be peculiar to some of the very hot regions situated within the tropics, in Africa and Asia, though in individuals who have contracted it there (and it is by no means confined to the natives) its development may take place many months after in America or Europe. The countries in which it most frequently occurs are Arabia, Upper Egypt, Abyssinia, and Guinea. It is likewise very common on the shores of the Gulf of Persia and of the Caspian Sea, along the banks of the Ganges in Bombay, the island of Ormus, &c. Even within the torrid zone different districts suffer in very unequal degrees. Thus it is endemic at Senegal, and comparatively rare at Congo and Angola. In America it is said to make its appearance almost exclusively amongst the negroes, and chiefly in those who are newly arrived from Africa. To this, however, the island of Curaçoa seems to form an exception, as in it, according to Dampier, the whites and the blacks are indiscriminately attacked; and on Von Jaquin's authority it has been stated that nearly a fourth of the population of that island suffer from it, and it even developed itself on board-ship in the person of one of his fellow-voyagers, who had never been either in Asia or Africa in his life. This fact seems to indicate that the disorder is of a contagious nature; and Lind firmly believed that it might be communicated to Europeans by contact with the negroes. It seems sometimes to prevail in a truly epidemic form, as in the instance of the eighty-sixth and eighty-eighth regiments at Bombay, recorded by Sir James M'Grigor. The first of these regiments, which was quite free from the disease till after the setting in of the monsoon, had subsequently no less than three hundred men attacked by it; and the second, after having replaced the former regiment in garrison at Bombay during a period of two months, and then embarked, was attacked while at sea so generally with this affection, that out of three hundred and sixty as many as one hundred and sixty-one became the subjects of it. In Egypt, M. Clot mentions that it has been much more common since the Ethiopians have been largely incorporated with the Arab regiments. He has seen as many as a hundred patients labouring under Guinea-worm in hospital at one time, at Abou-Zabel, where he observed that the treatment, so long as it was left in the hands of the ignorant native practitioners, was at once empirical and remarkably unsuccessful. Of the worms which he has seen extracted, none were longer than four feet, nor shorter than six inches. It is said to have been seldom met with in that country prior to the conquest of Sennar by Mohammed Ali.

Of its causes nothing certain is known. By many authors, as Bernier, Bruce, Niehbuhr, &c. it has been ascribed to some bad quality in the water used as drink, and filtration is occasionally employed as a precautionary measure; but of the reality of the cause, as well as of the efficacy of the preventive, there is every reason to doubt. Kier thinks it is introduced into the body through the medium of the rain and certain winds, but gives us no proof of his opinion, nor any explanation as to whence the animal or its ova are originally derived. It has even been said to be sometimes carried from one island to another in the West Indies by the high winds so often occurring there; but this, too, stands much in need of confirmation. Heath and other practitioners have made the remark, that it is comparatively rarer amongst the officers than in the common soldiers, and those who occasionally lie on the ground or go with their feet or arms naked. Those who conceive that the swallowing of stagnant water, supposed to contain its ova, is the source of its introduction into the body, have yet the difficulty to account for as to how it reaches its destination in the cellular membrane, and why it shows such a remarkable preference for the legs. One writer has suggested that it may make its way from the intestinal canal to its appropriate locality by a process of slow interstitial absorption without inducing any irritation in its course, in the same manner as needles or pins are often known to work their way from the stomach or intestines to very distant parts of the body. The Hindoos, according to Dr. Scott, believe that these worms are sometimes dug up in considerable quantities out of the ground during the rainy season. The water-carriers in India are very liable to be affected with them in those parts of the back where the skin is frequently wetted by coming in contact with the leathern water-bag. By M. Chapotin they are said to abound during the rainy season at Bombay, and this is especially the case in the earthen floors of the prison, whence they penetrate into the flesh of the unfortunate persons

confined there, causing them eventually great suffering; though occasionally they do not manifest their existence for eight or even so long as eighteen months afterwards. Of its origin or predisposing causes, M. Clot could obtain no certain information. The inhabitants attribute it to the rainy season, and think that it attaches itself, while in a very minute state, to the skin in bathing; but no one asserted that he had himself actually seen it whilst of this diminutive size. It is very common amongst the negroes, by whom it seems to be communicated to the Arab soldiers, and in some rare instances to Europeans also. It becomes much rarer, or even disappears for years together, when no recent incorporation of negro troops has taken place. Dogs which were kept in the hospital and fed on the poultices which had been applied to the sores caused by this worm, occasionally became affected with it.

Touching its true nature many errors have at various times prevailed. Thus Baron Larrey, strange to say, reviving the old opinion of Ambrose Paré, has denied it to be an animal at all, asserting that it is merely dead cellular membrane extracted from a boil! He states, by way of proof of this notion, that he had twice cured it without extraction, and merely by means promotive of suppuration. The view which he has taken of the case, as Bremser remarks, is attributable perhaps to the comparative infrequency of the disease in Lower Egypt, and is altogether refuted by the testimony of numerous and very competent observers. Thus Kæmpfer twice extracted it from the scrotum alive, its removal in each case being effected at a single operation. That it is really a living animal is confirmed by the observations of Dubois, Bajon, Delorme, &c. The last-named writer says he witnessed its undulatory motions; and these have likewise been felt by the patient himself before its complete extraction. This last-mentioned view of their nature is also strongly supported by analogy, as similar worms in a living state occur also in the lower animals, and that very extensively.

Some writers have erroneously supposed the Guinea-worm to be the larva of an insect; but as no one has ever seen this insect, and as the filariæ are met with both in animals living in the air and in those living in the water; and as it seems incapable of making its escape spontaneously, being invariably destined to die either in its nidus in the cellular membrane, or immediately after its extraction; and as it has never been known to pass into any ulterior state of existence, Bremser rejects this opinion as altogether untenable. Joerdens will have it that it is identical with the gordius aquaticus or hair-worm, and that it penetrates, whilst still very small, under the skin of the legs of persons who go into the water. Others, again, though they believe it to be the same animal, think that it makes its way into the body by the mouth. Unfortunately for all these hypotheses, the gordius seems to abound most in the water of those countries where the dracunculus is totally unknown; and in some places where the latter prevails, the former has not yet been observed. (See *Læffler*, *Pallas*, *Lind*, &c.) An accurate examination of these two species of worms is conclusive against their identity; thus the head of the gordius aquaticus, as figured by Blainville, is forked, and quite unlike either extremity of the Guinea-worm.

In fine, in the present state of our knowledge, and till more definite proof shall have been adduced of its external origin, we are inclined to conclude with Bremser, that the filaria is a creature sui generis, of which the natural abode, as well as that of other intestinal worms, is the animal body, where, and where alone, it originates and multiplies.

Its *symptoms* and *treatment*, as they have nothing in common with those of other intestinal worms, may as well be disposed of here. It frequently, as already stated, remains for a very considerable time under the skin without producing any inconvenience, or affording any evidence of its presence. The period of quiescence has been satisfactorily ascertained, in many instances, to last several months. Thus Dampier had no symptoms of the complaint till about half a year after leaving the country where he had contracted it; and Kæmpfer speaks of one case where it did not develop itself for three years.

Amongst the first symptoms is a sense of itching in the affected part, more rarely accompanied with that of something creeping under the skin, and a superficial cord-like elevation can occasionally be felt. At the point where the worm is about to issue, a vesicle containing a whitish mucous fluid, and accompanied with heat, redness, and swelling, or, as others describe it, a pustule, furuncular tumour, or small abscess forms, which breaking gives exit, either immediately or after some days of suppuration, to the head of the worm. According to Kæmpfer and Dubois, these local appearances are occasionally preceded for a day or two by a slight feverish attack, accompanied, as the latter adds, with headach, nausea, and derangement of the stomach. The affected part sometimes swells and inflames considerably, and the motion of the subjacent joints becomes thus much impaired. When situated about the fingers or toes, or other places thinly supplied with soft parts, and where it is wound around nervous filaments and tendons, it may occasion severe suffering, and is with difficulty got rid of. If the vesicle is prematurely broken, intolerable itching, not only in the affected part, but of the whole body, is induced.

The *treatment* consists in the cautious and gradual extraction of the worm, every care being taken to avoid breaking it across, — an event which is said to be followed by violent inflammation, and the formation of sinuous abscesses in its course, together with great constitutional disturbance; and these dangerous consequences have been attributed by Hunter to the contact of the dead animal matter with so great an extent of living surface, to which it now bears the relation of a foreign body; such violent symptoms being rarely seen as long as the dracunculus is alive and uninjured. Most writers agree in thinking that it is better to let it make its way to the surface spontaneously, and then, as soon as it protrudes, cautiously to pull at it, desisting the moment that any resistance is felt. As much of it as has readily come forth is then wound round a small roll of diachylon, a morsel of bougie, or a

bit of stick, which is to be fixed near the aperture, and a slight dressing or a poultice applied over all. The operation of traction may be repeated once or twice in every twenty-four hours till the whole worm is at length brought away, the period required being on an average about ten days, though not unfrequently it amounts to some weeks, whilst from the scrotum, on the other hand, it has often been entirely extracted at a single attempt. When superficially seated, as about the chest, &c., the native Indian practitioners, who are now imitated by our own surgeons, cut down as nearly as they can guess upon the middle of the animal, and greatly shorten the period requisite for its removal by pulling simultaneously on both ends, in the manner mentioned and recommended by Sir J. M'Grigor, Bruce, Lœffler, and others. Some have thought that frictions made over the tract of the worm with ammoniacal and other liniments, facilitated its extraction: the placing of the muscles of the part in a relaxed position is of more obvious and unquestionable utility. When once the animal has been entirely removed, the fistulous ulcer rapidly heals up. Rudolphi, upon the authority of Kæmpfer, cautions practitioners against the use of greasy applications in hot climates, as they may induce gangrene. An onion poultice, which is a popular remedy, is not liable to the same objection, and has been recommended by Bancroft. Dr. Scott had some peculiar notions in regard to the process of extraction. Believing that the worm has no power of retracting itself, he did not in any way fasten it, but was in the habit of immediately cutting off the portion daily drawn out, thinking that the common method of rolling it up and keeping it on the stretch, irritated both the animal and the surrounding parts, occasionally inducing fever and other ill consequences. He was, on the other hand, satisfied that it had a power of slowly and insensibly protruding itself, as he always found at each successive examination that the cut portion projected further than when he had last seen it. The use of internal medicines, such as aloes, &c., as well as mercurial frictions, and many other empirical devices, appeared to him totally inefficacious. M. Clot likewise has been led by experience to the same conclusion, as he has in vain tried, in addition to the measures just mentioned, sundry liniments, sulphur, oil of bitter almonds, and various other reputed adjuvants. The latter writer adds, that when the worm is deeply seated, it sometimes causes considerable fever, great swelling, and tedious abscesses and sinuses, giving out a serous ill-conditioned discharge for many months together, without the worm making its appearance. Here local and general antiphlogistics have been employed with advantage. In some instances, however, patients with these deep-seated abscesses have died without the worm ever having discovered itself externally. In two patients, in one of whom the disease was seated in the fore-arm, and in the other about the ankle, most excruciating suffering, with cramps and convulsions, was experienced. After a variety of antiphlogistic, narcotic, and other remedies had entirely failed, M. Clot succeeded eventually in affording relief by means of the cautery. In Drummond's case, in the Edinburgh Medical Commentaries, severe sympathetic affections of the head and abdomen were induced, as he supposed, by the worm changing its place in the cellular membrane of the leg.

The old Arabian physicians in obstinate cases were in the habit of using venesection, fomentation, and purgatives, especially aloes, which was likewise employed externally in the form of cataplasm, from its supposed tendency to prevent gangrene, and to accelerate the coming forth of the worm. To Loeffler, however, aloes appeared perfectly useless. Assafœtida is confided in by the Brahmins as a preventive, and it has been said that they themselves, from a constant use of this drug, enjoy a total immunity from the disease. It forms an ingredient in many of the formulæ recommended for the cure of this affection.*

[6¹. **Filaria Oculi.** — This parasite has been seen in the anterior chamber of the horse's eye; occasionally in temperate climates: and by no means uncommonly in India. (Lawrence *on Diseases of the Eye*, Amer. edit by Dr. Hays, p. 685, Philad. 1843.) Communications on the subject are contained in the *Transactions of the American Philosophical Society*, 1st series, vol. 2, p. 183, F. Hopkinson, Esq., and ibid. p. 383, by Dr. Morgan; and an interesting case was seen by the writer, and reported upon by him to the American Philosophical Society. It was a *Filaria papillosa*, was from 3½ to 4 inches in length, and was situate in the aqueous humour in which it moved about with great activity. (*Proceedings of the American Philosophical Society*, i. 200, Philad. 1840.) The same case was described by Dr. Charles A. Lee, of New York, with remarks on similar phenomena. (*Amer. Journ. of Science and the Arts*, vol. xxxix. No. 2.)

These parasites have been found in the eyes of other animals; and under the conjunctiva, and in the crystalline lens of man.]

7. **Hamularia Subcompressa.**—*H. lymphatica*, Treutler, Joerdens, and Brera. [*Filaria bronchialis.*] *Hamulaire de l'homme.* Lamarck. *Der fühlwurm*, in German.

The hamularia has a linear, roundish body and an obtuse head, furnished beneath with two projecting hook-shaped processes. The species in question is somewhat flattened and attenuated anteriorly. It has only once been found in man, namely, by Treutler, in the enlarged bronchial glands of a phthisical patient, or in what Rudolphi and Bremser suspect may rather have been distinct cysts. Worms apparently somewhat similar have been discovered in the bronchi of some

* In the Medico-Chirurgical Review for July, 1833, there is a singular case by Mr. Neilson of Killala, in the West of Ireland, where worms are said to have been discharged from various parts of the body. The disease, from the symptoms and the situation of the worms in the cellular membrane, bears some analogy to cases of the Guinea-worm. Under the skin of the patient, a delicate boy of ten years old, tumours formed in various places near the epigastrium, chest, and other parts of the trunk; on the face, and in the extremities. These, bursting, discharged pus; and a white worm about half an inch in length, and like the common ascarides, came from each. It continued to live commonly for a few hours afterwards; there were in all twenty tumours and as many worms. These appeared in succession during a course of three or four months. No worms were passed from the bowels; yet it is conceived by the narrator, that they may have made their way from the intestines to the skin by a process of progressive absorption. The duration of the disease was thought to be shortened by a mild mercurial course.

of the lower animals. Bremser doubts whether it really belongs to a distinct genus, and suggests the possibility of the so-called hooks being a double penis. Those described by Treutler were about an inch in length, curved into the figure of S, not quite cylindrical, the sides being slightly compressed, and were somewhat attenuated towards the head, which forms an abrupt termination to the animal at this end, whilst towards the tail it is semi-transparent and somewhat fusiform. Except the small hooks, which it has the power of moving, no other organs were observed. Its colour was of a dark brown mottled with white spots.

8. **Strongylus Gigas.**—*Strongle géant*, Cuvier; *Strongle des reins*, Lamarck. *Pellisaden wurm*, in German.

In this genus the body is round and elastic, and attenuated or fusiform towards both extremities, the mouth orbicular in some species, and angular in others. The tail of the male terminates abruptly in a kind of shallow cup-shaped cavity, called the bursa by Rudolphi, through which the delicate spicular penis protrudes. The species *gigas* is distinguished by the obtuse head, by the mouth being surrounded by six flattish papillæ, and the bursa of the male being truncated but undivided. The tail of the female is likewise truncated.

This worm, which before Rudolphi's time was generally confounded with the ascaris lumbricoïdes, to which it bears a considerable general resemblance, occurs, though extremely rarely, in the kidneys of man, and much more frequently in those of the dog, wolf, horse, polecat, &c. Its name, derived from the Greek adjective στρογγύλος, signifying cylindrical, was once used to designate the common round-worm of the intestines; yet from this species it may readily be distinguished by the six flattish papillæ alone. It has the appearance of being composed of rings, and displays several longitudinal depressions or nearly parallel striæ on its surface. It is the only species of strongle in which the caudal bursa is neither bifid nor otherwise diversified. The female is larger than the male, and its tail straight and somewhat obtuse, on which the anus, of a longitudinal shape, opens; and about an inch or more from the extremity, according to the size of the animal, is the vulva, leading to the elongated uterus with its two ovaries. Like most of the genus, it is oviparous. A nervous system has been discovered in it by N. Otto, and it is one of the only intestinal worms in which Rudolphi seems inclined to admit the existence of such a system.

These worms are sometimes of a very considerable size. Thus, the last-named physiologist has found them of all lengths, from five inches to three feet, and from two to six lines in thickness,—a magnitude more congruous with our notions of a small serpent than a worm, and which fairly entitles them to their appellation of the giant strongle. Their ordinary dimensions do not, however, exceed fifteen inches long by two lines in diameter. In the museum at Vienna one of the largest is thirty inches in length by four lines in thickness. When first removed from the body of an animal recently killed, they are of a deep blood-red colour.

In the lower animals they have been found in a much greater variety of parts than in man; thus, for example, they have been met with in the tympanum of the delphinus phoca; and in the respiratory and digestive organs of other genera, as well as in the kidneys, the heart, &c. They have been seen, moreover, in aneurismal tumours of the great vessels of the horse, being here of a diminutive size, or about three inches in length (*strongylus filaria*), and their extremity actually projecting into the arterial cavity. A species of the genus strongle has been detected in great numbers in the trachea and bronchi of calves by Campier, and of the sheep by Daubenton, as well as in the duodenum and fourth stomach of the latter animal by Rudolphi. The strongylus armatus occurs in the cœcum of the horse; and Duhalde has described a kind of worm found in the throat and stomach of the tiger, which is supposed to have likewise belonged to this family; as is probably also the case with certain worms which have repeatedly been met with encysted in the stomach of the dog. It is not by any means improbable that they may yet be found in new situations in man besides those in which they have hitherto been recognised: a knowledge of the above examples furnished by comparative anatomy may tend to promote their discovery in other parts of the human subject. Haehne speaks of a living worm found in the chest and adhering to the heart, and both Rudolphi and Bremser are disposed to think it was the species with which we are at present occupied. When these worms have been discovered in the kidneys of man or of the lower animals, they were often found bathed in blood, the containing organ being in a state of very extensive disorganization. According to Rudolphi, however, there is no proof that they are the original cause of the formidable state of disease which coexists with them. On the contrary, as they are never seen except in such kidneys as have their structure already in a great degree broken down and destroyed, their development seems to be rather a consequence of some peculiar diseased state of the parts than its exciting cause; and we see here one of the many instances in which morbid structures become the favourite nidus of animated beings. On escaping from the kidney, their natural situation, they often induce violent agony whilst still in the ureters, the bladder, or the urethra. They may probably, as Rudolphi himself is willing to admit, be very injurious even whilst still confined to the kidney, by preventing the healthy reinstatement of the parts, or the healing of any abscess in which they may have established themselves.

In the body of Ernest, grand-duke of Austria, who died in the Low Countries in the end of the sixteenth century, it is mentioned by the celebrated Grotius that a stone and a living worm were found in the kidney, and that the parts around the animal appeared to have been eaten away or destroyed by it. Ruysh also once met with a worm in the human kidney; and Blasius with two of a red colour and about an ell in length in an old man in the same situation. Rhodius speaks of a case in which one was discharged from the urinary passage in the course of a fever, although no inconvenience had ever arisen from it.

In Albrecht's case, on the contrary, there had been considerable difficulty in making water for seven years previously, which ceased immediately after the expulsion of the worm from the urethra. It measured about a foot in length, and was of the thickness of an ordinary writing-quill. Raison tells us of a man of fifty, who had suffered for two years from nephritic colics and bloody urine, and who recovered forthwith upon passing with his water a worm about three inches long. Several similar cases are alluded to by Bremser. One of the most remarkable is that by Moublet, to be found in the ninth volume of Roux's journal, of a child who had been operated on for the stone at three years old, and who became affected at ten years of age with great pain in the region of the kidneys. In this situation a tumour formed, accompanied by partial retention of urine. From the tumour, in which an incision had been made more than once for the discharge of the contained pus, and which always healed imperfectly, bursting open from time to time, a worm five inches long, and as thick as a quill, eventually came away; and soon afterwards another about an inch shorter. After a complete retention of urine and great distension of the bladder, two more came forth, and the child then recovered completely.

Mr. Lawrence, in the second volume of the Medico-Chirurgical Transactions, has described a singular case of a woman who voided by the urethra, in the course of some months, no less than a thousand worms. During the four or five years previous to their first appearance externally, she had been suffering from severe pain in the bladder and down the thighs, accompanied with a retention of urine which rendered the daily use of the catheter necessary. The worms passed were of two kinds; the larger varied from four to eight inches in length, and were slender, especially in the middle, where they were bent and apparently nearly broken across; towards their extremities they had a floating edge or alar process; their under surface was grooved, and their colour yellowish; they seem to have been a perfectly homogeneous structure, no traces of organization being discoverable in them even with the aid of the microscope. They appeared generally to be dead when passed, though in some an undulatory motion was observed. The smaller kind was only about an inch and a half long. Their escape seemed to be in some degree facilitated by leaving a large-sized catheter in the bladder, as well as by turpentine injected into this organ and taken by the mouth, till its use had to be renounced on account of a cutaneous affection induced by it. The sufferings of the patient throughout were very considerable; nervous affections, fits, &c. Rudolphi and Bremser, who both received specimens of these supposed worms, express great doubt as to the organized nature of the larger kind, and from the want of perfect uniformity in their shape, incline rather to consider them to have been merely portions of coagulable lymph moulded into a cylindrical form in the ureters. As to the smaller ones, as they lived in tepid water for forty-eight hours after they were passed, and discovered sufficient evidence of organization at their extremities, as seen in the microscope, there can be no doubt of their having been real worms; and by Bremser they are supposed to have been young strongles. Dacerf gives the case of a man who, after an urethral hemorrhage accompanied with violent pains in the thighs and bladder, passed a worm about fourteen inches long, which was unfortunately thrown away. Several other vermicular substances continued to be passed with the urine for a considerable time after; but from the great dissimilarity in their size and appearance, both Duméril and Bremser were satisfied that those submitted to them were merely lymphatic concretions; though the first and largest one passed, which was unluckily lost before any scientific person had examined it, may very possibly have been a strongle.

The symptoms induced by the presence of these worms in the kidney, so far as they are yet known, are in no wise characteristic, as they do not differ from those of renal disease in general, when attended with irritation and inflammation; nor do they seem to call for or admit of any peculiarity of treatment.

9. **Distoma Hepaticum.** — *Fasciola hepatica*, Linnæus, Gmelin, Joerdens, Brera, Lamarck, &c. *Douve de foie*, Cuvier. *Der Leberegel, Leberwurm. Schafegel, Gallenwurm, Die Egelschnecke*, &c. of the Germans. *The fluke, or liver fluke.*

The distoma is soft, roundish, or flat, and is distinguished from other genera by possessing two pores, an anterior and a subventral one. The species *hepaticum* is somewhat oval and flat, the neck rather conical and very short, the pores orbicular, and the ventral one the larger.

It bears a considerable resemblance in its shape to a melon-seed, being flat, and appearing lanceolate at each end as seen with the naked eye; though, when slightly magnified, the extremities are found to be obtuse, the tail being the broader of the two. Their form, however, varies considerably at different moments according to their state of contraction or dilatation. As found in the gall-bladder of man, (the only situation in which they have yet been discovered in the human subject, and even there very rarely) they are from one to four lines in length, and from half a line to a line in width. But in the livers of some of the lower animals, sheep, cow, stag, horse, pig, &c. they occur of much greater dimensions, being often so much as an inch long by nearly half an inch broad, though others much smaller, which are the young ones, are generally intermingled with them. They have been found by Frommen in the fœtus of the sheep. Their colour is yellowish or light brown. Of the two openings from which they take their name, the anterior one is directed obliquely inwards and backwards; the posterior or ventral one projects slightly, and is supposed to be the vulva: behind it are seen some whitish spots, and a set of vessels of a brownish yellow colour, which Bremser takes to be the oviducts, the vessels along the sides of the animal being considered by him to be the intestinal canals. In front of the ventral pore Goeze describes a tubular body, which he calls the penis. They are all hermaphrodite and oviparous. It lives upon the bile, which is absorbed by the anterior pore, and which is at once so digested or modified by the vessels which go off from thence as to render it fitting nutriment for the animal, and is likewise

distributed by them to its various parts—the same apparatus performing here, as in so many other instances amongst the lower orders of organized beings, the double functions of a digestive and of a circulatory system.

The genus distoma is very extensively distributed, occurring not only in the ruminantia, rodentia, and several other classes of the mammalia, but also in the stomach and intestines of birds, fishes, &c. In the human species, however, it is so rare, that Bremser has not met with it in any of his numerous dissections, and in the course of his very extensive reading, has been able to collect only five or six well-authenticated instances of it. Unquestionable examples of its occurrence have been recorded by Bidloo and Pallas. Bucholz found them in great numbers in the gall-bladder of a man who died of a putrid fever; and Chabert, by means of his empyreumatic oil, effected the expulsion of a great quantity from a girl of twelve years old. In the biliary ducts of the lower animals, they are not only, as already mentioned, infinitely more frequent, but occasionally exist in such numbers as greatly to distend these canals, which often become lined with an ossific deposit in consequence of the irritation induced by them, and in this state impart to the liver an inequality of surface, by which, as well as by the crackling sound and feel on pressure, the presence of these worms can be surmised even before we have cut into the organ.

As for the symptoms of this affection in man, they are as yet unknown; and with regard to its treatment, Chabert's is the only case we are acquainted with, which seems to show that it is within the reach of medicine. From the success of his empyreumatic oil in this one instance in the human species, its employment has been suggested in the case of sheep suffering from the disease called the rot, in which the liver fluke is often known to exist in great quantities. Whether it be the cause, or merely the effect of the disorder, is an undecided point; analogy would lead us to believe the latter. These worms are often thrown up in great numbers by the diseased animals, and thus getting accidentally into the water from which they drink, and being found there, the error of supposing them to originate from without might readily be adopted. The best cure for them, says Rudolphi, is wholesome food and a dry pasture-ground. The large use of salt has also been found useful both as a remedy and as a preventive. For some additional facts in regard to this affection in sheep, see the article Hydatids.

10. **Polystoma Pinguicola.** — *Hexathyridium pinguicola*, Treutler and Brera; *linguatule des ovaries*, Lamack; *fettblatt-wurm*, Joerdens.

In this genus the body is roundish or flat; there are six anterior pores; the ventral and the posterior pores are each solitary. In this particular species the body is flat, truncated anteriorly, and acuminated posteriorly; the six pores in front are arranged in the form of a half-moon.

It has only once been found in the human species, namely, by Treutler, in a small tumour about the size of a hazel-nut, in the adipose tissue connected with the left ovary of a young woman who had died in childbed. The tumour, which seemed to consist merely of indurated fat, was of a reddish colour, and hollow within. Its cavity was nearly filled by the above-named worm, which appears to have been about half an inch in length and between one and two lines in width, truncated in front where the semicircle of pores is seen, and lanceolate posteriorly with somewhat of a curve to one side.

11 and 12. **Cysticercus Cellulosæ** and **Echinococcus Hominis** have been already described in the article Hydatids, to which, to avoid repetition, the reader is referred.

[13. **Diplosoma Crenata.**—This worm has been confounded with Spiroptera hominis, to which, however, it would not seem to bear any resemblance. The confusion appears to have arisen from both having been passed from the urinary bladder of the same individual, whose case occurred to Dr. Arthur Farre (Tweedie's *Library of Medicine*, 2d Amer. edit. iii. 610, Philad. 1842). This worm varies in length from four to six or eight inches, and is thinnest at the middle, where it is bent upon itself at an acute angle, so that the two halves hang nearly parallel, and give to the entozoon an appearance as if two worms were tied together by their heads. It has been doubted, however, whether the specimens observed have really been worms; but Dr. Farre asserts, that the woman, who voided them repeatedly, assured him, that when first discharged they were seen to move, and were found to make their way for a distance in the bed.

14. **Spiroptera Hominis.**—This is the worm alluded to above, as having been voided with the Diplosoma crenata. It was met with only during the early period of the case, and had long ceased to be passed, although the Diplosoma continued to be occasionally voided (Farre, *Op. cit.* p. 622). Considerable obscurity prevails, however, in regard to it (Mr. Owen, art. *Entozoa*, in *Cyclop. of Anat. and Physiol.* ii. 123, Lond. 1839). The worms observed were of different sizes,—the male being 8, and the female 10 lines in length, of a white colour, slender, and very elastic;—the head rather truncated, furnished with an orbicular mouth, and one or two papillæ. The body is attenuated towards each extremity, but especially towards the head. In the female, the posterior extremity has a short obtuse apex, and is thicker than that of the male: in the latter, there is at this point a short tubulus, which is probably the sheath of the penis.

15. **Dactylius Aculeatus.**—This Entozoon was first described by Mr. Curling (*Medico-Chirurgical Transactions*, xxii. 275). It was found in the urine of a little girl, five years of age, during convalescence from a slight attack of fever. When first passed, the worms floated separately in the urine, but in a short time they coalesced, and coiled themselves up together in the form of a ball, at the bottom of the vessel. When disturbed, their motions were often lively, and if permitted to remain in the urine, they lived for two or three days. The worm is of a light colour, annulated, cylindrical, but tapering slightly towards both extremities, chiefly towards the anterior, which is the smaller. The female measures about four-fifths of an inch in length; the male is about two-fifths of an inch long. (Dr. Farre, *Op. cit.* p. 623.)

16. **Trichina Spiralis.**—This parasite would seem to exceed in minuteness and numbers every other that infests the human body. It is, indeed, so minute as doubtless to cause it to be often overlooked. It has been well described by Mr. Owen (*Op. cit.* p. 114); by Dr. Arthur Farre (*Lond. Med. Gaz.* xvii. 382, and Tweedie's *Library of Medicine*, edit. cit. iii. 617), and by Dr. Bowditch (*Boston Med. and Surg. Journal*, for 1842).

The cysts are generally so numerous as to give to the muscles in which they are found a peculiar grey speckled appearance, as if the part had been thickly sprinkled with the eggs of some small insect. They are commonly about $\frac{1}{50}$th of an inch in their longitudinal diameter, and $\frac{1}{156}$ of an inch in their transverse diameter (Owen, *Op. cit.*) They are elliptical in form, attenuated towards the extremities, which are opaque and bulging in the centre, which is usually transparent. Each cyst generally contains only one worm; but in one subject, dissected by Dr. Farre, most of the cysts contained two worms, and one contained three.

The Trichina is found both in the healthy and diseased muscle; and no phenomena occur during life which can indicate its presence.

A full account of the animalcule, with lithographic illustrations, is given by Dr. Bowditch, in the Journal referred to.

The following table affords a view of the entozoa that have been met with in the human body, and their usual habitat.

ENTOZOA.	WHERE FOUND.
Tricocephalus dispar	In the intestines.
Oxyuris vermicularis	
Ascaris lumbricoïdes	
Bothriocephalus latus	
Tænia solium	
Ditrachycaros rudis	
Diplosoma crenata	In the urinary bladder.
Spiroptera hominis	
Dactylius aculeatus	
Distoma hepaticum	Gall-bladder.
Strongylus gigas	Kidney.
Filaria oculi	Eye.
Acephalocystis endogena	Liver.
Echinococcus hominis	Liver, spleen, and omentum.
Polystoma pinguicola	Ovary.
Filaria bronchialis	Bronchial glands.
Trichina spiralis	Muscles.
Cysticercus cellulosæ	
Acephalocystis multifida	Brain.
Filaria Medinensis	Cellular texture.]

Spurious Worms.

The number of these must obviously be altogether indefinite, as innumerable objects belonging both to the animal and to the vegetable kingdom have at various times been mistaken for worms. Our limits will only permit us to notice the insects or their larvæ, and other animals which have been accidentally introduced into the body.

Individuals of the human species are very liable to such fortuitous inmates. The larvæ or ova of insects may be introduced into the nose or ears, or into the stomach and intestinal canal by the mouth, or, finally, may occur in the skin, especially when wounds, ulcers, or cutaneous affections exist. M. Daquin has described what he calls a species of worm, though it was probably the larva of an insect, which came out of the ear. Kerkringius gives an account of certain animals found in the ears, which Rudolphi supposes were of the same nature; as also of others which came from the nose, and appear to have been the scolopendra electrica; and this seems also to have been the case with those mentioned by Honold. Ernst speaks of a worm which was blown from the nostril, its appearance being followed by a great hemorrhage. Razouz published a case in which a prodigious number of worms, as he calls them, (though there is reason to think they were the larvæ of flies,) came from the same part. Martin Slabber, a Dutch writer, tells us of a man fifty-two years old, who had laboured under severe headachs from an early period of his life, which ceased immediately on his expelling, in the act of sneezing, a worm, called by him a lumbricus, and described as being above eight inches long. Lange, in the third volume of Blumenbach's Medicin. Bibliothek, gives the case of a peasant, from whose frontal sinus a worm of a similar appearance came forth; and Blumenbach himself, in his anatomical treatise concerning the frontal sinuses, speaks of the scolopendra electrica and other insects and worms being found in this part. Sandifort makes mention of a living earwig escaping from the nose. Tengmalm, a Swedish writer, has recorded a very interesting case, in which above two hundred larvæ of the domestic fly, covered with mucus, were expelled from the nose of an infant of eight months old. In the eighth volume of the Edinburgh Medical Commentaries, is a case which occurred in Jamaica, of worms (larvæ ?) in the nose, which caused very severe symptoms, till they were at length expelled by injecting a decoction of tobacco into the nostrils. In the history of the Academy of Sciences for the year 1708, there is an account of a woman who, at thirty-six years of age, began to suffer from a fixed pain in the forehead, on the right side, near the nose, and which gradually extended towards the temple. This, by the end of two years, had become very violent, and almost constant, and was accompanied by convulsions, an almost perpetual insomnia, and temporary affection of the intellect. At the end of four years, after having tried a great variety of remedies in vain, she began to use snuff, in hopes of its assuaging her sufferings; when one morning, after a violent fit of sneezing, a worm, or, more properly speaking, an insect, gathered up into a lump, came away from her nose, and along with it a little blood. From that moment she was well. The animal, which was alive, measured, when stretched at full length, six inches, but only two when it folded itself into a zig-zag form,—a habit which it had acquired from its long confinement in the limited space of the frontal sinus, into which it had perhaps been introduced in the state of an ovum. It was two lines broad, and about one and a half thick in the middle of the body. It was of a clear coffee colour, convex above and flat beneath, and covered with annular scales separated from each other by minute intervals, through which the feet came out, there being fifty-six of them on each side, about a line in length, and as thick as a hair. It seems, in short,

from these particulars, as well as from the remainder of the description, to have been a species of centipede. It lived for many hours after its expulsion, and even for two or three after having been plunged into brandy. M. Littre, who relates the case, suggests that in similar ones, if injections of oil, infusion or smoke of tobacco, and other ordinary measures failed, a surgical operation on the frontal bone might be had recourse to with safety and success, and would be fully justified if the symptoms were violent. Insects in the ears may be removed by frequent mild injections, especially of an oily nature; or if very obstinate, they may be first killed with sulphureous fumes, and then washed out.

Such instances as those above alluded to may be supposed commonly to originate from insects depositing their ova in the auditory or olfactory passages, or creeping in unobserved, especially in individuals who are fast asleep or broken down by disease, and hence less attentive to external impressions, or not in full possession of their senses; and also in infants. Sometimes, perhaps, they may be drawn in, in the act of smelling strongly of flowers, or they may be swallowed with fruits, cheese, flesh meat, or various other articles of food, or in impure water used for drink. Rudolphi discredits their entrance per anum, as well as that by the urethra. Of the cases in which worms have been said to be passed with the urine, almost all, except those which we have already spoken of when treating of the strongylus gigas, seem to have been instances of the larvæ of insects (the oniscus asellus most frequently, according to the author just named) which had been introduced furtively, and with a wish to deceive, or casually and unobserved, into the containing vessel.

The worms alleged to have been discovered in wounds and ulcers, as in the case published by Stenevelt at Leyden, in the year 1697, — and in cutaneous diseases, as in a case of lepra, of which an account was published by Murray at Göttingen in 1769, appear likewise to have been merely larvæ. M. Bosse, in the thirty-second volume of the "Journal de Médecine," gives a description of the larvæ of flies found in pustules in the skin of a negress. Such seem also to have been the *eleophagi* of the old writers, or worms found in wounds and supposed to feed on the flesh. There is a case mentioned in the Lancet, for May 21, 1831, of a compound fracture of the humerus treated in one of the Parisian hospitals, in which, on the fifth day, intense itching was complained of, and was found to depend upon a multitude of worms in the wound and on its edges. Similar facts were frequently observed in Syria by Larrey, who thinks that the worms rather favoured the healing process by devouring the putrid matter and not touching the living flesh. Camphorated spirits and other antiseptics were found to be quite adequate to prevent their immoderate increase. Worms resembling the lumbricus teres, but more of a white colour, have been seen, according to Lister, coming from an abscess in the ankle. What these were we cannot pretend to say.

Of insects inhabiting the skin, the American species of acarus mentioned by Humboldt, and the acarus scabiei and louse are likewise examples. The latter is well known to be peculiar to man, and incapable of existing elsewhere. Their abundance seems to depend on the greater or less degree of cleanliness of the individual, and certain cutaneous affections seem greatly to favour their multiplication. The inunction of mercurial ointment is a certain mode of destroying them. It is commonly believed by sailors that they die under the equator, being killed by the excessive heat; but the truth of this is not generally admitted. They seem, however, to flourish in cold situations. Thus Humboldt mentions that they are very abundant in the higher regions of the Andes; and in Greenland they exist in prodigious quantities, according to the late Sir Charles Girsecke, and are turned to account there as an article of diet.

The *pulex penetrans* or *chigoe* is very troublesome in sugar colonies in South America, penetrating into the skin and lodging its eggs there, and causing malignant and often fatal sores. It is of a reddish-brown colour, and the proboscis is as long as the whole body. The abdomen of the female, when gravid, becomes swollen to a hundred times its natural size.

"The chigoes," says Dr. Elliotson, in his lectures, "are a sort of large fleas which infest the inhabitants of the West-India islands; they get under the skin, and there form a bag, in which they lay about sixty eggs, which hatch there and produce a very bad sort of ulcer. The negro women are very expert at extracting this bag by means of a needle, without wounding it. If it is wounded, an acrid fluid which it contains escapes and produces an ulcer, which is also troublesome to heal. The genus of the chigoe was formerly disputed, till a Capuchin friar, to settle the dispute, allowed one to breed in his great toe, and such mischief ensued that amputation was necessary."

The *œstus humanus*, described by Linnæus and more recently by Humboldt, occurs in the warmest regions of America. It deposits its ova on the skin, which the larvæ soon after penetrate, remaining beneath it for about half a year, when they pass into small brown flies. If they be not interfered with, they make their appearance in due time, and the part quickly heals; but much deep-seated pain is induced by attempting their premature extraction. The *œstrus bovis*, which also infests sheep and goats, deposits its eggs more especially on the back of the animal, where it forms a small tumour, in which the larvæ remain from autumn to the commencement of the ensuing summer. The fly is said always to select the most vigorous and fattest animals. The torture which the reindeer experiences from a similar species of fly is well known. The *œstrus ovis* lays its eggs on the margin of the nostrils, whence the larvæ make their way into the frontal sinuses, and remain there, often in very great numbers, from autumn till the end of spring. The *œstrus equi* deposits its ova on the skin of the legs or sides of the horse, which on licking itself conveys them into the stomach: here they become converted into larvæ, and are at length passed along with the fæces, soon to undergo their final metamorphosis. Another species, according to Bracey Clarke, deposits its ova in the lips of the horse. Bots, though often very numerous in the stomach, do not induce any inflammation. The larvæ of

the œstri appear, from the experiments of Fischer, to be very tenacious of life; even spirits and a strong solution of salt did not kill those of the sheep. Anointing their respiratory orifices with oil, and keeping them for several hours in this fluid, only produced a temporary languor. The fumes of burning sulphur, however, killed them in a very few minutes. Rudolphi believes that they do little injury to the horse and the other animals which they infest. If, however, we wish to destroy them, turpentine or Chabert's oil may be employed. Those in the frontal sinuses of sheep are expelled with difficulty; the frequent introduction of tobacco-smoke has been recommended. Larvæ have been observed in the expectoration when the vessel containing it has been kept in a warm place, of which an instance is to be found in the fourth volume of Hufeland's Journal. These originated, doubtless, in ova deposited in the sputa subsequently to their excretion.

The digestive organs, and especially the stomach, are by far the most frequent receptacle of these extraneous animals. Albrecht has recorded an interesting case where a boy passed a considerable number of what the narrator calls worms, though doubtless they were the larvæ of flies, the origin of which was traced to some cakes which the child had been in the habit of eating; and similar ones were found to abound in the cupboard in which the cakes were kept. Odhelius mentions an instance where the larvæ of the musca pendula were evacuated with the stools; and in the first volume of F. B. Osiander's "Denkwurdigkeiten," a still more remarkable one is to be found of a woman who passed, both upwards and downwards, a great variety of insects and worms, viz. millepedes, flies, and their larvæ, the curculio and staphylinus, spiders, earth-worms, ascaris lumbricoïdes, tricocephalus, &c. Rosenstein, moreover, has described a case in which numerous larvæ, curculiones, scarabæi, elster, modella, &c., came away from a woman by stool; and Ariel has also given, in the "Scientific Transactions of Upsal," a somewhat similar but still more wonderful instance, where an immense number of such insects existed in the stomach for the long period of two years, when they were at length, after a great number of unsuccessful experiments, expelled by means of a mixture of turpentine and linseed oil: amongst them were observed staphylinus splendens, staphylinus fuscipens, oxyporus subterraneus, pæderus elongatus, carabus leucopthalmus (alive). Of the staphylini there were two hundred and sixty-three in all. The larvæ were almost past counting, especially those of the tenebris molitor and of the carabus. Such unnatural inmates, as Rudolphi remarks, give rise to very great distress by their restlessness, and perhaps also by gnawing at the coats of the stomach, (for it is chiefly in the stomach that they seem to take up their abode,) and they may induce very violent spasmodic affections. It is in the debilitated, cachectic, ill-fed, and hysterical, that they have chiefly been observed: a vigorous digestion and an active peristaltic motion would generally speedily effect their destruction and expulsion.

Of all the marvellous cases of this kind on record, one of the most so, and yet at the same time one of the best authenticated, is that related by Dr. Pickells, in the fourth and fifth volumes of the Transactions of the King and Queen's College of Physicians in Ireland. The person in whom it occurred was a young woman of a chlorotic habit and melancholy disposition, who, from certain superstitious notions, had been in the habit of drinking daily a mixture of water with the clay taken from the grave of two priests, who had maintained during life a high character for sanctity, by which practice she in all probability acquired the ova of those insects which continued to be developed at intervals for some years afterwards. It is also mentioned, that on one occasion she lay out the entire of a rainy winter's night, stretched across the grave of her mother; and moreover that she was addicted to eating chalk in incredibly large quantities. Of the larvæ of the beetle evacuated per anum prior to the publication of his first paper, Dr. Pickells estimated the number at above one hundred, and supposed that above seven times that quantity had then been vomited: and in the next year and a half, the period comprised in his second account, terminating with June, 1825, above thirteen hundred beetle larvæ, all of which he himself reckoned, were discharged. Thus the whole number during about three years and a quarter amounted to above two thousand, and most of these were alive. Both the larvæ, pupæ, and the perfect insects, were simultaneously observed. Many made their escape the instant they were vomited, and ran off into holes in the floor; and two large winged insects were so lively on their expulsion, that they immediately flew away and escaped.

The relator of the case and several other credible witnesses actually saw her vomit up many of the larvæ. Amongst these is mentioned that of blaps mortisaga, which was an inch and a half long by four lines and a half in girth; also the tenebris molitor or meal-worm, and the larvæ of two kinds of fly, one of which seems to have been the musca vomitoria or blue fly. By this case, says Dr. Pickells, "the interesting fact seems to be established, that the different successive metamorphoses of insects may take place in the human stomach during life." "The present," he continues, "is, as far as my inquiries have extended, the first well-authenticated case in which the larvæ, pupæ, and imago of the same insect have been discharged from the same individual." The train of symptoms to which they gave rise was most complicated and distressing—a gnawing and sense of something creeping at the pit of the stomach, hæmatemesis, amenorrhœa, hysteria, convulsions, perversion of the senses, and also at times a degree of mental derangement, with headach, retention of urine, dropsy, &c. &c. Emetics and various other remedies were employed, but what seemed most effectual, and eventually appears to have cleared the stomach and intestines of these formidable inmates entirely, was turpentine given in enormous doses, being gradually carried so high as six ounces in a day. When given, it generally induced an immediate flow of the menses, with giddiness of some days' continuance, and an herpetic eruption. During its employment, ascarides vermiculares were passed in considerable numbers, and were generally found, notwithstanding the largeness of the dose of turpentine, to be still alive.

In the Transactions of the Royal Society of Göttingen, Klaerich has given a description of a convulsive affection caused, as he asserts, by the creeping of an insect in the stomach, which appears to have been a scolopendra electrica. Dr. Elliotson likewise has seen two centipedes which were said to have been vomited by a girl: he has also known two cases where a live caterpillar (the noctua proxuba) was discharged from the bowels; and a third is to be found in Duncan's Medical Commentaries. Their introduction into the stomach seems to be explained by a habit which the individuals had of eating raw cabbage-leaves, in which the ova were probably contained. Cases in which earth-worms, snails, lizards, spiders, bees, frogs, toads, leeches, and even serpents, have been thrown up from the stomach, are upon record; the great majority of these we may be justified in ascribing to deceit and imposture. Some of them, however, are supported by respectable evidence; and there is evidently no physical impossibility in such animals being swallowed under the influence of mental derangement, or with a view to excite wonder and gain profit; and from their great tenacity of life they may doubtless continue for some time to exist even in the stomach, especially if this organ be in a debilitated state, and while there they may excite a train of very aggravated and inexplicable symptoms. Thus, Bremser mentions a case which fell within his own knowledge, of a hypochondriacal woman, who, upon one occasion, when out of her right mind, swallowed a young toad wrapped up in a morsel of the peritoneum of a cow or sheep, which she got of her butcher for the purpose. She conceived the toad to be poisonous, and was desirous in this way of getting rid of her existence. It remained in her stomach all day, but towards night great oppression and sickness coming on, it was thrown up, with its hind legs broken, along with the half-digested membrane. In his useful synopsis of intestinal worms, Mr. Rhind details a case, on what appears credible testimony, where the common grey snail (limax major), four inches long, was vomited by a farm-servant in Haddingtonshire, after suffering from various obstinate dyspeptic symptoms for above a year and a half; namely, inordinate appetite, vomiting of fœtid slimy matter, sour eructations, constipated bowels, swelling and tenderness of the epigastrium. Various treatment had been ineffectually employed, till at length, whilst making use of a strong solution of soda, and of pills of calomel, hyoscyamus, and gentian, the snail was expelled in one of his severe fits of vomiting, and lived five days in the possession of the medical man who was attending him. All the distressing symptoms disappeared immediately after. The man was in the habit of drinking daily out of a muddy ditch, which may perhaps be thought to afford some explanation of its origin. The introduction of leeches into the stomach, where they are said to attain to an enormous size, is a very dangerous occurrence, and may even prove fatal by the loss of blood occasioned. Large doses of salt constitute an obvious remedy. It is supposed that they have sometimes been swallowed when in a very minute state in a draught of turbid water.

Larvæ and most insects are very tenacious of life; thus coleoptera are known to live for weeks after they have been pierced through with pins; and Rudolphi has seen a species of curculio walk about as usual after part of the elytra and most of the abdomen had been eaten away by ants. The larvæ of flies are very common in ordure, putrid flesh, &c. When tainted meat is eaten, the ova may thus get into the stomach and be developed there; and of the possibility of the propagation of the staphylini and other insects even in the interior of the body, as occurred perhaps in Acrel's case, Rudolphi does not doubt, though in all probability this is very rare. Larvæ and insects are best got rid of by means of turpentine; and Chabert's oil has also been suggested as likely to prove a useful remedy.

On the Origin of Worms.

There are but two conceivable modes in which the presence of intestinal worms can be accounted for; they must either come from without, or they must originate within the body of the animal in which they are found. To the improbability of the external origin of the worms infesting the human body, we have already repeatedly alluded; and Rudolphi and Bremser, after a careful analysis of all the supposed instances of their introduction from without, whether in man or in the lower animals, are led to pronounce that this view of the question is utterly unsupported by any positive evidence, whilst at the same time the arguments against it are at once numerous and apparently insuperable. How very improbable does it seem that these animals, which are delicate and easily injured, should be capable of sustaining such a violent and sudden change of temperature, food, and all their habits, as this theory would imply. It is unquestionable that the few instances in which they have been detected accidentally existing externally, bear no kind of proportion to the frequency with which they are discovered in the interior of animals; and the situation in which any creature is most usually met with, is, it may be presumed, its natural one. The rare exceptions as to situation just alluded to, may be safely attributed to the casual transplantation of these worms from their native region; and if they be found when so misplaced still in a living state, it only shows that they are capable for a limited period of resisting the hostile influences by which they are surrounded.

Brera, who inclines to a belief in their external origin, notwithstanding all the difficulties with which it is accompanied, suggests that they may undergo such a complete metamorphosis in their new position within the body, as no longer to betray the source whence they were derived; but as they have never been detected in any intermediate condition or state of transition, this hypothesis may be dismissed without ceremony.

The arguments for their internal origin are, as we have just stated, weighty, and many in number. Thus their structure is altogether peculiar, being quite unlike that of worms and other animals existing externally, whether on the land or in the water. Particular kinds of intestinal worms are, with a few exceptions, appropriated to different species of animals, and even to particular parts of the same animal, which could scarcely be expected if they came promiscuously from without: they occur in all parts of the body, even in those

which have no communication with the external world, and have been met with in some well-attested cases in the fœtus both of man and of the lower animals: they not only multiply most abundantly within the bodies they inhabit, but very soon die when removed from them, in which latter circumstance they altogether differ from the larvæ of insects: and, finally, their presence, even in very considerable numbers, is frequently unattended with any obvious inconvenience to the individuals in whom they have their abode, these being often found to be fat and in all respects healthy; and if neither nervous nor previously debilitated, they are sometimes quite unconscious of their presence; whereas, with regard to larvæ and other living things fortuitously and unnaturally located within us, the case is quite otherwise, as they usually give rise, as we have already seen, to much suffering.

Pallas and some other authors, who fully admit the internal origin of intestinal worms, are yet disposed to think that they do not in all, nor even in most instances, take their rise in the individual in which they happen to be found, but that they or their ova have commonly been transmitted to them from other animals, of the same or a different species, previously infested with them; and in support of this view, Pallas, its chief advocate, brings forward the three following propositions, which are, however, very far from being conclusive.

1st. He asserts that worm-diseases are most common in great towns, where a want of personal cleanliness, and the use of water impregnated with various impurities, often of an animal origin, facilitate the transmission of the ova. But both the fact and its explanation are liable to dispute. Were it even proved that they are more frequent in crowded cities, the debility of the digestive organs so common in such situations from the influence of bad air, bad food, privations, or intemperance, would much more satisfactorily account for it. The specific gravity of the ova seems incompatible with their aerial transmission, and the cold of water at ordinary temperatures would inevitably destroy their vitality.

2dly. The limitation of particular worms to particular animals, he thinks, may be explained on the principle of the ova becoming developed in those, and those only, which afford them a congenial nidus. The fact is admitted, but the explanation is not the only one, nor the most satisfactory. On the contrary, the appropriation of peculiar species is so general as to furnish a strong argument for their innate origin.

3dly. He adduces the fact of the occasional occurrence of worms in the fœtus, as well as their remarkable frequency in certain families, as proofs of the possibility of their transmission. As to the latter fact, however, it seems to be merely one of the examples of hereditary predisposition to a particular disease; and with regard to the former, we shall afterwards see how very improbable it is, if it be not altogether impossible, that a body of the dimensions of an ovum should be transmitted through the vessels of either parent to the embryo.

To Pallas's assertion that the rodentia and ruminantia, which carefully comminute their food, are less liable to acquire worms than the carnivorous and predaceous tribes, or such as swallow their food hastily and voraciously, Bremser's more extensive knowledge of the subject enables him to give an unqualified contradiction, and even to reverse the proposition. In the case of hydatids, which are so common in herbivorous animals, the supposed transference seems quite inconceivable, for they have no known ova, and are besides completely insulated by a cyst.

An experiment made some years ago by M. Schreiber, the distinguished director of the museum of Vienna, seems to prove that worms and their ova are not capable in ordinary circumstances of resisting the digestive powers of the stomach, and consequently that they cannot be introduced by this channel into the system. During six months he fed a polecat almost exclusively on various kinds of intestinal worms, and their eggs mixed up with milk; and on killing and examining it at the end of this period, not a single worm of any kind was found in it. Yet it is not denied that, in some rare instances, the worms of one animal introduced into the stomach of another have lived there for some short time. Bremser himself mentions some examples of it. Thus a particular species of ligula, belonging to certain fishes, have been found in the stomach and intestines of aquatic birds, by which these fish were devoured; but even in these cases they had already undergone manifest changes, if it was some time since they had been swallowed.

Rosenstein thought he had once seen a ligula alive in a fish after it had been boiled and sent up to table; but it is supposed, with some probability, that he may have mistaken the contractions produced by the change of temperature in placing them on a cold plate, for vital motions. Bremser states, moreover, that if we remove small worms out of spirits of wine into water, though long dead, they will appear to move in an extraordinary manner, till all the alcohol within them, or adherent to them, has become perfectly mixed with the water.

Pallas inserted the ova of the tænia of one dog into the peritoneal cavity of another, and on opening the latter about a month afterwards found young tæniæ, about an inch in length, in its abdomen;—an experiment which shows that if the ova of worms be only placed in a favourable condition, as far as regards heat and moisture, and are out of the reach of all injurious influences, such as we have seen that of digestion to be, their evolution, as in the parallel instance of the eggs of birds, readily takes place.

It now only remains to consider whether worms or their ova are, strictly speaking, hereditary,—that is, whether they are communicable to the germ by one or other of the parents. Such a supposition, when considered in relation to their first origin, would imply that every kind of worm now found in a given species of animals, (and in man no less than twelve have been already recognised, and nearly as many in various other species,) must have coexisted in their first parents at the epoch of creation, and been transmitted in an uninterrupted line through their several descendants;—a proposition for the truth of which no adequate evidence has been adduced, and in itself most improbable when we consider the incessant changes which the body is undergoing by the ab-

sorption, excretion, and renovation of its component parts. If the ova exist in all individuals, why are they not developed in the intestines of all; heat and moisture, as we have seen by Pallas's experiment just related, being alone necessary?—if they exist in the male semen, why are they not evolved even in the uterus after impregnation, where likewise these requisites are present? Some species, as the strongylus and distoma, on the contrary, are so infinitely rare in man that only a few examples of their occurrence are on record; whilst others, such as the hamularia and polystoma, have as yet been found but once in our race. The cœnurus cerebralis, in the brain of the sheep, is alone decisive of this question; for, left to nature, it constitutes a fatal malady, and consequently, as it occurs chiefly in young lambs, the whole race of the worm would have been extinguished with the first animal that suffered from it.

This supposed communication by the father's side is inconceivable, for in many classes of the animal kingdom copulation does not take place. The quantity of semen requisite to fecundate the spawn of the frog is, as Spallanzani has shown, infinitely small; merely touching one of the ova with the point of a needle dipped in this secretion is sufficient, and three grains of it added to a pint of water impart the fecundating property to the whole of the fluid. Now it is not conceivable that the rudiments of all the worms to which this animal is liable should be contained in so inappreciably minute a quantity. That their communication to the embryo should take place through the mother is equally incomprehensible. The absorbents and exhalants by which, according to this hypothesis as well as the last, they must be taken up out of their natural situation and deposited again in the torrent of the circulation, and thus introduced into the system of the fœtus, are quite inadequate for the office assigned them, being of such a degree of tenuity as not to let even a globule of red blood, which, according to Rudolphi's calculation, is ten thousand times less than one of these ova, pass through them. Besides, these ova have never been detected by the microscope in the blood either of mother or fœtus. The influence of climate and locality, moreover, on the generation of worms, which, in consideration of the changes produced on the general health, is reconcilable enough with the theory of their innate production, is totally opposed to that of their origin by hereditary descent. The Guinea-worm is confined to particular regions; and in these the European becomes liable to it, though none of his progenitors ever suffered from it. The cysticercus cellulosæ of the domesticated hog is never met with in the wild boar, which is the original stock. Nor can lactation be the medium of their introduction, as is evident from the minuteness of the extreme vessels already alluded to;—to say nothing of the innumerable tribes, birds, fishes, &c. which never suckle their young: besides, children which are entirely spoon-fed are notoriously more liable to worms than those which are nourished exclusively by the mother's milk; indeed, it is a well-known fact, and one which is all but universal, that infants at the breast are not affected with these parasites.

The improbability, not to say impossibility, of worms having an external origin being thus established, we are compelled to adopt the alternative, and to admit that they originate within us. Further than this we cannot go; and we believe that we must for ever rest content with this almost negative species of knowledge. The terms spontaneous or equivocal generation explain nothing. With the conception of creation in all its modes, whether the object be a world or a worm, our limited faculties are altogether incommensurate.

Causes.—It is singular that in a disease of such common occurrence as worms, so little should as yet have been ascertained in regard to their causes. Almost every generalization or rule which has been attempted to be made on this subject is very nearly counterbalanced by the exceptions. A feeble state of the general health, debility of the digestive organs, food either in excess or in too small quantity, or of unwholesome quality, sedentary habits, damp and ill-ventilated habitations, peculiarities of climate, together with the influence of season, sex, and age, have, separately or collectively, been accused of favouring their appearance and encouraging their multiplication.

Their connection with a debilitated state of the constitution, and in many cases with a scrofulous habit, seems to be pretty well made out. The inactivity of the lacteal and absorbent vessels, and the consequent accumulation in the intestines of chyle and mucus, which form so congenial a food or so favourable a nidus for these animals, together with the generally weakened condition of the digestive organs in strumous patients, enable us in some degree to comprehend this cause. Yet it is indubitable that they are often also met with in the robust and healthy. Rush has even endeavoured to make it appear that they are indicative of, or almost requisite to, the possession of perfect health, in which opinion, however, he has but few followers. It would seem that whatever produces a redundancy and stagnation of nutritive or animalized fluids in the intestinal tube—whether it be too abundant a supply of food, too active a chylification, or too great a secretion of mucus,—is to be ranked amongst their causes. The peculiar prevalence of worms in certain localities may, according to Rudolphi, be explained by the unwholesome influence of a moist atmosphere or bad food. If there be any epidemic disease in which they are generated in unusual numbers, (which, however, the author just named is inclined to doubt, as fevers seem rather to exercise a destructive influence over them,) it is to its debilitating tendency that it must be ascribed. When the tricocephalus was rediscovered by Rœderer and Wagler, it was attributed, but erroneously, as we have seen, to the peculiar fever which happened to prevail at the time. That in several *chronic* diseases worms are often very numerous, is an unquestionable fact, however it may be explained; and it would seem that it was from falsely ascribing to their presence the symptoms really produced by the affection which they complicate, that their importance has come to be so much overrated. Thus, in very indolent cases of scrofula, accompanied by disorder of the digestive organs, if medicine, a change of climate, the approach of puberty, or other circumstances happen to lead to an improvement of the general health, and to a coincident discharge of

worms, the latter are immediately pronounced to have been the cause of all the previous ill symptoms; or if the glandular affection assume a more acute form, and is attended with well-marked hectic, and worms make their appearance, the fever is immediately laid to their charge, and called a worm-fever. That there is really no such disease, we have attempted to prove in a former part of this work, (see INFANTILE REMITTENT FEVER;) for though this disorder is vulgarly attributed to worms, yet, in the great majority of cases, none are either evacuated during life, or discovered after death on dissection. That the local irritation which they occasionally cause may, in some instances, give rise to a slight and passing feverishness, is not denied; but this will have neither the progress, the duration, nor the general character of an ordinary fever, much less of an epidemic.* Scrofula may with much more truth be said to be often the cause of worms, than these of such symptoms as we have just been speaking of. In the parallel case of glanders in the horse, which commences in a tubercular state of the Schneiderian membrane, the disease subsequently extending to the lungs and enfeebling the whole system, worms are known to be extremely common.

Aliments of a peculiarly nutritious quality, such as fatty substances, milk and its various preparations, cream, butter, and cheese, are very commonly supposed to produce a slimy state of the intestines and a prolific progeny of worms; and of this Holland and Switzerland have been adduced as proofs. An exclusive use of farinaceous foods has been frequently suspected to have a similar tendency. But when we recollect how rare these parasitic animals are in infants at the breast, and couple this with the fact that the fine peasantry of the Tyrol, who, as Mr. Inglis in his recently published tour remarks, live almost exclusively on Indian corn and milk, and are yet, as Bremser informs us, (unlike their neighbours, the Swiss,) little troubled with worms, we are forced to doubt the reality of some of these supposed causes, or, to speak more correctly, the universality of their influence: for it is highly probable, that in the case of individuals unaccustomed to their use, and leading a very sedentary life, they may, by lowering the tone of the digestive organs, and keeping them overloaded with a mass of ill-digested food, promote the production of these creatures. Guersent agrees with the common opinion as to their greater frequency in summer and autumn than in other parts of the year; and in alluding to their prevalence in Normandy, ascribes it to the almost constant use of milk, apples, and cider. He adds, that he has often known children who had been staying in the country, where they were fed chiefly on milk and fruit, discharge great numbers of worms on returning to town and being put on the use of a meat diet. To us, on the other hand, it has sometimes appeared that fruits, and especially unripe ones, have unjustly got the credit of causing worms, merely from their use being immediately followed by the appearance of these animals in the stools—a circumstance which should, we think, rather be ascribed to such food proving, from its acid and purgative qualities, actively anthelmintic.

As to sugar and saccharine matters in general, there has been a great difference of opinion; many persons supposing that, opposed as they are in their nature to bitters, they must necessarily be productive of worms; whilst others attribute to them, with equal confidence, much vermifuge power. The truth seems to be, that when long used and just in sufficient quantity to enfeeble the tone of the digestive organs, they have the former of these effects; and that, on the contrary, when very largely and only occasionally taken, they prove purgative, and may thus lead to the expulsion of some of these animals.

Climate and locality have indubitably much influence in the production of worms. The cause of their frequency in Switzerland and Holland is to be found, perhaps in the humid atmosphere which both of these countries possess, rather than in any peculiarity of diet common to the two. It has been stated, we know not with what truth, that when the inhabitants of other countries continue to reside for a length of time in Switzerland, they become, like the natives, very liable to the bothriocephalus.

[It would seem that particular countries possess a species peculiar to themselves, and some even a distinct genus. The inhabitant of Switzerland, for example, whilst in his own country will suffer from the presence of the bothriocephalus latus; and if this have been got rid of, on changing his residence for Vienna, he may become infested by the tænia solium, which is another genus; whilst the German, who emigrates to Russia, may experience the development of the bothriocephalus latus, a species which rarely or never occurs in his own country. (Wawruch, *Praktische Monographie der Bandwurmkrankheit*, u. s. w. Wien, 1844, cited in *Brit. and For. Med. Rev.* Oct. 1844, p. 321.)]

In respect to Holland, the frequent use of fish has been accused, but unjustly, of the production of worms; for as Müller remarks, the Danes and other people who live on the sea-coast and partake largely of this kind of food are not particularly troubled with them: and some traveller, we think Hasselquist, has mentioned that, in Cairo, the very lowest classes, who from poverty are unable to procure fish, are much more infested with tape-worm than those in a more comfortable condition, into whose diet it enters pretty largely. In the fenny parts of England the ascarides vermiculaires are said to be a very frequent disease. If they really prevail there more than in other districts, the fact may be explained by the general impairment of the health, and the debility of the digestive organs in particular, which such situations almost invariably produce, without supposing the introduction of these animals or their ova into the body from without. Their greater frequency in autumn, mentioned by Hippocrates and many subsequent writers, is attributed by Hoffmann to the moisture and variability of the atmosphere at that season. In the lower animals, and especially

* Fevers and most of the other ill effects at various periods ascribed to worms, were believed to be produced in one of two ways, viz. either through the medium of local irritation, or by the absorption of a putrid matter which they were supposed to generate; the latter is, however, altogether hypothetical, as, in whatever abundance they may exist, they do not cause any peculiar fœtor in the intestines, and even their maceration in water is not productive of any bad smell, as Rudolphi remarks, save that from the adherent fœcal matter.

sheep, certain species can be produced almost ad libitum by wet pasturages and too watery food. Dumèreil mentions that rabbits and hares often die in a swollen dropsical state, accompanied with hydatids, from the same cause; and Andral thinks that the measles in swine may depend on the foul and damp situations usually assigned to them. The deprivation of solar light and of exercise are also powerful auxiliaries in the production of such diseases.

Hamilton, in his work on the diseases of women and children, treats as a vulgar prejudice the ascribing of worms to peculiar kinds of food. Rudolphi, on the contrary, is one of those who believe that they are peculiarly abundant in such children as eat voraciously of potatoes, or of coarse bread and other farinaceous foods. Where the climate is very relaxing, the effects of an injudicious diet are particularly felt. Thus amongst the Hindoos, who live almost entirely on rice, worms are, according to Annesley, amazingly frequent, having been passed in nine cases out of ten by the patients in the native hospital, which was at one time under his charge; and even Europeans, if they fail in paying a sufficient degree of attention to the state of the bowels and to the tone of the stomach, are said to acquire by long residence in India a similar tendency to generate these animals.

A low scale of diet, in which nothing more is eaten than can be perfectly digested and is absolutely requisite for the support of the system, seems, along with regular exercise, to be the best preventive of worms. The perfect absorption of the chyle is thus insured, and the quantity of mucus effused into the intestinal canal reduced to a healthy pitch. Bremser has observed, that in the fish which are kept up for the Vienna market in reservoirs off the Danube, where they are ill supplied with their ordinary nutriment, the intestinal mucus becomes scanty, and worms are extremely rare.

An inadequate supply of stimulants with our food appears to predispose to worms. In Holland those criminals who, according to an ancient law of the country, were fed on bread made without salt, are said to have been horribly infested with these animals,—an effect which, in prisoners cooped up in that moist climate, seems not altogether incredible, especially when coupled with the acknowledged efficacy of this condiment in preventing and curing worms in some of the lower animals as well as in the human species. They certainly make their appearance more frequently in women than in men,—a fact which has been ascribed by Rudolphi to the former making use of a more relaxing diet together with fewer stimulants, whilst at the same time their habits are, generally speaking, more indolent and sedentary, and their constitutions less robust. The moderate use of wine and spirituous liquors is thought by the same author to have somewhat of a preventive tendency.

The very means sometimes employed for the expulsion of worms may in injudicious hands, by the debility which they are capable of inducing in the intestinal canal, favour their speedy reappearance.

After every due allowance has been made for the influence of external agents in their production, much remains which can only be explained by the existence of a peculiar predisposition. Thus, children are much more liable to the common round-worm and to the thread-worm than adults, and the tendency to their formation often ceases spontaneously on the approach of puberty. In some instances the predisposition appears to be of an hereditary nature. Thus Rosenstein mentions an instance where some of the individuals of a family were affected with tænia for three successive generations.

Symptoms.—The symptoms caused by worms in the alimentary canal may be divided into those which are common to all of them, and those which are peculiar to each kind; and these may again be subdivided into the local and the general.

Of *local* symptoms, taken in the strictest sense of the term, we know of none but pain in the abdomen, especially about the navel, of a colicky character; swelling and hardness of the abdomen; an increased secretion of mucus giving rise to slimy stools, and the occasional appearance of worms in the evacuations; but if taken in a somewhat wider sense, so as to embrace all the various signs of disorder in the digestive organs which are occasionally present, the list of local symptoms will be much extended. Thus, to commence with the parts seated next the upper extremity of the alimentary canal, we find the tongue often white and loaded; the secretion of saliva increased; the breath heavy and fetid; a disagreeable or sweetish taste in the mouth; occasionally thirst; the appetite extremely variable, sometimes remarkably deficient, and at others voracious, returning immediately after eating, and felt especially at night. There is sometimes a sickish feeling, with mucous vomitings, flatulence of the stomach and intestines, and indications of irritation in some part of the mucous membrane, relief being obtained by lying on the belly; the bowels are irregular, successively constipated and relaxed; the stools, except when some worms happen to be evacuated, presenting nothing in any degree characteristic, save an increased quantity of mucus and an occasional tinge of blood. The urine is often turbid or milky, and deposits a sediment. There is frequently itchiness of the parts at each extremity of the digestive tube, namely, of the fundament and nose; hence frequent picking of the nose, which, as well as the upper lip, is often swollen and red.

Many patients complain of a feeling of something creeping within them, or gnawing, piercing, or sucking at the stomach or intestines; but Bremser attributes no importance to such imaginary sensations, having even more frequently met with them in those persons in whom there was no reason to suspect the presence of worms, than in those who were known to be affected with them. It seems to be only when they approach to either extremity of the alimentary canal, as in the case of ascarides in the rectum, and the lumbricoïdes in the stomach and œsophagus, that there is any distinct consciousness of their movements in the sensorium. It is very rare on dissection to find them adhering to any part of the lining membrane of the intestines. The mucus in which they are enveloped, and which, according to Alibert, is the

consequence and not the cause of worms, as commonly supposed, must serve in a considerable degree as a protection to the mucous membrane, and tend greatly to diminish its irritation by their contact. But that they are capable of producing a certain degree of local excitement in irritable habits is evident from the *general symptoms* to which they sometimes give rise, the chief seat of which is the brain and nervous system. Thus there is occasionally disturbed sleep, with grinding of the teeth, and sudden awaking in a fright. There are at times headach or giddiness, ringing in the ears or even deafness, faintness and syncope, convulsions, somnolence, indolence of manner, and ill-temper. In some rare cases epilepsy and chorea, and even apoplectic and paralytic symptoms, and several of the signs of hydrocephalus, and catalepsy, have appeared to be connected with worms. The respiratory functions likewise may suffer a certain degree of sympathetic derangement, as is indicated by the frequent existence of a short dry cough, along with which there are in some rare cases hæmoptysis and even pleuritic pains.

From the intimate connection of some of the nerves of the thoracic organs with those of the intestinal tube, such sympathetic affections are readily explained. It is well known that even flatulence in the stomach or bowels occasionally gives rise to a pungent pain erroneously referred to the pleuræ, and Morgagni asserts that he has known a stitch in the side cease immediately after the expulsion of worms. The circulatory system also not unfrequently participates in the general disturbance, as is obvious from the occasionally feeble and irregular pulse, the occurrence of palpitations, and the appearance from time to time of an irregular pyrexia. Coldness of the extremities and a sour smelling perspiration have also been enumerated amongst the symptoms. The nutritive functions are sometimes greatly impaired, as is evident from the degree of emaciation and debility induced. The countenance often undergoes considerable alteration, being generally pallid or sallow, and somewhat bloated, and there is occasional flushing of one or both cheeks. The eyes are hollow and surrounded with a livid circle, and the pupils, as was first observed by Monro, are sometimes much dilated, and the vision impaired.

We have thus attempted to arrange in a somewhat more physiological order than they are usually exhibited, the greater number of the symptoms which by systematic writers are commonly ascribed to worms, and more especially to the lumbricoïdes. Amongst them all, however, (and many of them are of very rare occurrence,) there is not a single one, save the actual appearance of these animals in the evacuations, which is truly pathognomonic; for any or all of the others may be present and yet no worms exist, and worms, on the other hand, may abound, and yet all these signs be absent. Even the occurrence of worms in the stools, when considered in regard to its practical indication, is open to cavil, for it affords us no certain proof that they were the cause of the coexistent symptoms, nor yet that any more of the race still remain behind. Even the relief which follows their expulsion may depend on the simultaneous evacuations which take place. The itching of the nose, with the incessant picking at it, and consequent hemorrhage, to which so much importance has been attributed, is nowise conclusive, for it may occur equally from any other cause of gastro-enteritic irritation, and as Guersent suggests, may not unfrequently depend merely on the presence of hardened mucus in the nostrils, to which children, as yet unable to blow the nose, are peculiarly liable. Most of the other symptoms enumerated are merely indicative of dyspeptic derangement. Even the sudden and severe abdominal pain is not by any means characteristic, for it may depend on flatulence or any other cause of spasmodic constriction in the intestines. The shreddy substances occasionally observed in the slimy stools, and mistaken for the debris of worms, seem to be really the morbid secretions from the mucous membrane. The existence of reddish particles in the evacuations, which Geischläger, in the fifth volume of Hufeland's Journal, asserts to be a common and conclusive sign of the presence of the lumbricoïdes, has not been confirmed by other observers. The diagnosis of worms is in fine often extremely difficult, or even impossible; and this has long been admitted. St. Clair, the professor of medicine of Edinburgh, observed, about a century ago, that all the symptoms ordinarily ascribed to worms may coexist though none of these animals are present, and relates the case of a child of four years old who had pains in the stomach, itching of the nostrils, watchings and terrors in its sleep, after which it would start in a fright, and it was perpetually rubbing its nose whether asleep or awake; after some time convulsions came on, of which it died on the sixth day. Worms were in vain searched for in the intestinal canal: about two ounces of a gelatinous fluid were found in the jejunum near its commencement.

Though there is no unequivocal sign of the presence of worms, yet the existence of an atrophic state of body, a tumid abdomen and emaciated extremities, with swelling of the nose and upper lip, and other evidences of a scrofulous habit, in conjunction with frequent colicky pains, will often, as Rudolphi remarks, enable us to guess at their presence without much risk of being mistaken; for these animals form, as we have already seen, a very frequent complication in strumous diseases.

With regard to the cases of aphonia supposed to be excited by worms, the greater number of those met with in authors appear to have been merely instances of extreme debility and consequent indisposition or inability to speak, occurring in the course of febrile disorders, in which the coincident evacuation of worms was merely accidental. Yet that they have really in some rare instances induced a temporary dumbness, we have the evidence of Hoffmann, who asserts that he had himself seen cases where the voice, which had been lost for some time, was immediately recovered upon the evacuation of worms. Their influence on the organ of vision, rendered evident by the occasional dilatation of the pupil and imperfect amaurosis, as well as that over the organ of hearing, as manifested in some very rare cases by temporary deafness, seems unquestionable. In the fourth volume of Hufeland's Journal, there is

mention made of a man who saw all things yellow, though he was not affected with jaundice, and this singular symptom at once vanished on the expulsion of worms. Bremser cured a child of nine years old of epilepsy, by medicines which destroyed a tænia with which she had been long affected; but he admits that the removal of this formidable complication may have depended as much on the direct and well-known influence of the turpentine employed over the epilepsy, as on the mere removal of the worm. Numerous cases of chorea have been said to have been cured by the expulsion of worms. But in these there was always room to doubt whether the system of purgation pursued, and the consequent removal of fæcal accumulations and improvement in the intestinal secretions, may not have had a much more important share in subduing the disease. An instance is mentioned by Dr. Suck, of Wolmar, of a girl twelve years old, in whom a violent spasmodic affection of the eyes, followed by general convulsions and furious delirium, was induced by ascarides. After persisting for some time in the use of purgatives and vermifuges, a great number of these worms were passed, and the patient immediately recovered. Moennich cured a child of two or three years old of a sudden paralysis of the legs and strabismus of the left eye by the use of vermifuges, which caused the expulsion of eighteen worms and much slimy matter. Trismus and tetanus, satyryasis, nymphomania, and hysteria, have all in some very rare instances been apparently traced to worms. Various other singular states of the nervous system have been at times attributed to them; thus a case is mentioned by Delisle, where a patient suffering from worms could not endure music; and another, on the contrary, by Désarneaux, where the concomitant convulsions were always relieved by it.

As to catalepsy, we have included it amongst the sympathetic affections which have been known to arise from the same cause on the authority of Van Swieten, who says that he had himself witnessed a case of it originating in this source. He had also known a violent vertigo cease immediately on the vomiting of worms. Hoffmann believed them capable of inducing temporary mental alienation. That cough may be excited by stomachic and intestinal irritation, is an indisputable fact, however we may choose to explain it, whether by reference to the double functions of the pneumo-gastric nerve, or to the extensive distribution of the great sympathetic. Thus, in the case of a soldier, who had an artificial anus in the tract of the colon, the consequence of a wound of the abdomen, Albinus mentions that coughing was instantly induced as often as the cool air was suffered to come in contact with the mucous membrane, which occasionally protruded; and the cough did not cease until the intestine became again warm. Dr. Elliotson had a patient, an infant, which instantly lost a chronic cough upon discharging from the bowels several large larvæ of the common fly. A child of eleven years old, which was in the habit of frequently passing morsels of tænia, was affected with a dry cough, which ceased for two months on the expulsion of a very large fragment of the worm by means of vermifuge medicines. The same thing happened three or four times in succession; and Bremser, by ridding the patient entirely of the tape-worm, succeeded in curing the cough permanently. In the ninth volume of the Medico-Chirurgical Transactions, there is a paper by Mr. Rumsey, on the occasional connection of pulmonary and hemorrhagic affections with worms. Both Abernethy and Cheyne have pointed out the occasional connection of epistaxis with disorder of the digestive organs, which probably takes place, as the former has suggested, through the medium of the excitement of the heart and arteries.

The following passage from Dr. Annesley's work on the Diseases of India, exhibits the train of symptoms and disorders which occur in connection with worms in that country:—"Cases of asthenia, dyspepsia, colicky pains, diarrhœa, vomiting, pains of the head, of the upper and lower extremities, pains of the back, slight fever, hemorrhoids, rheumatism either with or without fever, epilepsy, hemeralopia, and marasmus, were most frequently observed as the consequences or concomitants of worms in the large bowels, and of morbid accumulations in the same situation; the worms being in all these cases evidently the consequence of the morbid secretions formed upon the digestive mucous surface, and the disorders enumerated above being symptomatic of this state, as well as of the irritation occasioned by the worms themselves."

The symptoms caused by worms have in some instances given rise to an erroneous belief in the presence of hydrocephalus, as in both cases there may be pain in the head, convulsions, enlarged pupil, tendency to vomiting, and great depression of spirits. The mistake is, however, hardly excusable, inasmuch as the symptoms are far less intense and less continuous in the former case than in the latter. But in forming our diagnosis, it must not be forgotten that worms and hydrocephalus may coexist.

On the importance of Worms in a pathological point of view.

"The evil effects attributed to worms," says Rudolphi, after a careful analysis of the symptoms commonly ascribed to them, "are only occasional and accidental, and when they do occur, depend as much or more on a debilitated, disordered, or over-irritable state of the body, and especially of the intestinal canal, as on the mere presence of these its natural inmates. In a very great majority of cases they do not excite any inconvenience, and even with regard to tænia, the most dreaded of them all, the first suspicion of its existence is often awakened by the appearance of fragments of it in the evacuations. The ascaris lumbricoïdes and tænia, in such peculiar cases as those just alluded to, and in those only, are capable," continues the same author, "of exciting convulsions and certain other spasmodic affections, and the ascaris vermicularis may produce itching of the anus and genitals; all the other evils ascribed to worms in the intestines of the human species are fictitious." Such is the opinion of one of the highest authorities on this subject; and Dr. Parr expresses himself very much to the same effect. "Worms," says he, in his Medical Dictionary "seem to form a part of a healthy constitution, and are scarcely injurious but from accidental cir-

cumstances." He admits, however, that when in great numbers they may excite irritation and lead to disease. "Their formation," he adds, "is assisted by the accumulation of mucus, and consequently in children, and sometimes in cachectic patients, they may become inconvenient, but are soon destroyed by any kind of fever." Agues in particular are said to determine their speedy expulsion. Clarke thinks that they serve to keep away other diseases; but this is not very probable. Healthy children, as Rudolphi remarks, do not stand in need of them; and to the delicate they are obviously injurious. Such hypotheses have arisen from the vanity or error of supposing that all animals were made in reference to man, and for his advantage alone, instead of primarily for their own sake and for their own enjoyment of existence. Bremser likewise rates their importance in relation to pathology very low, insinuating that the chief reason for investigating the means of expelling them is to be found in the fancy which all patients in whom they are known to exist have to get rid of them; and his testimony is the more disinterested as he seems to be very extensively employed in this department of practice. The account, however, which M. Louis has given of the symptoms of tænia, drawn from cases which have fallen under his own immediate observation, leads us to believe that several of the above distinguished physicians have made rather too light of the matter.

M. Fortassin has run into the opposite extreme, ascribing all manner of evils to worms—affections of the brain and lungs, ophthalmia, dyspepsia, gangrene, paralysis, as well as various spasmodic and nervous affections.

The only morbid appearance, as discovered by dissection, which worms seem capable of exciting in the intestines, is a slight injection of the mucous membrane, together with an unusual quantity of mucus. Whether they have ever, from their numbers being very great, caused obstruction and consequent inflammation and gangrene, is doubtful. In the human species we have rarely opportunities of ascertaining by actual dissection the number of worms which may at once be present, or the state of the intestinal canal which coexists with them in *healthy* individuals. Comparative pathology, however, enables us to supply this deficiency. Rudolphi has found the intestines of horses and lambs, and of various birds, fishes, &c. stuffed full of worms, and yet no inflammation was induced. One animal he found filled up with them from the fauces to the cloaca. He does not, however, think they can ever produce absolute obstruction, as there will always be room for the passage of chyle and fæces. Their agglomeration, occasionally detected in the human intestines along with ileus, as in a case mentioned by Rahn, is probably the effect and not the cause of the obstruction.

That such worms as are met with in the intestinal canal of man are altogether incapable of perforating the healthy tissues is the belief of Wickmann and Bianchi, Rudolphi, and Bremser, and was indeed long since advocated by Plater. And even in the case of the ecchinorhynchi, which by means of their proboscis armed with curved hooks do occasionally perforate the walls of the intestines of fish, birds, and some of the mammalia,—Rudolphi having himself seen not only the proboscis and part of the body thrust through the aperture, but even the whole animal in the abdominal cavity,—the process is so gradual, and the organs by which it is effected are so minute, that no inflammation is produced. The wound inflicted is extremely small, and heals up so rapidly that he never was able to discover an unoccupied aperture. For the most part, however, only one of the intestinal tunics is penetrated by them. Bremser doubts whether the lumbricoïdes can even induce irritation of the intestines. In animals just killed, he has always found them insulated and enveloped in mucus, so that they were not even in contact with the internal membrane. Neither he nor Rudolphi ever found them adherent to this part by either extremity, though they do not absolutely deny the possibility of such an occurrence. Their smooth and taper surface will also tend to prevent their getting impacted. If they be ever capable of causing irritation, Bremser thinks it can be in those cases only where the intestines are independently in a morbid condition. The tape-worm, though it affixes itself so firmly as to break rather than to loose its hold, and to retain its position even when put up as a preparation in alcohol, induces no local inflammation. All the reputed cases of perforation by worms seem to have originated either in ulceration of the intestines, or in strangulated hernia accompanied with inflammation, suppuration, or gangrene, the worms merely passing out through the lesion into the cavity, or to the surface of the abdomen. It has been supposed by Richter and others that worms may themselves be the cause of strangulation of the intestines; and Widekind has endeavoured to show that they produce this effect either by producing spasmodic contractions and consequent inflammation and incarceration of the portion of gut in the hernial sac, or else by mechanical obstruction. But all this is rejected by Rudolphi, who believes that worms are totally incapable of producing such phlogosis or obstruction whether in the free intestine or in the case of rupture; and Bremser's extensive experience has never furnished him with a single instance of the kind. He quotes, however, two cases, one from Daquin, and the other from Campedon, which were perhaps of this nature. There was violent colic in both. Daquin's patient, a child of ten years old, had obstinate vomiting, delirium, amaurosis, and eventually coma. The small intestines and cæcum were found quite distended with worms, as if they had been forcibly stuffed into them. The head unfortunately was not examined. The other case was that of a man who died after enduring excruciating pains for twenty-four hours, and on dissection the cæcum and part of the colon were found filled up with worms, the number of which amounted to three hundred and sixty-seven. The intestines were inflamed and gangrenous.

Of the Symptoms peculiar to each kind of Worm.

Symptoms of the Ascaris lumbricoïdes.— In the preceding section nearly all the symptoms to which this species gives rise have been enumerated. The general description of worm-symptoms met

with in professed writers on the subject, who have for the most part merely copied their predecessors from the time of Andry down with great assiduity, have commonly been made in reference to this the most frequently observed of the whole race. The group which Dr. Baillie selects out of them as more particularly indicating the presence of the round worm is as follows, — "a swelled belly, emaciated extremities, an offensive breath, and a deranged appetite." "The appetite is often greater than in health, but sometimes it is much less. The stools are slimy, and the patient frequently picks his nose, and during sleep grinds his teeth." In Heberden a still fuller list is to be found, but in giving it we should only be repeating the enumeration already made at so much length. According to Laennec, the most frequent symptoms are colics and other kinds of pain in different parts of the belly, alternation of anorexia and excessive appetite, nausea, hiccup, cardialgia, diarrhœa, and tension of the abdomen: and to these he annexes a long catalogue of general symptoms which do not differ materially from those to be found in a preceding page. Whether the lumbricoïdes is capable of causing pain even in a morbidly sensible mucous membrane, is one of those points which Rudolphi believes it impossible either to prove or to disprove. Similar pains occur where none of these animals exist; and even the cessation of suffering on their expulsion is not conclusive, for to the evacuation of fæces, flatus, &c. which takes place at the same moment, the amelioration may be equally ascribed. Where they leave their natural abode, the small intestines, and mount into the stomach or œsophagus, parts not destined for their reception, they may doubtless produce very distressing symptoms, pain, nausea, vomiting, titillation of the throat, convulsions, &c. The convulsions induced by them are not generally of a very formidable nature. Guersent never saw them prove fatal save in the single instance already alluded to, where they seemed to have suddenly introduced themselves into the biliary ducts.

Symptoms of the ascarides vermiculares.—Itching of the anus, coming on especially in the evening, and aggravated by the warmth of bed, violent exercise, or anything else which overheats the body, is, next to the actual detection of these worms in the stools, their most characteristic symptom. In the early part of the day the patient is often entirely free from this annoyance. There is occasionally an uneasy heavy feel or dull pain, more rarely a lancinating one, about the extremity of the rectum, where from the frequent rubbing of the part to relieve the pruritus, small tumours, like piles, form, and sometimes secrete a fluid from their surface, which concretes into thin scales. An oft-recurring inclination to go to stool is a frequent symptom, along with tenesmus, and slimy evacuations, which are at times tinged with blood. We have known a spasmodic state of the sphincter ani also to exist along with other symptoms indicating a considerable degree of irritation in the mucous membrane, which, perhaps, in some instances, passes into subacute inflammation.

Many additional symptoms have been ascribed to them by various writers. "Sickness, gripings, faintness, tremblings, indigestion, giddiness, pains of the head and stomach, too much or too little appetite, itching of the nose, unquiet sleep, coughs, offensive breath, have all," says Heberden, "been found in different persons together with ascarides; but experience teaches us that none of these symptoms are necessarily connected with them, and therefore it is doubtful, whenever they have met, whether chance or the nature of the distemper have had the greatest share in bringing them together. This sort of worm has continued for twenty or thirty years without doing any considerable injury to the health."

The general symptoms to which they have in some rare instances given rise in very irritable habits, and especially in young children, have been of an alarming nature. Thus, Hoffmann gives the case of a boy of seven years old, who, being active and healthy previously, was suddenly seized with an acute pain in the head along with febrile heat and quickness of pulse. Shortly afterwards there supervened tormina about the navel, efforts to vomit, intolerable itching of the anus, and obstruction of the bowels of three days' duration, succeeded by convulsive movements of the head and feet. On the cessation of these, he lay breathing heavily, with his eyes fixed, and deprived of sense and motion. Antispasmodics, anthelmintics, and purgatives were administered. Numerous stools were induced, and along with these above a thousand ascarides rolled up into a ball were passed, after which all the symptoms immediately ceased. The same writer assures us that he had in several other instances seen them induce violent nervous symptoms, not only in children, but also in cachectic females whose health had been impaired by a deranged state of the menstrual function.

Restlessness, insomnia, and a very irritable and even wretched state of body and mind during those hours in which their motions are most felt, are not uncommon. Brera, and even Rudolphi, have conjectured that their intolerable annoyance, in the worst cases, may depend on a deficiency of protecting intestinal mucus; this cause, however, appears very doubtful, being inconsistent with the well-ascertained fact, that the severityof the symptoms may be greatly reduced by such means as are known to diminish the quantity of this secretion, as by extreme temperance in eating and drinking, regular and active bodily exercise, &c.

Their irritation often causes, or at least is accompanied by, symptoms of indigestion, as an uneasy faintish feel at the pit of the stomach; a capricious or sometimes a depraved appetite manifesting itself in a desire for indigestible substances; pains in the belly, itchiness and redness of the nose. In females they may induce, either by sympathy, or, as is much more frequently the case, by their actual presence in the vagina and orifice of the urethra, intolerable pruritus, leucorrhœal discharges, or even irritation of the bladder, nymphomania, and other evil consequences alluded to by Wichmann; and in males, likewise, a tendency to excessive sexual indulgences has sometimes been attributed to the state of congestion and excitement induced by their proximity to the genital organs. Prolapsus ani has been supposed both by Plater and Van Phelsum to be sometimes induced by them, and a sensation compared to a

drop of cold water falling in the rectum has been said by the latter to be sometimes produced by them. If the falling down of the gut be ever really produced by them, it must be in an indirect manner, through the medium of the long-continued and vain efforts made at stool. In many patients most or even all of the above symptoms are absent though ascarides are found in the stools, which can only be explained either on the supposition of an unusually low degree of sensibility in the rectum, or on that of these animals occupying a higher situation than usual in the bowels. In forming our diagnosis we must bear in mind that the pruritus, and many of the other inconveniences enumerated above, may equally owe their origin to hemorrhoids.

Symptoms peculiar to tænia.—The effects to which the presence of tape-worm gives rise in the animal economy are represented in the most dissimilar lights by the different writers who have treated of it; for whilst to some it has appeared scarcely to merit the name of a disease, others speak of it as one of the most formidable affections to which humanity is liable.

The tænia solium and tænia lata, says Rudolphi, are found in very healthy individuals, and are generally known to exist only in consequence of portions of them being evacuated. They seem commonly to remain at rest; and though patients sometimes speak of their producing an undulatory sensation, yet this is probably often the result of fancy; for such a motion should no more be felt by healthy individuals than the peristalsis of the intestines. That the feeble and irritable, who have a mucous membrane possessed of a morbid degree of sensibility, should be capable of perceiving such motions, is conceivable. The occasion on which they will be felt is most probably when the creature gathers its whole length into a ball in one spot of the intestine. Women of a very nervous habit complain of their causing disagreeable undulatory, creeping, or rotatory movements; but though these may sometimes really depend on the presence of tænia, they probably much more frequently originate in imagination or in globus hystericus.

M. Hippolyte Cloquet, on the other hand, says that the symptoms of tænia, though often obscure and equivocal, are very numerous and varied, and are capable of similating any disease, however rare and extraordinary. Those which first appear, according to this author, are swelling of the abdomen, pain, and borborygmi; the colour of the face is altered, being redder or paler than natural, of a leaden hue or mottled, and changing momentarily; the eyes are fixed, watery, dull, and surrounded by a dark circle, and the pupils are greatly dilated; the eyelids yellowish and puffy; there is pruritus of the nostrils, and occasionally epistaxis; the tongue is whitish, speckled over with purplish points, (the prominent villi,) and reddish or inflamed at the tip. At a later period come on headach and a sense of confusion, loss of sleep, severe pain in the orbits. The appetite is unnaturally increased or diminished, or each alternately, there being at one time excessive hunger, and at another disgust for food. The urine is turbid, milky, jumentose; the perspiration of a fetid acid odour, and the extremities are cold. There are ringing in the ears, much frothy saliva in the mouth, hiccup, nausea, sour eructations, fetid breath, desire for cold drinks, night-sweats, rigors, an uncomfortable feeling of weight in the abdomen, vomiting of a yellow or porraceous bile, a short dry cough, cardialgia, frequent lipothomy, respiration difficult and stertorous, or even panting in the sleep, which is broken and unquiet, somnambulism, trembling of the limbs, vertigo, palpitations, hardness, frequency, and intermittence of the pulse, an obscure sensation of pricking or dragging in the abdomen, diarrhœa or obstinate constipation, tenesmus and extreme itching of the anus, an irregular anomalous fever, a fungous state of the gums, livid lips, and great emaciation, even when the appetite is great. There exists, moreover, a state of great anxiety, depression of spirits, and debility. The uneasy feelings are for a time appeased by eating, but return as soon as digestion is finished. There is a disposition to lie on the abdomen, and a temporary feeling of ease after a draught of cold water. Out of this formidable host of symptoms, those which he selects as most characteristic, are dilatation of the pupils, itching of the alæ nasi, a sour breath, lividity or paleness of the face, derangement of the digestive organs, emaciation and a sense of creeping or dragging within the abdomen, and ptyalism.

The symptoms which were considered by Dr. Baillie as most indicative of its presence, are a gnawing uneasy feeling in the region of the stomach, diminished or removed by eating, an appetite commonly somewhat voracious, though occasionally less than natural, an itching of the nose, frequent nausea, colics and giddiness, in some cases a cough, and in others convulsions.

The great majority of cases which have fallen under our own observation have been in middle-aged females in the poorer classes of life. The symptoms complained of were occasional pain in the stomach, vomiting of a watery fluid in the mornings, anorexia or craving appetite, thirst, swelling of the abdomen, itching of the anus and nose, a sense of general soreness all over the body, weakness of the limbs and of the back, great tendency to perspiration, heaviness of the head and a stupid confused feeling, dulness of sight, though the pupils were natural, and finally portions of the worm coming away, not only when at stool, but even while walking.

Amongst the symptoms of impaired digestion, caused by these animals, Van Swieten mentions in particular borborygmi, which were so loud in one instance as to be audible at thirty paces distance; and a similar case is mentioned by a French author.

In a well-marked case of tape-worm, detailed in one of Dr. Elliotson's clinical lectures, the subject of which was a man of twenty-seven years of age, the following were the symptoms present:—constant hunger, confusion of head, with heaviness and tension of the forehead; throbbing of the temples, and starting from sleep; pain in the region of the heart, and palpitations; frequent and fruitless visits to the water-closet, and tenesmus; itching of the nose, and nausea before breakfast; in addition to all of which, he had frequently passed large portions of the worm. The pains in the limbs, which occur in many cases of tænia, as

Dr. Elliotson remarks, are not peculiar to worms, being met with in irritation of the stomach and bowels from various causes. In cholera, they are seen at their maximum of intensity. Examples of pains in distant parts of the body, neuralgia, cramps, &c., from derangement of the digestive organs, are daily presenting themselves to the medical practitioner. In bilious attacks, as they are popularly called, or in gastro-hepatic derangement, pain in and over the eye-balls is an almost constant symptom. In gastric fevers, and cases of subacute inflammation of the mucous membrane of the stomach and intestines, pains and a feeling of extreme fatigue, or of the parts having been bruised, are, as every one knows, extremely common. On the exhibition of medicines tending to procure free evacuations from the bowels, to reduce inflammation of the mucous membrane, and to restore the digestive organs to a healthy condition, all the symptoms which had been ascribed to worms will often immediately cease, though none of these animals may have been passed.

Of all the accounts of the symptoms of tænia, that by M. Louis, drawn from the careful observation of ten cases in the hospital "La Charité," at Paris, a few years ago, is by far the most satisfactory. Three of the patients were females, and seven were males, the youngest being a boy of twelve years old, the son of one of the other patients, and the oldest seventy-four years old. Most of them were in a very comfortable station of life, and all were habitually well fed. All, except two, were of a good constitution, and generally healthy prior to the appearance of the tape-worm, the disagreeable symptoms all dating from the period when they had first perceived the joints of the worm in their evacuations. Their mode of life was generally active. Thus, as far as these ten cases go, there is no reason to attribute the disease either to bad food, to the influence of age, debility of constitution, previous maladies, or a sedentary mode of life; all that could be made out about the matter, was the existence of the worm, and of certain symptoms to which it gave rise. The greater number of the patients had been evacuating fragments of tænia almost daily for several years, some even from their earliest youth up; and the joints of the worm came from them even in the intervals of the stools, and were found in their clothes or in their beds. In one individual, however, the appearance of the articulations in the evacuations had been observed but twice, and each time after the exhibition of a purgative. In all except two the period of the origin of the symptoms, and that when the first traces of the worms were detected in the fæces, were coincident. Louis accounts for this by supposing, that until their attention was awakened to the subject, the patients had overlooked or forgotten the symptoms which may have long previously existed. But this absence of symptoms in the earlier periods of the affection, taken in conjunction with their temporary subsidence after each expulsion of a large portion of the worms, seems to us rather to indicate that it is chiefly when it becomes so elongated as to get into the large intestines that it is productive of serious annoyance. That the lower portion of the worm does occasionally extend so far down, is unquestionable. Thus, in a case to be found in a recent number of the Medico-Chirurgical Journal, it is mentioned that a patient was in the habit of ridding himself of large fragments of tape-worm by introducing a stick into the rectum, and twisting the worm around it till it broke. In none of M. Louis' cases were the functions of the body in a state of perfect integrity, though the degree of derangement varied much in different individuals, being very inconsiderable in some, and yet so annoying to others that they took every means within their power to get rid of the disease.

The chief symptoms were colic and pain in the abdomen of various kinds, itching about the anus and at the end of the nose, more or less derangement of the appetite and digestion, and pain at the epigastrium. Headach was rare, but pain and lassitude in the limbs very frequently existed, and that to so considerable a degree as often to interfere materially with the free exercise of their several trades. The most constant of the above symptoms was pain in the abdomen, which existed in all the cases, though in very different degrees of intensity, being in some like a colic, and in others of a less marked kind, the nature of which they could not well explain. It was seated chiefly towards the flanks, intermittent and recurring at various intervals. The colicky pains were neither accompanied nor followed by diarrhœa except in one case, that of a female who had likewise been labouring under a menorrhagic affection for four years. Itching at the margin of the anus was the symptom next in frequency, being present in seven-tenths of the cases. Itching at the end of the nose was much less frequent, being present only in four-tenths of the patients. But with the exception of a single case, pruritus existed in one or other of these situations in all; and the degree of it seemed to be often proportional to the number of joints passed, which appears to prove that this symptom depends in a great degree on the local irritation of the rectum from the actual presence of portions of the worm in it. The appetite in one case was sensibly increased; in four not notably altered; in the remainder it had fallen off or was subject to alternate increase or diminution. In the case of the women especially, there frequently occurred a degree of hunger difficult to satisfy, and requiring the repeated ingestion of food at very short intervals; and in one individual nothing but animal food seemed capable of allaying this craving, which was accompanied with a distressing feeling of convulsive motions or spasmodic contractions within the abdomen. It was also chiefly the females who complained of sharp pain at the epigastrium: in one case this seemed to have been induced by the violence of the remedies which had been imprudently employed, but in the others it was caused evidently by the tænia itself, as it ceased immediately after its expulsion. One woman complained of a sense of weight at the stomach after eating. In one case only was there any vomiting; and in this it was constantly induced by eating carrots, of which the patient, a young Swiss, was very fond. He was able to eat them without inconvenience, both before he became affected with tænia and after its expulsion. The same patient complained likewise of bor

borygmi and pains in the regions of the kidneys, and a sense of debility in the mornings without any known cause. All of these symptoms ceased after he got rid of the worm. Headach, as already mentioned, was rare; in one instance where it existed, the patient was phthisical, and it may have depended on the violence of the coughing. Yet in two of the females pain in the head seemed to be connected with the presence of the tape-worm. Pains, lassitude, and even cramps in the extremities were very common, and from interfering with the patient's avocations, were, with many, the symptoms which chiefly urged them to seek a cure. Emaciation to a certain degree existed in all; it was not, however, very marked in any, and had not generally become obvious till one or more years after the fragments of tænia began to be passed. Singing in the ears was a symptom in the women's cases; in one only was there slight dimness of sight. The pupil was in its natural state in all; hence its dilatation cannot be considered an ordinary symptom of tænia, though mentioned as such by many writers. The intensity of the symptoms, as well as the number of fragments passed in two instances, increased notably in spring.

From the above review of the symptoms, it appears that their number and variety were greatest in the women, as in addition to those complained of by the men, they had singing in the ears, occasional imperfection of sight, pain at the epigastrium, and a considerable derangement of the appetite. M. Louis thinks that we may almost with certainty conclude that a worm of some kind or other is present in the intestinal canal, when there exists the following combination of symptoms, viz. pain in the belly, colic of various degrees of frequency and intensity, but unaccompanied with diarrhœa; and finally pruritus about the anus and the end of the nose. Other symptoms, such as pains in the limbs, lassitude, disinclination to work, and various nervous affections occasionally present, may also assist our diagnosis. To M. Darbon's remedy, by which the tape-worm was so speedily and safely expelled in the above cases, we shall afterwards allude. All the symptoms ceased within a few days at farthest after their expulsion; the appetite and digestion became natural; the colour, flesh, and strength returned; and the patients all continued in perfect health four months, when the stability and completeness of the cure were tested by again exhibiting the anthelmintic medicine. Those who had previously been relieved by other modes of treatment had never enjoyed so long an interval of repose after their use.

Diarrhœa, though excluded by Louis, seems, according to the experience of Dr. Darwall and various other practitioners, to be by no means a rare symptom in cases of tænia, though tenesmus seems to be a still more frequent one. The last-named author, though he has treated some hundred cases of the disease, never once observed that temporary alleviation after eating, of which so many writers speak; on the contrary, the patient's sufferings were usually rather increased by it. Pains of a rheumatic character appeared to him to be very common, and were influenced in some degree by the weather, though they ceased entirely on the worm being destroyed. He confirms the observation made above, as to dilatation of the pupil not being one of the ordinary symptoms of this affection, never having met with it except in cases of concomitant cerebral affection.

Treatment.—In the treatment of worms we have a twofold indication to fulfil,—namely, first to expel those which are already present, along with their ova, and the superfluous mucus in which they exist; and, secondly, to prevent their reproduction.

The medicines by which these objects are attained are called anthelmintics, which, as stated in a former part of this work, are divisible into evacuants, which simply expel the worms, either by their mechanical, chemical, or purgative influence; the specific, which act as a poison to the worms; and the corroborant, which tend to correct that state of the system on which their generation depends. (See Anthelmintics.) Though the first of the above-mentioned indications be that which commonly attracts most attention, yet in real importance it is infinitely inferior to the second. The worms themselves in many, perhaps in most instances, are productive of little inconvenience; whereas that impaired state of the digestive functions to which, as we have seen, they so often owe their existence, is incompatible with the perfect enjoyment of life.

The number of reputed vermifuge medicines to be met with in authors, even limiting the term to such as are thought to have the power of killing or expelling worms, is very great; their mere enumeration would occupy several pages; but, as commonly happens, this apparent superfluity of means is deceptive, the invention of new remedies being generally the result of the inefficiency or of the dangerous nature of those previously in use. The following heterogeneous catalogue, though brief in comparison to some others that we could mention, contains, we believe, most of the anthelmintics which enjoy any degree of credit in the present day, and certainly many more than the practical physician will almost ever find it necessary to have recourse to. Those which are most in use have already been noticed in the article Anthelmintics, with appropriate directions and cautions. Many which have in their day been zealously advocated are infinitely more to be dreaded than the disorder they are intended to combat.

1. **Mechanical Anthelmintics.** — Metallic zinc, tin, or iron, in a state of somewhat coarse subdivision; cowhage, [the short thick bristles surrounding the nut of *Corylus rostrata* or beaked hazel, (see the writer's *New Remedies*, 4th edit., p. 200, Philad. 1843,)] charcoal.

2. **Specific Anthelmintics.**—Various empyreumatic and essential oils; turpentine; Dippel's animal oil; Chabert's oil; petroleum; cajeput oil; essence of bergamot; oil of juniper; camphor; pomegranate-root bark; the male fern root; veratrum sabadilla; Geoffræa inermis and Surinamensis; spigelia Marylandica and anthelmintica; scabiosa Indica; colchicum; areca oleracea; carica papaya; helminthochorton; chenopodium anthelminticum; the hellebores; savine; rue; bastard dittany; tobacco; prussic acid.

Bitters.—Tansy; artemisia Santonica and Judaica, (worm seed, semen contra); hiera picra; chamomile, &c.

Acids. Vegetable and mineral; fixed air, &c.

Metallic Salts. Sulphate and carbonate of iron; nitrate of silver, &c.

Common salt; sea water; sugar; sulphur; sulphuretted hydrogen; sulphuret of tin; muriate of ammonia; muriate of barytes; ether; alcohol; assafœtida; garlic; onions; squills; valerian; green shell of the walnut; juice of carrots; large draughts of cold water; mare's milk; electricity.

3. **Purgatives used as Anthelmintics.** The saline class of purgatives; oily purgatives; (castor oil, croton oil, olive and other bland oils in large quantities, &c.); drastic and other purgatives; gamboge; scammony; colocynth; gratiola; jalap; aloes; senna; rhubarb; ipecacuanha; mercurial medicines, especially calomel; antimony (tartar-emetic).

Of the medicines enumerated above under the head of specifics, several are of a highly dangerous nature, and, we repeat it, quite disproportioned to the importance of the malady; and some of the rest have but a doubtful claim to the place which they here occupy. Thus it is very uncertain whether the salts of iron, as well as bitters and mineral acids, do not owe the whole of their beneficial influence, not to any direct or immediate impression on the worms, but to their gradual effect in improving the tone of the stomach and intestines. But however this may be, their utility in the treatment of worm cases is well established.

Amongst the best accredited vermifuges, or substances which seem really to exercise a specific influence over worms, are turpentine, Chabert's oil, the root of the pomegranate and of the male fern, Geoffræa inermis, spigelia Marylandica, and Cevadilla. The use of the three last is, however, attended with a degree of risk which is scarcely counterbalanced by such efficacy as they possess; and we can the more easily dispense with them in consequence of the well-ascertained vermifuge power of those which precede them, and which are more manageable and more readily obtained here of an uniform strength. Even in the use of many of the purgatives employed against worms, considerable caution is requisite, as the debility which their untimely or excessive employment may induce is not only more detrimental to the patient's health and comfort than the worms usually prove, but actually predisposes to the recurrence and multiplication of these parasites. Where an inflammatory condition of the mucous membrane of the stomach or intestines happens to exist, the injurious effects to which drastics might give rise scarcely need to be pointed out; and, indeed, in most cases where a febrile state of the system connected with some acute or subacute local affection is present, the treatment of the coexisting worms may be safely postponed as altogether of secondary importance. These exceptions being made, aperient medicines judiciously employed constitute, it must be confessed, one of the most useful and most generally applicable remedies against worms, and especially in the cases of children. They at once improve the secretions, tend to relieve the coexisting dyspeptic and nervous symptoms and to prevent any inordinate accumulation of these animals, and thus greatly alleviate the symptoms even where they do not altogether put an end to the affection. The mild influence of certain mineral waters often proves very beneficial in worm-cases, both immediately, by keeping up a free state of the bowels, and mediately, through the accession of energy which the digestive organs receive during their use. The water of Seidlitz, abounding in the muriate of magnesia, has long been celebrated in such cases; and sea-water, which owes its bitterness to the presence of the same salt, is likewise often found very useful. The presence of sulphuretted hydrogen, in addition to the above-named and various other purgative salts, gives the Harrowgate water a still higher claim to our confidence. The waters of Pyrmont, from containing iron in solution, were reckoned by Hoffmann and many other German physicians very beneficial in cases of tænia.

The employment of such measures as strengthen the body constitutes by much the most important part of the treatment of worms, as it tends not only to prevent their formation, but also to remove the irritable state of the system so often present, and to add energy to the various functions on the imperfect performance of which much more than on the presence of these animals, the troublesome symptoms depend. A diet, consisting of food of easy digestion, and so restrained in quantity as to insure its perfect assimilation, along with a healthy habitation, a dry atmosphere, and regular exercise, will often, alone or with the aid of the mineral and vegetable tonics, prove perfectly sufficient to attain the desired end. If, however, they fail, and the evidence of the existence of worms and of their inducing irritation in the system continues strong, the employment of some of the best established and safest of the anthelmintic medicines mentioned above becomes justifiable. If a scrofulous diathesis, as is so often the case, coexists, all those means which are known to be useful in its management must be simultaneously brought into action. As to the nervous affections which form the great bulk of those fairly traceable to worms, we must endeavour to palliate them as they rise, by the use of a mild and demulcent diet, the tepid bath, and other ordinary antispasmodic remedies, until we can succeed in removing their cause by the means just alluded to. Some of the German practitioners are extremely partial to the use of Chabert's oil. "It is the only medicine," says Rudolphi, "which at once expels the worms, and by giving that degree of stimulus to the enfeebled body which is so requisite in scrofulous and hysterical cases, removes the tendency to their reproduction."

It only remains to make a few remarks on the particular treatment more especially applicable to each of the three species of intestinal worm from which inconvenience may in this country be experienced. The treatment of the bothriocephalus is of little comparative interest here, and will, therefore, only be cursorily noticed when we come to speak of that of the common tape-worm. The trichocephalus, as already stated, does not appear to induce any disturbance in the economy, and is hence rarely if ever the object of medical treatment.

Treatment of ascaris lumbricoïdes. — The means generally resorted to in this country for the removal of this species of worm, consist in the

employment from time to time of active purgatives; whilst bitters and tonics, together with such mild aperients as suffice to keep the bowels in an open state, are administered in the intervals. A combination of calomel and jalap is the purgative most frequently employed; from two to five grains of the former along with from four to fifteen of the latter, according to the age and strength of the individual. Larger doses than these might perhaps, sometimes be advantageously substituted, and have, in the case of adults at least, been recommended by the best practitioners. Thus a formula employed by Dupuytren in worm cases contains thirty grains of jalap with six of rhubarb and two of calomel. Both Wepfer and Van Swieten, also, give jalap in half-drachm doses; and Pringle administered even in fevers a similar quantity of rhubarb with twelve grains of calomel. If the more moderate of the above-mentioned doses be preferred, and the patient be of a tolerably strong constitution, they may be repeated for a few days in succession, and their action aided either by castor oil, infusion of senna, or some of the saline aperients. Scammony, aloes, and rhubarb enter into the composition of several of the formulæ employed in such cases; and the last-mentioned substance forms a useful addition to whatever purgative may be selected, as it tends, whilst producing an aperient effect, likewise to support the tone of the mucous membrane. Bitters, quinine, or some of the preparations of iron, the carbonate, sulphate, or acetate, may be subsequently employed and continued for a considerable length of time, along with such mild aperients as will produce two, or at the very most three stools daily. For the latter purpose the infusion of rhubarb, combined with a bitter and an alkali, answers extremely well, or a combination of rhubarb and carbonate of iron with some bitter extract. Such preparations, whilst they prevent the accumulation of worms, serve likewise to give energy to the process of digestion, and if employed in conjunction with a tonic and moderately stimulant system of diet, and healthful exercise, remove that condition on which the production of worms so often depends. Calomel is thought by many practitioners to possess a power of destroying those animals greater than its purgative effects alone are capable of accounting for; and a perseverance in its use, where the constitution admitted of it, has subdued some very obstinate cases. "Calomel, in order to be effectual," says Rush, "must be given in large doses. It is a safe and powerful anthelmintic." That mercury really exerts a poisonous influence over worms in certain circumstances seems proved by an observation of Laennec's, who says that he once procured their expulsion in a dead state by means of mercurial frictions; whereas, after all the previously employed anthelmintics, they came away alive. Such an effect from mercury is, however, very far from being universal. Thus Scopoli observes that worms are in no persons more abundant than in those living near the great quicksilver mines of Idria, though their constitutions are often thoroughly saturated with mercurial exhalations. Van Helmont, Hoffmann, Dionis, and others, had great faith in water in which quicksilver had been boiled as an anthelmintic; yet there is no reason to suppose that any portion of the metal is dissolved if the water be pure. Van Helmont, indeed, was aware of this, but fancifully believed that the water borrowed the property though not the substance of the mercury. Rush has great confidence in the carbonate of iron, taken daily in doses of from five grains up to half a drachm, a purgative being occasionally interposed to carry down the worms.

The following combination of bitters and purgatives was much employed by Hoffmann, and, as he informs us, with great success. Assafœtida, extract of rhubarb, tansy, aloes, myrrh, and calomel, of each a drachm, together with four grains of extract of saffron and as much castor oil, were all well mixed together; and each scruple of the mass divided into fifteen pills, of which the dose was from five to eight, according to the age. Rosenstein's favourite anthelmintic powder consisted of four grains of sulphate of iron, with ten of semen Santonici, and twenty of jalap, very well rubbed up with an equal quantity of sugar to prevent its griping, and administered in a little honey at breakfast-time. When it began to operate, a glass of cold water was to be taken after each stool. It was administered for three mornings running at the beginning and end of the wane of the moon, a part of the prescription to which much importance will not now be attached. He was also in the habit of giving repeated small doses of assafœtida (five grains every four hours) for two days, and then purging it off on the third with rhubarb. Störk's vermifuge electuary, which still enjoys a high reputation, was composed of sal polychrest, jalap, and valerian, a drachm each, along with four ounces of the oxymel of squills, the dose for an adult being half an ounce four times a day; and for a child one or two drachms. "Most of the empirical remedies," says Underwood, "consist either of bitter purgatives or mercurials; calomel, scammony, and jalap, have been said to be the active medicines in several of our worm lozenges and worm cakes. That their efficacy is often superior to that of the medicines used in similar cases by the regular practitioner, depends, therefore, rather on the greater size of the dose than on any peculiarity in the ingredients.

Bremser's treatment consists in the administration of a tea-spoonful of the following electuary, (called by him No. 1,) night and morning for three or four days, or till the bowels are well cleared out by it, increasing the dose if necessary, but taking care that it shall not be carried so far as to induce watery and debilitating evacuations. R. Semen Santonici et s. tanaceti rude contus, ā ℥ss.; pulv. valerian s. ℥ii.; jalapæ, ℥iss.-ii; sulphat. potass. ℥iss.-ii.; oxymel scillitic, q. s. ut fiat electuarium. As the taste is very disagreeable, the same ingredients may be given, as suggested by M. Grundler, in the form of pill, when children cannot be prevailed on to take it otherwise. Bremser attaches some importance to the two first ingredients being only slightly pounded, in order that, being in a state of coarse subdivision, they may act in some degree mechanically, or at least retain more of their peculiar virtue in their transit through the stomach, and thus carry part of it with them into the intestines. By being

long kept, they lose much of their efficacy. Valerian he considers to be at once an excellent vermifuge and antispasmodic, and jalap he conceives to be less apt than most other purgatives to weaken the bowels, and most proper to remove stagnant mucus and fæces; whilst the slow solubility of the sulphate of potass causing it to act more slowly and certainly renders it peculiarly suited to such cases. Should the diagnosis even have been erroneous and no worms exist, such an electuary cannot fail of being beneficial to the health by removing those symptoms of intestinal derangement and inactivity which had given rise to the suspicion of their presence. He has rarely had occasion to renew the prescription more than once. Where a more active purgative seems called for, he suspends the use of the electuary for the following preparation — (No. 2.) R. Pulv. rad. jalap. ℈i.; fol. sennæ. ℥ss.; potass. sulphat. ℥i.; M.—to be divided into four parts, of which one is to be taken hourly (by an adult) till it operates. If the patient be of a lymphatic habit, he gives for some time after, by way of preventing a relapse, from ten to thirty drops of the following tonic tincture three or four times a day, in a glass of wine or water.—(No. 5.) R. Tinct. aloes comp. ℥i.; tinct. martis pomat. (Ph. Austriacæ,) ℥i.; elixir vitrioli, ℥ss. M. For the tincture of the malate of iron, that of the acetate of the Dublin Pharmacopœia may be substituted. A decomposition ensues in the mixture, and the sulphate of iron is formed. During the whole duration of the treatment Bremser prohibits the use of farinaceous and greasy articles of diet, and even restricts the patient as to his allowance of bread. He has never found it necessary in this species of worm to have recourse to any other remedies than the above.

The cowhage (stizolobium or dolichos pruriens) long employed against worms by the natives of the East and West Indies, and so highly recommended by Chamberlaine, Bancroft, and other British practitioners, was much used in cases of lumbricoïdes a few years ago; a teaspoonful of the electuary being given for two successive mornings, and worked off on the third by an active purgative. Granulated tin, another mechanical anthelmintic, has likewise been employed with advantage, about half a drachm of it being given for four or five days, and then a purgative interposed. For both of the last-mentioned remedies, and for a more particular account of their mode of administration, see the article Anthelmintics.

As for the spigelia and Geoffræa, they have already been alluded to; and though it is against this species of worm that they have been found most effectual, we believe they need rarely be had recourse to, inasmuch as we are in possession of other means of equal efficacy and of much greater safety. The first is rejected by Bremser, and he does not appear ever to have found it requisite to have recourse to the second. The account of the mode of employing them will be found under the head just referred to. The epithet Branvilliers, which the French have given to the spigelia, from a female celebrated in the annals of poisoning, alluded to by Madame de Sevigné in one of her letters, is not very inviting.

Dr. Wenzel, in a work published in 1828 at Erlangen, strongly recommends croton oil as one of the most efficient remedies, in cases both of the ascarides lumbricoïdes and tænia. It has the great advantage, that in the case of children, who often vehemently refuse to swallow any medicine, its external application is almost equally effectual. A few drops rubbed on the abdomen will very often, he insists, lead to the expulsion of the worms.

Camphor seems entitled to some consideration as a vermifuge. Rosenstein occasionally used it, and Moscati is very partial to its employment. He suspends half a drachm of it in half a pint of water by means of a drachm of gum-arabic, and administers it in divided doses.

Turpentine is a very effectual means of expelling this kind of worm, and may be employed either in small and frequently-repeated doses, as described in the article Anthelmintics; or, if, as happens in some habits, it should excite urinary irritation in this form, it may be given in larger doses and unfrequently, either suspended by means of mucilage in milk, or combined with castor oil.

The tartrate of antimony has been strongly recommended by Mellin as a vermifuge, especially where the worms exist in complication with fever; and Armstrong and others think it particularly applicable where epilepsy coexists. Both Rudolphi and Bremser countenance its employment where the primary and more important disease requires such an evacuant. In such fevers, however, as are accompanied with gastro-enteric inflammation, it would be obviously improper.

The muriate of soda was a favourite remedy with Rush. "I have administered," says he, "many pounds of common salt coloured with cochineal, in doses of half a drachm, upon an empty stomach in the morning, with great success, in destroying worms." The use of common salt as an anthelmintic medicine is both ancient and universal. Celsus recommends it. In Ireland, it is a common practice to feed children who are afflicted by worms for a week or two upon a salt sea-weed; and when the bowels are well charged with it, to give a purge of wort in order to carry off the worms after they are debilitated by the salt diet. It is probably from the acknowledged efficacy of salt when given alone that it has become so usual in Germany to recommend salt fish and pickled meats previous to or during the employment of an anthelmintic course. The helminthochorton (mousse de Corse, corallina Corsicana, &c.) so much in use in France as a vermifuge, has been thought by Bremser to owe its influence to the salt which it contains; but this is probably a mistake, as the quantity of the muriate of soda discoverable in it is but small. Duméril and others attributed its efficacy to the presence of iodine. The terms mousse de Corse and helminthochorton were formerly used synonymously; but M. de Candolle has shown that the substance met with in the shops under these names, and which is mostly obtained from submarine rocks on the coast of the island of Corsica, is of a very mixed nature, belonging partly to the vegetable, and partly to the animal kingdom; not above one-third part of it consists of the fucus helminthochorton, its most active portion, the rest being made up of other fuci and conferva, as well as

of corallines, sertulariæ, &c. It has, according to Richard, a bitter nauseous taste, and a smell of sponge. It is given either in powder, in doses of from twenty grains to a drachm, in a little wine and water, or in some conserve; or else in the form of decoction, syrup, lozenges, &c. Its solution, on cooling, forms a jelly, and in this state also it is sometimes administered. Gardien fancies it has some power of dissolving the worms, as they are rarely discoverable in the stools after its use.

Externally, various applications have been made, either with a view to expelling the worms, or of affording temporary relief to the colics they are supposed to cause, but which probably, as has been already hinted, are most commonly merely of a flatulent nature. In cases of sudden abdominal pains, in conjunction with the exhibition of oily mixtures internally, and the use of the tepid bath, Rudolphi countenances the employment of frictions with petroleum and oil of cajeput; and in similar cases Rosenstein, with a view to detaching the worms which he supposed to be engaged in the work of perforation, rubbed the surface with the former of these two substances, previously impregnated with garlic.

Underwood recommends the application to the umbilical region of a plaster composed of a drachm of aloes with the same quantity of powdered chamomile flowers or rue, with a little Venice turpentine; or frictions twice or thrice a week, with equal portions of aloes and ox-gall mixed up with any unctuous substance; either of these applications will often, he asserts, without the use of aperients by the mouth, keep the bowels open, and prove quite sufficient to carry down the worms; whilst a course of the rust of iron is simultaneously exhibited in the manner advised by Rush. Hoffmann speaks favourably of the use of epithems, or plasters made of absinth, aloes, colocynth, the lesser centuary, &c. Boerhaave likewise was an advocate for purgative and aromatic ointment. The unguentum Agrippæ, containing very strong purgatives, such as briony root, the juice of the wild cucumber, squills, &c. and the unguentum arthenitæ or ointment of sowbread, which, besides the roots of cyclament and the wild cucumber, contained colocynth, ox-gall, scammony, aloes, euphorbium, &c., were very frequent applications to the abdomen in worm cases, in the middle of the last century, in Germany; but from the nature of their ingredients, even the external use of such preparations demands much caution, as hypercatharsis and dysenteric symptoms have followed their employment; and hence, as soon as they have induced a copious stool, the anointed parts should be immediately and carefully washed, in order to prevent any further absorption. Brera recommends a liniment of gall, Venice soap, and oil of tansy, as well as an ointment containing aloes and colocynth, æthereal tincture of garlic and camphor, and a plaster of assafœtida, galbanum, cerussa and yellow wax. In domestic practice, frictions with ointments of savine and rue are still a popular remedy. Epithems of tobacco-leaves moistened with vinegar have been recommended by Barton; but even the external use of this plant is sometimes attended with dangerous consequences. All these external medications participate in the common disadvantage, that we cannot well estimate beforehand the quantity of effect likely to be produced, nor graduate their influence. Purgative enemata are also occasionally employed, but much less frequently than against the following species of worms.

Treatment of the ascarides vermiculares. — Many individuals are troubled with ascarides almost from their cradle to their grave. The most various remedies have been employed against them, often with no other effect than a temporary alleviation of the symptoms. They constitute, perhaps, the most obstinate of all the forms of worm disease; and it must be confessed, that though the annoyance to which they give rise may be very materially palliated, medicine alone rarely if ever produces a perfect cure. Even where their expulsion in vast numbers has been effected, they are so amazingly prolific, that they are speedily replaced. Fortunately, however, these worms are attended for the most part with inconvenience alone; and as life advances, and especially at the period of transition from childhood to puberty, they become often greatly reduced in their numbers, or are even altogether got rid of by the mere efforts of nature; and even if they persist after this epoch, or originate subsequently to it, and maintain their ground up to a very advanced age, as is sometimes the case, the symptoms do not seem ordinarily to have any tendency to become aggravated in proportion to the duration of the affection. They are often, indeed, undergoing slight variations in intensity, induced either by fluctuations in the number of worms present, or by almost inappreciable changes in the health or habits of the individual at whose expense they subsist; yet, upon the whole, they produce a pretty equable degree of suffering; or this tends, if any thing, rather to grow less than to increase, in proportion as habit and the diminishing sensibility of advancing years reconcile the mind as well as the body to their presence. The amount of suffering at all times depends much upon the temperament of the patient; in the irritable and impatient, it forms a kind of periodical martyrdom, recurring daily at a fixed hour, sometimes with singular precision. Bianchi says that a friend of his own was for many years constantly troubled with itching from this cause, from nine till ten o'clock at night, during which time he was unable to do any business, though at all other times entirely free from this annoyance. If the pruritus can, by any effort of the will, be patiently endured for a few minutes, it soon reaches its acme, and then its intensity spontaneously declines; whereas, if additional excitement and congestion of the hemorrhoidal vessels be brought on by giving way to the desire to rub the part, the suffering is very generally aggravated and prolonged. The means by which the annoyance arising from ascarides may be reduced to the lowest possible point, consist in keeping the bowels constantly free, so that the patient shall have one or two stools daily, an appropriate diet, and medicine also, if necessary, being employed for the attainment of this desirable end. If at any time they happen to accumulate to an unusual degree, an active purgative or an aperient enema will generally be found to give immediate though but temporary relief. Regular walking exercise, and great

abstemiousness in eating and drinking, so as to prevent an excessive formation of mucus, or the heating and distension of the parts supplied by the hemorrhoidal vessels, are most important. Particular articles of diet, which can only be ascertained by individual experience, occasionally produce an immediate exasperation of the symptoms. Thus we have known one case in which the use of strong tea or coffee, beverages which temporarily increase the sensibility of the body, was always followed within a few hours by a great increase of the pruritus; and small doses of opium, which of themselves so often produce an itchiness of the skin, had a similar effect. We have lately seen another patient in whom the disease seemed to have been induced, or so much increased, as for the first time to attract his notice, by drinking very largely of hot beer for several weeks together.

The following case, to be found in one of Heberden's papers in the first volume of the Transactions of the College of Physicians, contains a very full and clear account of the symptoms of this affection, and of the numerous measures which were put in practice with a view to its relief. Being acquainted with an experienced and intelligent physician, who from his infancy had been troubled with ascarides, Dr. Heberden desired to be informed by him what were the inconveniences which they had occasioned, and what was the success of the remedies which he had used; to which he replied, that "according to his experience the peculiar symptoms of this species of worms are a great uneasiness in the rectum, and an almost intolerable itching of the anus. These symptoms usually come on in an evening, and prevent sleep for several hours; they are attended with a heat which is sometimes so considerable as to produce a swelling in the rectum, both internally and externally: and if these symptoms be not soon relieved, a tenesmus is brought on, with a mucous dejection. Sometimes there is a griping pain in the lower part of the abdomen a little above the os pubis. If this pain be very severe, there follows a bloody mucus, in which there are often found ascarides alive. They were sometimes suspected of occasioning disturbed sleep and some degree of headach. Purging and irritating clysters were injected with very little success. One drachm and a half of tobacco was infused in six ounces of boiling water, and the strained liquor being given as a clyster, occasioned a violent pain in the lower part of the abdomen, with faintness and a cold sweat. This injection, though retained only one minute, acted as a smart purge, but did little or no good. Lime-water was also used as a clyster, which brought on a costiveness, but had no good effect. Six grains of salt of steel were dissolved in six ounces of water, and injected. This clyster in a few minutes occasioned an aching in the rectum, and griped a little without purging, and excited a tenesmus. Some few ascarides were brought off with it, but all of them were alive. The uneasy sensation created by the clyster did not abate till some warm milk was thrown up. Whenever the tenesmus or mucous stools were thought worth the taking notice of, warm milk and oil generally gave immediate relief. If purging was necessary, the lenient purges, such as manna with oil, were in this particular case made use of; rhubarb was found too stimulating. But in general the most useful purge, and which, therefore, was most usually taken, was cinnabar and rhubarb, each half a drachm: this powder seldom failed to bring away a mucus as transparent as the white of an egg, and in this many ascarides were moving about. The cinnabar frequently adhered to this mucus, which did not come off in such large quantities when a purge was taken without the cinnabar. Calomel did no more than any other purge which operates briskly would have done; that is, it brought away ascarides with a great deal of mucus. Oil given as a clyster has sometimes brought off these animalcules: the oil swam on the surface of the mucus, and the ascarides were alive, moving in the mucus, which probably hindered the oil from coming in contact with them and killing them. The same mucus may reasonably be supposed to preserve these worms unhurt, though surrounded with many other liquors the immediate touch of which would be fatal. If the ascarides be taken out of their mucus and exposed to the open air, they become motionless, and seem to die in a very few minutes.

"The general health of this patient did not seem to have at all suffered from the long continuance of his disorder, nor the immediate inconvenience of the disorder itself to have increased. It is perhaps universally true that this kind of worm, though as difficult to be cured as any, is yet the least dangerous of all. They have been known to accompany a person through the whole of a long life without any reason to suspect that they have hastened its end. As in this example there was no remarkable sickness, indigestion, pain of the stomach, giddiness, nor itching of the nose, possibly these symptoms, where they have happened to be joined with the ascarides, did not properly belong to them, but arose from other causes. Purgatives which carry off mucus never fail to afford some relief, which may be attributed to their carrying away some of the worms, and enfeebling or causing the death of others through the want of a sufficient supply of their ordinary pabulum. Those purgatives," continues Heberden, "are best which act briskly, and of which a frequent repetition can be easily borne: purging waters are of this kind, and jalap especially for children, two or more grains of which mixed with sugar are easily taken, and may be repeated daily."

In another paper, which forms the pendant to the one which we have just been quoting, the same author has communicated a very striking instance furnished to him by Mr. Thomas, of the good effects of common salt when taken in very large quantities. The patient, Daniel Neal, of Doddlestone, in Cheshire, had been complaining for four or five years of violent pains in the stomach. The other symptoms were, nausea, restlessness and anorexia, constipation, a hard retracted belly, loss of sleep, emaciation and debility, and milky urine with a whitish sediment. He was bowed down almost double by the pain in the abdomen. The symptoms had persisted in spite of various modes of treatment recommended by different physicians in his neighbourhood. At length, at the advice of a friend who had seen similar pains of the belly

and stomach cured by the use of salt and water, he swallowed within an hour two pounds of kitchen salt dissolved in two quarts of water; violent vomiting ensued, with ejection of half a pint of ascarides and other worms, somewhat like bots, only much smaller; five or six copious bloody and fetid stools followed, with a quantity of similar worms. He had previously been costive for a fortnight, for his excrements were never voided without the assistance of medicine, being hard, lumpy, and in small fragments, like those of the sheep. Being greatly fatigued, he went to bed, slept quietly two hours, all the while sweating profusely. Instead of his usual pain, he now only complained of rawness in the œsophagus, stomach, and bowels, with an unquenchable thirst, which obliged him to drink abundantly. The urine was small in quantity, passed with difficulty, and extremely saturated with salt. These symptoms gradually abated under the use of cold drinks, water, buttermilk, whey, &c. Three days after, he took another such dose of salt, with similar effects, voiding dead worms, with much mucus, and again suffering temporary inconvenience from thirst and dysury. After this he enjoyed a good state of health, but by way of precaution continued to take, a few days before the full and change of the moon, half a pound of salt in a pint of water. "If he had taken," adds the narrator, "smaller doses, he would have avoided much pain, and by degrees have gained the same point."

In the treatment of ascarides, purgatives taken by the mouth are, generally speaking, insufficient, as they lose almost all their virtues, with the exception perhaps of aloes, in their traject through the bowels, long before reaching the rectum, the seat of these worms; hence the necessity for enemata. The injections recommended by Macbride consisted of decoctions of wormwood and rue, or of oil with a small quantity of aloes dissolved in it; "or, what is still more effectual, blowing the smoke of tobacco, by a proper contrivance, into the rectum once or twice a day." (Practice of Medicine, ii. 290. Essay on Scurvy, &c., p. 162.) Darwin likewise praises the use of tobacco-smoke in these cases; Pallas, too, says he has seen it employed with success; and Turner, in his letter to Dr. Fothergill, in the second volume of the London Medical Observations, has given a very convincing example of its efficacy. It is a remedy, however, very troublesome in its application, and from its danger quite disproportioned to the trifling annoyance which it is intended to remove, to say nothing of the temporary nature of the relief which it is calculated to afford. Yet Dr. Mason Good has given his sanction to the employment of tobacco in injections, "in which form," says he, "it succeeds admirably against the small ascarides." A long course of Harrowgate water has been found very beneficial in ascarides, and its good effects may be increased by its simultaneous use from time to time in the form of clysters. Enemata of the sulphuret of potass have likewise been employed with advantage. Hamilton recommends aloes suspended in milk to be employed in this way, or a strong decoction of chamomile-flowers along with castor oil and salt; and we have known the latter to afford very great and immediate relief. If the restlessness of the child renders the exhibition of these remedies impossible, a large dose of powdered aloes, with a little calomel, administered every third or fourth night, has been found very effectual by the author last named. Turpentine enemata, or those of lime-water and olive-oil, may also be tried. Camphor and the essential oils, suspended by means of yolk of egg in water, appeared to Laennec to be often extremely useful; but he reminds us that the exhibition of medicines for the expulsion of these worms constitutes the least part of the requisite treatment, the great object being to re-establish the tone of the organs, and improve the health generally, if we would prevent their constant reproduction. In Martinet's Manual of Therapeutics, we find some very good directions as to the most essential mode of employing enemata in this disease: it is there advised to throw up three of these, one after another, at short intervals; the first a common aperient, one to unload the intestines of their fæcal contents: the second to kill and expel the ascarides; this may consist either of a strong solution of common salt, or of the chloruret of soda much diluted, or of vinegar and water, and should be injected cold, and retained as long as possible;—the third and last consisting of three or four large spoonfuls of olive oil, or of a thick mucilaginous decoction of flax-seed or marsh-mallows; the object of which is to mitigate any remaining uneasiness in the rectum, whether caused by the previous remedies or by a few straggling worms newly descended from the higher portions of the colon. "Another precaution," he continues, "which is in general by itself sufficient when the ascarides are few in number, and do not occasion great uneasiness, is to solicit the action of the bowels regularly every morning, and to resist any desire to go to stool in the afternoon; otherwise the pain and itching, which in general begin towards night, come on at an earlier hour, and with much greater severity." Of the advantage of following this last piece of advice, even where practicable, there is room for doubt.

By Dr. Darwall, an enema composed of half an ounce of the tincture of the muriate of iron to half a pint of water, is strongly recommended. He regards it as the most useful kind of injection: "There are few cases so obstinate that this will not suffice to overcome. It will generally be useful," he continues, "to clear out the upper portion of the canal at the same time by an active purgative;"—as by calomel and jalap, for instance; and for ten days after he continues to give a wine-glass-full of an infusion of chamomile thrice a day.

Brera recommends the mechanical extraction of these worms by introducing into the rectum a piece of lard or candle, which, on being subsequently drawn out, brings along with it the greater number of those situated in the lower portion of the rectum. The advice is not new: a similar plan was acted on in France above a century ago, as we find from the following passage in Andry:—"One thing which I prescribed with success to several patients was to put up into the fundament a little piece of lard tied to a string, leave it there for some time, and after that you shall draw it back full of worms." Rosenstein likewise mentions it, only substituting a piece of fresh pork; and a somewhat similar expedient was

recommended not long since in our own country by Mr. Howship,—namely, the occasional introduction of the finger of the patient, previously well greased, high up into the rectum, which is then to be withdrawn in such a manner as to bring away all the worms within reach; and this will often, no doubt, prove a valuable palliative.

Frequent ablution with cold water is in all cases proper as an effectual means of allaying irritation, at least for a time; and where the ascarides have made their way into the external organs of generation in the female, in addition to vaginal injections consisting of infusions of the bitter plants, or of vinegar and water used cold, local baths containing salt of sulphuretted hydrogen may be employed.

Bremser's treatment of ascarides consists in the administration, night and morning, of a tea-spoonful of his electuary, the composition of which has been given above, to which he occasionally adds a little more jalap, in order to purge gently. He directs the patient, moreover, to take two small enemata daily, consisting of an infusion of absinth, tansy, and orange-peel along with valerian, and a spoonful of the empyreumatic oil of hartshorn; the fittest time for their administration being immediately after having had a stool, as they are then likely to be longer retained, and come more in contact with the worms, now no longer protected by the fæces. Where the patient is not of an irritable habit, he sometimes adds a spoonful of fresh ox-gall. These measures must be persevered in daily for many weeks, after which the patient will continue long free from all annoyance, or may even in some instances find himself radically cured. A small injection of olive-oil (two or three ounces) will sometimes, as has been remarked by Soëmmerring, give immediate relief to the insufferable itching. Van Swieten advised injections of cold water.

Bremser speaks of a young lady who cured herself by drinking twice a-week half a cupful of olive-oil, with a clove of garlic chopped small through it. Dr. Vest finds sulphur useful if taken every morning fasting, in doses of from ten to fifteen grains, and persevered in for a considerable length of time: in the hands of others, however, it has disappointed the expectations. A couple of tea-spoonfuls of Chabert's oil, in a bitter or mucilaginous decoction, has been found a very effectual injection by Fechner, Rollet, &c. Bremser apprehends some risk from this mode of its administration; but wherefore does not appear, as he himself has given very large doses of it, even by the mouth, with impunity. He suggests its internal use in conjunction with the employment of lavements containing the infusion of bitter herbs above alluded to; but he did not seem to have tried it himself against this species of worm when his work was published.

Treatment of tænia.—An almost incredible variety of remedies have at various times been employed as well by regular practitioners as by empirics against the tape-worm. Of these the terebinthinate and empyreumatic oils, tin granulated or in the state of filings, the rind of the pomegranate-root and the root of the male fern, and drastic purgatives in very large doses, are amongst the most conspicuous. It is with the tænia solium almost exclusively that we have to do in this country, and it is to this that the following remarks chiefly apply. Authors who have described particular modes of treating the tape-worm have not always distinctly stated to which of the two kinds their remarks are applicable. The tænia lata or bothriocephalus is generally supposed to induce milder symptoms, and its expulsion is said to be effected with less difficulty than that of the tænia solium.

The oil of turpentine, in large doses, has for some years past in this country almost displaced all other remedies in the treatment of tænia; a sufficient evidence of its efficacy. Dr. Fenwick of Durham generally gets the credit of having first made its value known to the public by a paper published in the Medico-Chirurgical Transactions in the year 1811. He had been made acquainted with the utility and safety of the practice by a non-professional person, who had employed it in several cases with success; and the latter, in his turn, had been instructed in its use by a seafaring man, who, having frequently freed himself from large portions of tape-worm by means of gin, was led by analogy to expect similar but still more marked effects from the spirits of turpentine; and on trial his expectations were not disappointed. The use of turpentine as an anthelmintic is noticed in Rudolphi's work published in 1808; and Underwood informs us that Dr. James Sims had given it, in two-drachm doses, in cases of worms, with success. The peculiarity of the plan promulgated by Dr. Fenwick consisted, it may be said, in the largeness of the dose: even in this respect, however, the practice was not absolutely unprecedented, Mr. Malden, in the Memoirs of the London Medical Society for 1792, having already shown the utility of turpentine so used in tænia; and in the Medico-Chirurgical Transactions for the year 1817 there is a letter of Dr. Walker's, claiming to have anticipated Dr. Fenwick in his knowledge of this remedy. It seems certain, however, that it was the paper of the latter gentleman, accompanied as it was by the most satisfactory evidence of the beneficial effects of this plan of treatment, which first led to its general adoption. The dose employed by him was two ounces in the first instance, to be repeated in two hours if no stools had been yet produced, and even a third time if requisite. The worm was generally passed dead an hour or two after the administration of the turpentine. He admits that the cures were not in all cases permanent, the symptoms in a few instances recurring within a few months, or even weeks. He directs it to be taken in the morning fasting, little or no supper being allowed the night before, and no food being eaten till two or three stools have been procured. The remainder of the day diluent drinks are to be freely used, and all spirituous and fermented liquors carefully abstained from, as a violent diarrhœa was observed to occur in one case where a draught of beer had been taken soon after the turpentine.

Dr. Elliotson, who makes much use of the oil of turpentine in the treatment of worms, both of the round and of the flat kind, has given even to a delicate female so much as from two to three ounces of it every second day for a fortnight; each dose being followed in two hours by castor oil,

and commonly with no other effect than that of expelling the worms and purging rather briskly. He does not concur in the general opinion that freedom from urinary irritation may always be ensured by administering the medicine in a large dose, much less in the ordinary explanation of such immunity,—namely, that when so administered it always acts as a purgative, and passes off before there is time for absorption to take place. On the contrary, he remarks that he has often found the urine smell strongly of turpentine for several days after such great doses, proving that absorption had actually taken place, and to a large extent; and he has moreover frequently found it necessary to follow it up with castor oil, or no purgative operation ensued. He has seen urinary irritation succeed to the use of large as well as of small doses, and is inclined to ascribe it in both cases to some peculiar susceptibility to its influence in the organs of the individual. The experience of this distinguished practitioner is here, however, in direct opposition to that of the great body of the profession. He recommends us to commence its use in doses of half an ounce, which are to be gradually increased to two or even three ounces, being administered either alone or in barley-water, &c. "Persons should remain quiet," says he, "after its use; and as it is not wished to irritate the stomach, and is very likely to produce vomiting, it is best given, not when the stomach is empty, but two or three hours after a meal. As it affects the head, producing vertigo and a feeling of intoxication, the fluid with which it is diluted should be given cold." "I may mention," he continues, "a curious circumstance which has occurred to others as well as myself; that when there were circumstances indicating the presence of intestinal worms, and oil of turpentine was given, no worms have been expelled, and yet all the symptoms have disappeared. This has been called helminthia spuria."

According to Dr. Latham, turpentine, when given in doses of from one to two ounces, generally passes off within two hours after it is taken. He recommends broths and mucilaginous decoctions to be taken during its operation, to preclude the occurrence of intestinal or urinary irritation. The sense of giddiness induced, he observes, will sometimes continue for several days after; a symptom which, however, gradually declines if the patient remain quiet, and the bowels be kept gently open. The occasional use of aperient medicine should not be neglected as long as the violent smell of the urine and the headach exist. In one case, the stool which followed in about an hour after the exhibition of the turpentine, contained some gelatinous-looking matter mixed up with it, apparently a portion of the tænia in a semi-digested state, as traces of the joints were still evident in it. The next day the patient, a female, complained of slight flatulence and frequency of making water, which, together with a little heat in the mouth, and a slight nausea and vomiting about an hour after the exhibition of the medicine, were the only inconveniences it induced; and in the great majority of cases, the annoyances from this remedy are even less, so that the apprehensions which some continental practitioners express as to the danger of this remedy seem entirely hypothetical and groundless. Dr. Latham admits that it does not always remove the tendency to the regeneration of the worm; thus, in one case, that of a fishmonger, the symptoms always recurred within a few weeks. The green portions of the common fir, of the savine, and all the terebinthinate class, powdered and taken in large quantities, would probably, as the writer just named suggests, prove as effectual in cases of worms in the human subject, as they are known to be in those of the horse.

The largest doses of turpentine which we have ever heard of being given, were those by Dr. Pickell, who, in the singular case already detailed, carried them gradually so high as six ounces, though, on its first employment, the system was not tolerant of it even in comparatively small doses, a cutaneous eruption and other inconveniences arising from its use. Raimann and several other German practitioners still seem averse to its employment in the large quantities given in this country, and think that it would be even more efficacious as well as safer if exhibited in small and frequent doses and long continued. Bremser comprises, in the list of its occasional inconveniences, pains in the belly, nausea, vomiting, and a general uneasiness, a sense of confusion in the head, and heat in the rectum and urethra; but grounds his strongest objection to its use on the very frequent recurrence of the disease requiring the repeated exhibition of the remedy. The dose for an infant, says Dr. Mason Good, is from half a drachm to a tea-spoonful in a little milk; "a child of ten or eleven years old may take an ounce without any evil effect in ordinary cases; but in delicate habits a full dose sits uneasily on the stomach, and disquiets the system generally, though in different ways; for it sometimes produces a general chill and paleness, sometimes a tendency to sleep, and sometimes an alarming intoxication. It is in small doses alone, as half a drachm or a drachm to an adult, that it enters into the circulation, and proves an acrid irritant to the bladder, often exciting bloody urine." We have often given it in dispensary practice, where economy is an object of importance, in doses of half an ounce mixed with twice that quantity of olive-oil as an aperient, in cases where castor oil would ordinarily be given, and have usually found it, when employed in this manner, at least as mild in its operation, and nearly as certain as the latter medicine. It has been suggested by Dr. Good, that some of the other finer terebinthinate oils, as the Hungarian balsam, the oleum templinum, or krummhölz-ohl, distilled from the green cones of a particular variety of the pinus silvestris, formerly sold at a high price and kept a secret by certain medicine-venders in Germany, might be less apt to disagree with the stomach and the system than the common turpentine, and yet prove equally deleterious to the worms.

Chabert's empyreumatic oil, which is prepared by mixing one part of the empyreumatic oil of hartshorn with three of oil of turpentine, letting them stand for three days, and then distilling off in glass vessels by the heat of a sand-bath three-fourths of the mixture, had often been given to animals with the greatest success in expelling worms of all kinds, by the distinguished veterinary

professor whose name it bears; the dose for a cow being about two or three drachms, that for a dog or sheep from half a drachm to a drachm. He once administered it also to a girl of twelve years of age, from whom it carried away numerous worms of the kind so rare in the human species, called flukes (distoma hepaticum). Goeze and Brera likewise proposed its employment in cases of worms in the human species; and by Rudolphi it was considered the first of all vermifuges. Bremser, before giving it to any of his patients, put the safety of its administration to the test on his own person, and thus ascertained its dose. By the contact of air, it is blackened and rendered thicker and more disgusting to take; it should, therefore, be kept in small phials well corked and covered with bladder.

Chabert's oil, as used by Bremser, appears to be unquestionably one of the most powerful as well as permanent remedies hitherto employed in tænia. He has treated with it above five hundred individuals suffering from this affection, and amongst them two children about a year and a half old; and of the whole number there were but four who found it necessary to take a second course of it. A fifth individual, after remaining free from the disease for two years, which may be considered equivalent to a cure, became again affected with it. The length of the interval indicates that the original tænia and its ova had been entirely destroyed, and that this ought to be considered in the light of a perfectly new affection. After submitting a second time to the treatment, he had had no further return of the disease up to the period at which Bremser was writing. The remainder of the patients, at least as far as he knew of, continued free from any recurrence of the symptoms.

He commences the treatment with his purgative electuary as already spoken of, and when the first portion of this is finished, he begins to give two tea-spoonsful of Chabert's empyreumatic oil in a little wate night and morning. Its very disagreeable taste and smell may be got rid of by swallowing with a certain degree of force a few mouthfuls of water, rather than rinsing the mouth, which might introduce it into the posterior nerves and prolong the annoyance. Chewing a clove or a morsel of cinnamon is also recommended, but peppermint and such other things as might cause eructation should be avoided. The above dose is, according to Bremser, easily borne by persons of all ages. There are, however, he admits, some individuals in whom it causes considerable irritation and even a slight confusion of the head, and here the quantity must be diminished till they become habituated to its use. Some can take it without inconvenience fasting; but where it causes nausea, it had better be taken about an hour and a half after breakfast. If it should cause dysury or a sense of heat in the intestines, as is sometimes the case, barley-water and oily emulsions soon afford relief. When the patient has consumed from two and a half to three ounces of this oil, that is, in about ten or twelve days, a light purgative, such as the powder marked No. 3, of which we have already given the composition, is administered, and the use of the oil is then immediately resumed, and persevered in till from four to six ounces shall have been taken in the whole course of the treatment. He admits that this is rather a tedious proceeding, but this disadvantage, he asserts, is fully counterbalanced by the certainty of the result, unattended as it is by danger, or even by any serious inconvenience.

All those remedies for tænia which are permanent in their effect require, as well as this one, to be persevered in for some weeks, in order to destroy all the ova as well as the worm itself. If there be a continuance of mucous stools after the disease itself has been cured, he gives the tonic tincture, (No. 5,) above described, for several weeks. The only rule which he lays down for the patient's diet during the treatment, is that he shall be moderate in the use of farinaceous food and fatty substances. He warns us not to expect large portions of the worm to be expelled visibly, as happens after many other vermifuge medicines, as this is rarely the case after the use of Chabert's oil, its efficacy being manifested sometimes solely by the disappearance of the symptoms, and of all evidence of its continued existence, as well as by the prevention of its return in almost every instance. It is probable that it is passed during the first few days of the treatment in a semi-digested state, and so much changed in appearance as hardly to be recognised. Nor does he give himself any trouble in looking after the head of the animal, as the discovery of this, even when it can be made, is one of equivocal value, as two or more tænia may coexist. When the patient continues free from the worm for three months after the treatment, he looks upon it as a perfect cure. Its occasional recurrence many months or years afterwards must evidently be considered a new formation or quite distinct affection.

Such is the account given by Bremser himself of this his favourite medicine. In the hands of others it has been found, though fully as efficacious as he represents it to be, yet not altogether exempt from considerable inconvenience in some cases; and these are, perhaps, more frequent than he seems willing to admit. M. Grundler, the French translator of his work, has found that where there exists a weak state of the stomach and intestines, it soon produces considerable general uneasiness, followed by colic, nausea, and frequent eructations; and hence he advises, by way of precaution, that we should in every case begin with a small dose, half a tea-spoonful, for example. He does not think that the small quantity of turpentine present can materially add to its anthelmintic virtues. The addition of a little syrup of lemon is found by M. Page to be the best mode of disguising its disgusting flavour; or the same end may be in some degree attained by making it into small boluses, and immediately swallowing them, enveloped in a thin wafer-cake. In an over-dose it gives rise to considerable pain and danger. In the case of a cook who drank off, in opposition to the directions given him, a whole phial of the medicine in one night, severe colic ensued, but it was subdued in the course of the following day by an oily emulsion. Rudolphi, on one occasion, not having Chabert's oil at hand, employed Dippel's animal oil, in doses of from five to ten drops in a cup of broth thrice a day, and succeeded in expelling by it, not only several

ascarides lumbricoïdes, but also some portions of tænia: it appeared to him, however, inferior in general efficacy to the more compound oil of the French professor. Another author, mentioned by Bremser, likewise employed Dippel's animal oil, in a case of tape-worm, for a considerable time and with good effect; and M. Grundler, by taking it in doses of from five to fifteen drops night and morning for six weeks, consecutively, got entirely rid of this disease, which he had had for two-and-twenty years. He had taken Nouffer's remedy in childhood, perhaps upwards of twenty times, without success, but, on the contrary, with no other effect than the permanent impairment of his general health. As to the worm itself, it had never, at any period of his life, given him the slightest inconvenience. Rosenstein mentions the case of a lady with a tape-worm, who took from time to time, by his orders, ten or twelve drops of Dippel's oil, and a purgative the next morning; this was continued for two years, a part of the worm being always expelled after each repetition of the treatment; but at length the medicine became so nauseous to her, that she gave it up in disgust. "The animal oil of Dippel," says Dr. Turner, in a recent edition of his work on chemistry, "is a product of the destructive distillation of animal matter, especially of albuminous and gelatinous substances. It was formerly much used in medicine, but is now no longer employed." The last assertion, as we have just seen, is not absolutely correct, at least in regard to German and French practice. It is, however, very seldom used, and its employment certainly requires much caution. In the Dictionnaire de Médecine it is described as being "a very energetic stimulant, which, when taken into the stomach, even in a very moderate dose, occasionally produces vomiting, diarrhœa, sweating, sometimes salivation, and enlargement of the glands of the neck and groin, with a certain degree of fever. It seems, in short, to be a very active poison: a person who took a spoonful of it by mistake, died instantly." "It is now," continues the same writer, "little employed in medicine in France, and not at all in England. Formerly, it had a great reputation in epilepsy, neuralgia, paralysis, &c. Internally, a few drops may be given in water or in an emulsion, and be gradually carried as high as thirty or forty drops, or even more, but we must never commence with so large doses."

In Egypt, as we are informed by Hasselquist, petroleum is in great repute as an anthelmintic, being administered either alone or in conjunction with turpentine, in cases of tænia, with great effect. The dose is from twenty to thirty drops, which is repeated thrice a day for a few days, and then a purgative is given. The three last days of the moon is the favourite period for the use of this medicine: if it fail, it is repeated again the following month.

The bark of the pomegranate root has lately attained to a very high degree of celebrity in the treatment of tape-worm. Though its efficacy was known to Celsus, and it is to be found in Andry's list of anthelmintics, and has long been employed in Indian practice, it is only within these few years that it has been prized, either in this country or France, according to its deserts. It was recommended some years ago by Dr. Fleming, in his catalogue of the Indian medicinal plants and drugs. An account of some cases in which it was successfully employed was published in the eleventh volume of the Medico-Chirurgical Transactions, by Mr. Breton, which contributed much to bring it into general notice. In the first case he tried the fresh bark of the root, boiling two ounces of it in a pint and a half of water till the quantity of fluid was reduced to three-fourths of a pint, and when cold he administered a glass of it, or about two ounces, every half-hour, till four doses were taken. About an hour after the last dose, that is, in three hours after commencing the remedy, an entire tænia was voided alive, no other effect than a slight nausea having been experienced by the patient. This dose is rather smaller than that usually recommended. In subsequent trials he found the bark which had been dried in the sun a still more potent remedy, its virtues being concentrated by the process, in which it loses near half its weight. Thus the same quantity of the dried bark made into a decoction as before, and similarly administered to a stout man forty years of age, after four doses had been taken, induced so much sickness at stomach, giddiness, and uneasiness in the bowels, that he was deterred from giving a fifth. About three hours from the taking of the first dose, after complaining of faintness, and after vomiting a little, he voided an entire tænia alive, measuring nineteen feet two inches—the longest met with in the whole eight cases; the shortest of the tænia solium being under eight feet, and of the tænia lata four feet nine inches. Immediately after passing the worm he was affected with faintness and universal tremour, and continued to feel sick for several hours. From this it seems that the decoction made of two ounces of the dried bark in the manner already described, "is rather too powerful, and that the exhibition of it may be attended with danger." To two boys of seven and ten years old he administered one ounce of a decoction of half the strength of that used in the preceding case, and repeated it every half-hour till six doses had been taken, without any other disagreeable consequences than a slight sickness of stomach and a little vomiting, which at length about this period occurred. The medicine, which in this as in all the other cases had been commenced early in the morning, was resumed again in the middle of the day in reduced doses of half an ounce each: giddiness and faintness soon came on, and prevented its further repetition. About five o'clock in the evening, however, each of these patients passed a tænia solium, one of these being fifteen feet four inches in length, the other fourteen feet two inches. These cases prove that a temporary suspension and renewal of this medicine may be successfully adopted in certain cases. The powder of the bark was found by Mr. Breton equally efficacious, and milder in its operation. To a boy of nine years of age he gave a scruple of it in an ounce of cold water every hour till five doses were taken: forty minutes after the last dose, an entire tænia came away alive. The next case is interesting, as showing the possibility of tænia solium and tænia lata coexisting. "A girl of ten years old took at eight A. M. the same quantity (a scru-

ple) of the pulverized bark in an ounce of cold water, and repeated the dose every hour till noon. At twenty-four minutes past one P. M. a tænia lata was discharged alive, four feet nine inches long. The next morning, about nine A. M. an entire tænia solium was voided dead, and measuring nine feet ten inches. In these two instances a little nausea only was occasioned, and three or four copious motions in the course of the forenoon." To two adults, two scruples, or double of the above dose of the powder, was given every hour or half-hour till the sixth dose, with similar success, and no other inconvenience than trivial nausea in one instance, and a little giddiness. On plunging living tæniæ either into the decoction, or into the mixture of the pomegranate bark and water, they writhe and manifest great suffering. In plain water they will live in the temperature of India for several hours. As all the trials detailed above were made on natives of India, and as their constitutions are generally more delicate and more susceptible of the influence of medical agents than those of Europeans, there was every reason to expect that its cautious exhibition in our own country would be unattended with danger; and repeated trials have now confirmed the safety of the practice. The shortest period from the commencement of the treatment in which the worm was expelled in any of the above cases appears to have been three hours, and the longest twenty-five hours.

Dr. Annesley, in his work on the Diseases of India, speaks very favourably of the effects of this remedy, both in the form of decoction and in that of powder, but seems yet to consider it in some degree inferior to the oil of turpentine, which, given by the mouth and in the form of injection, he has found to be the most successful of all the remedies yet known against tænia. By Dr. Elliotson, also, the pomegranate-root bark is characterized as an excellent remedy in tape-worm, especially the powder, which he considers still more effectual than the decoction. In the case of a female, detailed in his clinical lectures, he gave two scruples of the powder every half-hour till six doses had been taken, and the next day twelve similar doses in the same manner. Three days afterwards a drachm was given every half-hour to the sixth time, and all this with no other ill effect than an occasional slight giddiness and nausea, the bowels being opened two or three times daily, either spontaneously or with the aid of salts and senna. In another case, in addition to stupor and giddiness, it caused severe headach. After being exhibited thrice, at intervals of a few days, the symptoms of tape-worm gradually declined, and in six days after the last dose they had all entirely disappeared. M. H. Cloquet informs us that it is the medicine now most trusted to in France in cases of tænia, especially the decoction of the fresh root. Richard, who wrote the account of this substance in the Dictionnaire de Médecine only a year or two before, says that it had not then come much into use, but states the dose of the powder at from one to two drachms twice or three times a day, or else a decoction of half an ounce of the rind in a pint of water sweetened with syrup. Amongst the substances capable of effecting the expulsion of tænia, the bark of the punica granatum, says Martinet, merits the highest rank. "The decoction of the root of this plant has recently acquired such a great reputation, that it would be wrong to employ any other remedy against the tape-worm till a trial has first been made of this. It is prepared by boiling two ounces of the bark in a pint of water. It should be taken in the morning fasting and succeeded by an ounce or an ounce and a half of castor oil to obtain a free evacuation from the bowels." This is the mode of its exhibition recommended by Dr. Deslandes. (Nouvelle Bibliothèque Médicale, t. ix. p. 76, An. 1825.) M. Martinet has several times employed it in this manner, and never saw any ill effects follow its use. The patient should be put on a low diet the day the medicine is given.

The potion of M. Darbon, of which the composition is still, we believe, a secret, is very highly spoken of by M. Louis, in consequence of the invariable success and safety which attended its administration in the cases at La Charité already alluded to. This nostrum, which, according to the report of the patients, had no very well-marked taste, was taken to the extent of eight or ten ounces in the morning fasting, and the cure was effected by this single dose. It produced little or no inconvenience beyond a very slight uneasiness at the epigastrium or a colicky feel, but this was even less in degree than that often induced by castor oil or other mild purgatives; and as it was not left on the repetition of the dose four months after the cure, it should be ascribed rather to the motion of the worm through the intestines whilst in the progress of expulsion, than to the direct action of the medicine itself. It generally produced a few stools containing portions of the tænia; and if evacuations did not take place within a few hours, a simple lavement was given. The head of the tænia, which Louis describes as a small bulbous prominence marked with three dark spots arranged in the form of a triangle, was found in the evacuations in the greater number of the cases. In one instance the heads of no less than seven of these worms were expelled simultaneously. The expulsion of this part by most other modes of treatment appears from the testimony of authors to be rare, and hence, probably, their frequent failure in regard to producing a radical cure. It is doubtful whether M. Darbon's remedy acts at once as a specific and as an aperient, or only in the latter of these qualities. The portions of the worm expelled in the cases alluded to, though immediately placed in tepid water by M. Louis, did not appear to move; but M. Darbon assured him he had sometimes seen them alive after their expulsion, from which it would appear that it did not invariably at least act as an effectual poison to the worm. Yet from its feeble purgative action, on the other hand, we are forced to refer much of its influence to a specific power. It seems to have succeeded equally well in each species of tænia. The trial of the medicine was made in the presence of MM. Lerminier, Fouquier, Chomel, &c. and the notes of the cases were taken by M. Louis himself. No conjecture is offered as to the probable nature of its composition. Its speedy effect and the absence of any very strong flavour suggests the possibility of its containing some preparation of the pome-

granate bark rather than any of the other hitherto promulgated remedies.

Alston's method, which is praised by Pallas, Bloch, Brera, Alibert, and Cloquet, consisted in giving one ounce of the filings of zinc in four ounces of treacle, the patient having been previously well purged with senna and salts. The filings were again administered, but only in half the quantity, the two following days; and, finally, a purgative was ordered to work all off. Pallas preferred the granulated zinc, which is less apt to irritate the intestines, to the filings, though the latter are much more efficient in their action on the worm. They act merely mechanically, being always employed in a pure state, free from all alloy of arsenic or lead. Analogous instances of the effect of hard and sharp particles in the destruction of worms are seen in some of the lower animals. Thus Rudolphi has observed the tænia found in the intestines of birds to be often much lacerated by the rough husks of the grain they had swallowed; and Bremser mentions that certain birds are free from worms in such parts of the year as they take in sand and other hard substances with their nourishment, though they are liable to them at other periods when their food is of a soft nature. Yet Alston's, like all other mechanical methods, is defective in regard to the great object, namely, that of destroying the tendency to the generation of these worms; and accordingly Bremser always found that the patients whom he treated on this plan returned within three months after their expulsion, again complaining of the symptoms of tænia. In France, a modification of Alston's method is occasionally employed, the filings of tin in doses of from twelve grains to half an ounce being substituted for zinc; and in the only two cases in which Cloquet saw it tried it was permanently successful. By Brugnatelli, another preparation of tin, the sulphuret, in doses of from half a drachm to a drachm thrice a day, is considered as the most effectual vermifuge in tænia, if its use be continued for some days.

The root of the male fern (polypodium, vel aspodium filix mas) forms a part of the several modes of treatment which have been recommended in tape-worm. Its vermifuge powers are mentioned by Pliny, Galen, and Dioscorides, and by old Gerard; and likewise by Andry and Marchant in the beginning of the last century, and have enjoyed from time to time, even down to our own days, a kind of intermittent celebrity. Its sensible qualities are not very striking, as it possesses merely a glutinous and sweetish taste, combined with a barely perceptible degree of bitterness and a slight astringency. Hence doubts have often been raised as to its anthelmintic powers; but these have again speedily yielded to the test of experience. The good effects of M. Peschier's oil of fern, obtained by treating the root with ether, concerning which mention has been already made in the article ANTHELMINTICS, shows that Pallas was in error in supposing it to act merely mechanically. Its efficacy in tænia lata (bothriocephalus) seems well established; but with regard to the tænia of this country, (tænia solium,) it rarely succeeds in effecting its perfect destruction. Bremser suggests its utility as a means of detecting tænia in doubtful cases, as its use is commonly followed by the expulsion of large fragments of the worms. He directs the upper or green portion of the root and its lowest and oldest part to be rejected as comparatively inert. The root should be ascertained to be in a healthy state, and be prepared just before it is going to be used, the bark being removed before pounding it. It is a nauseous medicine, requiring to be taken in very considerable doses; and unless, moreover, it be long continued, and strong purgatives be taken after it, it is very apt to disappoint us; and with every precaution as to its mode of administration, it can very rarely be depended on in the ordinary cases of tænia of this country. Still, if very largely given and persevered in daily for some weeks, so as to keep the bowels constantly full of it, it will sometimes succeed even against this species, as in a case which occurred to Dr. Latham. In many instances, however, he found that the stomach could not bear it in sufficient quantities, and he substituted the powdered tin in very large doses, and generally, as he informs us, with success. After neither of these medicines is he anxious to procure stools by purgatives, believing that the efficacy of these and of most other anthelmintics depends on their extensive distribution through the bowels, so that they shall come in contact with every portion of the surface of the intestinal canal, as well as with all the parasitic animals which they are intended to remove. The ordinary dose of the fern-root is from two to four drachms taken in water. Gardien says it will be found less nauseous in the form of a bolus, which is to be wrapped up in a wafer-cake and swallowed at once, than in fluids, as commonly administered; a slice of lemon or orange, or a clove should afterwards be held in the mouth for a few minutes, or a cup of strong coffee, without milk, taken to obliterate the taste.

The method of a Swiss lady, Madame Nouffer, is the most celebrated of those in which the fern-root is used: being a secret, it was purchased by the king of France for about seven or eight hundred pounds of our money, and made public about the year 1776. On the evening preceding the exhibition of her medicines, she directs the patient to take, in place of his ordinary supper, a basin of thin panada, made with a little butter and enough salt to season it, and a goblet of white wine, or of water alone if not habituated to the use of wine; and a simple lavement is to be administered if constipation exists. Early the next morning the specific, consisting of two or three drachms of the male fern-root, gathered in autumn, and reduced to a very fine powder, is to be taken in six or eight ounces of "eau de tilleul," or some other slightly aromatic distilled water. Two hours afterwards the patient should rise and take the purgative bolus, consisting of ten grains of calomel and as much scammony, along with six grains of gamboge, all carefully mixed together, and swallowed in a little conserve of hyacinth, one or two cupfuls of weak green tea being drunk after it. The patient should now walk about his chamber till the purgative effect of the medicine commences, which is to be promoted by taking a cup of tea from time to time till the worm has been passed; then, and not till then, some broth

or soup is allowed and a very little dinner. If the bolus fails to purge sufficiently, a few drachms of Seidlitz or Epsom salts are to be taken in hot water about eight hours after it. Should the worm not come away at once in a ball, but on the contrary hang out from the bowels, no attempt should be made to pull it away: sometimes its exit may be accelerated by eating something, or by a lavement being injected. As for the heat and uneasiness which so violent a purgative is calculated to excite, Madame Nouffer looked upon them as mere temporary inconveniences and of no importance; and the French commissioners, to whom her treatment was submitted, never found it to do harm. The greasy panada taken on the preceding evening, and the free use of diluents, must no doubt have tended, in a very material degree, to protect the intestines; yet M. Odier, Vieusseux, and other later practitioners, have sometimes seen this very rough medicine induce considerable irritation of the intestines, as indicated by violent colics, pain in the præcordial region, vomiting, faintings, &c. In some cases it was found necessary to repeat the treatment on the following day, with the exception of the bolus, for which the aperient salts alone were substituted. It fails almost constantly, as the French commissioners were from the first aware, in cases of the tænia solium, but is generally quite adequate to the expulsion of the bothriocephalus, or tænia lata. In Great Britain, therefore, as well as in Germany, it need never be put in practice, and in a great proportion of cases in France, likewise, it will prove inefficient. Bremser approves of the postponement of the purgatives, as directed by Mde. Nouffer, till after the specific shall have had time to take effect on the worm. The combination and simultaneous exhibition of the two kinds of medicine is an injudicious practice. Sennert has made a similar remark with respect to specific anthelmintics generally.

M. Odier's method very nearly coincides with that of Madame Nouffer, save that for the powerful purgative bolus three ounces of castor-oil are substituted, a table-spoonful of it being taken every half-hour in a little thin soup. Rudolphi conceived that the castor oil was much more effectual if recently expressed than if some time kept; but we are not aware that this remark has been confirmed by the observation of others.

[A similar plan of treatment is pursued by M. Wawruch (*Op. cit.*)]

A variety of other methods of treatment bearing the names of the several persons by whom they were devised are given at full length in Bremser's work; but as they are admitted to be far inferior in efficacy, and many of them more dangerous than those already described, we shall not enter very minutely into their details here. Most of them consist of drastic medicines in extremely large doses, together with calomel, fern root, &c. Thus Beck's treatment consists in the administration of a scruple of calomel, with ten grains of burnt hartshorn, and of cinnabar of antimony; the patient drinking two ounces of almond-oil some time after, a practice enjoined in several of the other plans of treatment, and which will tend to protect the mucous membrane from the violent agency of some of the medicines exhibited. The following morning a powder is to be taken containing amongst other ingredients ten grains of gamboge and the like of jalap, and this is directed to be repeated every two hours, if necessary, till the third time. Clossius likewise gave large doses of calomel and gamboge. Dessault's method consisted of mercurial frictions made over the abdomen, whilst calomel was at the same time largely taken internally. Hautesierck gave ten grains of gamboge with colocynth and bitter almonds and extract of absinth, the dose being repeated in eight days; whilst pills of aloes and assafœtida, and an amalgam of tin and mercury, were taken daily in the intervals. Herrenschwand administered a drachm of fern root night and morning for two days, and then a powder containing twelve grains of gamboge and other minor ingredients; this was followed by castor oil and injections if requisite. Hufeland directs a decoction of garlic in milk to be taken night and morning, and a table-spoonful of castor oil midday and evening, and half an ounce of zinc filings in a little conserve of roses daily; the abdomen to be rubbed with petroleum, and an enema of milk to be administered in the evening, the patient all along subsisting chiefly on salted and high-seasoned meats. All this must be persisted in for several weeks, or till the worm be passed. Where this treatment fails, Hufeland recommends a course of the Pyrmont or Driburg waters. He seems, like Bremser, to have no faith in short or sudden cures. Lagene gives a powder consisting of a drachm of valerian and a scruple of powdered egg-shells for three mornings running, the patient observing a very low diet throughout. On the fourth day he administers a powerful purgative bolus containing ten grains of calomel and twelve of the diagrydium sulphuretum (a preparation of scammony), followed by the infusion of senna and enemata. When the patient is very robust, or the tongue very foul, with other symptoms of gastric derangement, he commences by a lavement of tartar-emetic. Lieutaud's process comprises diagrydium, fern root, savine, rue, calomel, a vinous infusion of the kernels of peaches, &c. Mathieu's method, purchased by the king of Prussia, comprehends the use of tin filings, fern root, semen santonici, jalap, sal polychrest, scammony, and gamboge; the exhibition of these medicines being preceded by a restricted system of diet for several days, salted foods, thin panada, &c. Rathier's formula contains calomel, savine, rue, oil of tansy, syrup of peach-flowers, and a vinous infusion of peach-kernels, &c. and is, in short, very similar to Lieutaud's, save that the doses are larger. Schmucker's plan consisted in the long-continued use of cevadilla, a purgative of rhubarb being premised, and also occasionally interposed during the treatment. Weigel's method was to give a small dose of Glauber salt nightly, and a few drops of elixir of vitriol twice a day for several months together; but Rudolphi, with much reason, doubts the adequacy of these measures to the cure of tape-worm. Kortum gives a case in which mare's milk taken for a day or two at the recommendation of a countrywoman, caused considerable colic and the expulsion of the worm. The use of an infusion of green flax continued for ten days, reported in one of the public journals not

long since, is said to have proved curative in one case.

Very cold or iced water, if taken in large quantities, seems to act injuriously on worms in the intestines,—such at least was the opinion of Rosenstein and of Pallas. As it must very quickly acquire the temperature of the body, its effects in the expulsion of these animals have been ascribed by Rudolphi in a great measure to the impression at first made on the stomach being propagated downwards to the intestines, a considerable degree of commotion taking place in them in consequence thereof. He supposes likewise that the large quantity of water absorbed by the worms will over-distend them and facilitate their displacement. Perhaps also the well-known purgative effect of large draughts of water contributes not a little to this result; for the addition of the muriate of soda, as recommended by Goeze, Brera, and Tommasini, or of various other kinds of aperient salts, contributes not a little to its efficacy. Many delicate persons, however, are quite incapable of bearing the necessary quantity of cold water. Rosenstein says, that half a large glass of it must be swallowed every four or five minutes till a gallon or upwards has been taken; the patient beginning to drink it just at the moment that an aperient of jalap or salts previously administered is beginning to operate, and thus the water will pass off rapidly and without any risk of injuring the individual by its accumulation.

The author whom we have last named mentions the case of a gentleman who cured himself of tape-worm by swallowing, three or four times a week, two or three cloves of garlic, chopped into small pieces, and washed down with water or tea, a purgative elixir being occasionally interposed; and he alludes to several other instances where garlic proved useful, when persevered in for several months. It is a very old remedy against worms, having been used in this way by Hippocrates. Any of the bland oils in large quantities, it has been said, constitutes an effectual remedy in tape-worm. Thus, in the Bulletin de la Société Médicale d'Emulation, for October 1822, it is asserted that if a pint and a half of either almond or olive oil be taken at the rate of about two ounces every quarter of an hour till the whole is finished, they prove a certain remedy against the disorder. The repugnance to the oil may be in some degree diminished by taking a little sugar after each dose. The patient should move about constantly, to facilitate the passing off of the oil by stool.

Carbonic acid gas has been considered vermifuge by Hartmann, Ingenhouz, and others. Meïer, in cases of tænia, used to give the carbonate of magnesia, and immediately after it the bitartrate of potass, which was followed by the disengagement of much gas: a tea-spoonful of each was taken hourly, and the practice was generally followed by the evacuation of portions of the worm. Seltzer water has likewise been recommended.

Professor Dubois's mode of treating tænia, as given by Ratier, is as follows. In the evening the patient is to take some panada, and the following morning half an ounce of the powder of the male fern root in a cup of broth; an hour afterwards he has a bolus composed of jalap, diagrydium, gamboge, and scammony, two grains each, which is repeated every hour till the third time. A little broth is to be taken from time to time throughout the remainder of the day.

M. Guilbert, as we likewise learn from Ratier, thinks it unnecessary in general to employ any remedies against tape-worm, having observed that it may exist for a length of time without exciting any disturbance in the economy, provided the patient be plentifully supplied with nourishing food. In a great number of cases which have come under his notice, drastic purgatives seemed to have been the chief cause of any disagreeable symptoms which happened to be present. His general rule is, to leave the disease in most cases to nature, being persuaded that the worm will almost always eventually disappear spontaneously. In the few cases, however, where it seems really to produce serious disturbance, he employs the treatment of M. Bourdier, as practised at the Hôtel Dieu of Paris, in preference to all others. This consists in giving in the evening a panada along with the yolk of an egg; and the following morning a drachm of sulphuric ether in a glass of strong decoction of fern, which is to be succeeded in about five minutes by an injection composed of the same decoction with two drachms of ether. An hour after this a purgative potion is administered, consisting of two ounces of castor oil and one of the syrup of peach-blossoms, the action of which is to be promoted by drinking a few cupfuls of broth. This treatment is to be repeated for three days running. It is said to have proved successful in the hands not only of Bourdier and Guilbert, but also in those of Halle, Alibert, Fortassin, &c.

If, by means of the remedies employed, a part of the worm makes its appearance and hangs out from the anus, the protruding portion should be received in tepid milk or water, by which means the exit of the remainder of the animal, provided it be still alive, is, according to Grundler, often greatly accelerated. "As soon," says Brera, "as a part of the worm has shown itself, one might suppose it easy to drag out the remainder. But observers are agreed that this is impossible; and I have had opportunity more than once, when attempting it, to satisfy myself that if we pull at it, however cautiously, the patient immediately is sensible of a sort of twisting or dragging in the intestines, which induces convulsions if we do not speedily desist, or cut the worm across. If, in place of cutting it, we tie a silk thread round the protruded portion, it will retreat several feet into the bowels, but some time after makes its appearance again at the anus. The moment the patient perceives the worm begin to come forth, he should place himself on the night-chair, and remain there until it is entirely evacuated. It is ordinarily expelled rolled up in the form of a ball along with the fæces; but if it comes out with difficulty, whether from the head being firmly attached to the mucous membrane, or from an accumulation of mucus interfering with its expulsion, the patient should still continue quietly seated, and drink frequently of an infusion of chamomile, or, what is better, of a solution of sulphate of magnesia, to quicken the peristaltic motion. If, after having taken the appropriate remedies, the worm is either not evacuated at all, or only in part, we must repeat the treatment on the following day, or sub-

stitute a more powerful one. It sometimes happens that the patient, when just about to expel the worm, experiences, after an abundant alvine evacuation, a sensation of heat, and a feeling of anxiety at the præcordial region, which terminates in vomiting. Such an occurrence should, however, cause no alarm, as the disagreeable sensation speedily passes off, and is unattended with danger."

W. B. Joy.

YAWS.—A word which has its origin in the vernacular dialect of Guinea and other parts of Africa, where it has been used to designate the fruit of the *rubus idæus* (raspberry); and from an imagined resemblance between it and certain fungoid excrescences from the dermoid tissue peculiarly characteristic of a disease indigenous in that territory, the latter has obtained the same denomination. Yaws continues also to be its popular name in our own language, and in its translation into others its etymological signification has been retained. Thus, on the coast of America it is vulgarly called *pian* or *epian*, and by the French *framboise*, whence systematic writers generally have adopted the name framboesia. By Mason Good, the more chaste and legitimate term *rubula*, the diminutive of *rubus*, (blackberry or raspberry,) has been substituted, and he has classed it under this name as one species of the genus Anthracia. The common distinctions into African and American yaws, adopted by the last-mentioned nosologist as they had been previously by Sauvages and Cullen, appear to be void of foundation.

The yaws first became known to Europeans as an endemic disease in that part of Africa called Guinea, but from what period it had prevailed amongst its uncivilized inhabitants it is of course impossible to ascertain. With the commencement of the slave-trade in the sixteenth century, it is probable that it was imported into our West India islands and America, where it has since prevailed to a great extent amongst the negroes, and has been found occasionally, but with comparative rarity, to affect individuals of the white population.

Dr. John Hume, formerly surgeon to the Naval Hospital in Jamaica, and a commissioner of the sick and hurt, was the earliest writer who drew the attention of British practitioners to the phenomena of this disease, in an account of it published in the sixth volume of the Edinburgh Medical Essays in 1744.* It was next treated of by M. Virgile, who practised for several years in the island of St. Domingo; subsequently, by M. Desportes, Peyrilhe, Dr. Hillary of Barbadoes, and Dr. James Grainger of St. Christopher's. To Drs. Winterbottom, Dancer, Moseley, Ludford, Thomson, Thomas, and Wright, we are indebted also for the results of their immediate and extensive experience of it. The last-mentioned writer supplies us with much of the information (not otherwise acknowledged) in this paper.

It appears that in general, if not always, the occurrence of the yaws is consequent to the application of its specific virus to an abraded surface of an individual in whom it has not previously existed, and this, although frequently by accident, not unfrequently by design,—in some instances with a view of obtaining exemption from labour, but in many from a popular though erroneous notion amongst the negroes, that, like measles, scarlatina, and small-pox, its invasion at some period or another (being common at all ages) is a fixed law of the animal economy. Observing also, as in these, that the constitution is rendered insusceptible of a second attack,† and that childhood is the most favourable period for its endurance, the parents are apt not only not to guard against the intercourse of their children with the infected, but even to contrive their exposure to it. The most usual circumstance, however, under which it is contracted, says Dr. Wright, are first, by sleeping in the same bed, and the ichor getting on the wounds or scratches of the uninfected; secondly, by handling the infected, and allowing the virus to touch scratches or excoriations; thirdly, by the use of the same bowl or basin in washing their sores which had been previously used for similar purposes by the infected negroes; fourthly, and most usually, by small flies, which, having gorged themselves with the virus of the diseased, alight on the ulcers of the hitherto uninfected, its propagation being as certain by the minutest quantity as if it were ever so considerable. (Memoirs of Dr. Wright, p. 408.)

The accession of yaws may in many instances be suspected by pre-existing lesions of the cutaneous surface assuming the appearance of its characteristic ulcerations; and if with such suspicious appearance the individual has frequented the company of the infected, and has for some weeks had pains in his joints and limbs, the disease will sooner or later take place, according to the condition of the individual. In some cases the eruptive fever is pretty smart, but in others scarcely discernible; frequently, says Dr. James Thomson, (Edin. Med. and Surg. Journal, vol. xv. p. 322,) prior to the eruption, the whole surface is covered with a white scurf, as if it were dusted with flour. The eruptions are at first about the size of a pin's head, and scarcely rise above the level of the skin, but soon increase and become protuberant like pimples. Some time after this the cuticle falls off, leaving the parts covered with white sordes or sloughs; under these, small red fungi or excrescences spring up and increase daily, some resembling in appearance and size the wood-strawberry, others the raspberry, and others even mulberries, being granulated, as it were, like them. They appear in all parts of the body, but mostly on the face, in the axillæ, on the groins, genitals, and perineum. The size of these fungi, as well as the number, depend on the state of the patient's health and habit of body; a healthy strong person will have few, but of a large size, whilst those of a thin or reduced habit will have

* This writer pointed out the resemblance of the yaws to the disease described in the thirteenth chapter of Leviticus, as affecting the Israelites in their passage through the wilderness, and Adams has expressed his belief of their identity. (Obs. on Morbid Poisons, p. 206.) Dr. Hillary supposes that Haly Abbas, who lived in the tenth century, refers to the yaws under the general term *lepra*, both kinds of the Arabian leprosy having been described in a preceding chapter under the name (as it is translated) *elephantia*. "Inquiry into the Means of improving Medical Knowledge, by W. Hillary, M.D."

† Dr. Owen, who had considerable experience of the disease, saw only two instances of its second occurrence in the same individuals, and that after an interval of twenty years. Edin. Med. and Surg. Journal, vol. xviii. p. 36.

a vast number of small eruptions, scarcely exceeding the size of a millet. In healthy subjects the disorder will arrive at its height in a month's time; in those that are sickly the period will be three or four months. At length the fungi decline; yellow scabs are formed, and the skin is left smooth and in general without cicatrices. One or two of these, however, larger than the rest, continue some time after the others have disappeared: these are called the master, mother, or mamma yaws, from the absurd idea that the others are supplied from them; they leave scars resembling, says Thomson, those of the cow-pox, but are broader and more superficial.

In the mean time the patient loses neither appetite, flesh, nor strength; he suffers no pain or uneasiness except from the nastiness of the disease, and a slight sense of soreness when the excrescences are rubbed or pressed. It is stated by Dr. Hume, Dr. Hillary, and others, that the hair proceeding from the spots where the peculiar fungi of the yaws have grown, changes gradually in colour until it becomes perfectly white; others have contradicted this assertion, and it has been suggested from this discrepancy, that it must have been mistaken for leprosy. It is much more probable, however, that the occurrence is an occasional though by no means a constant one, amongst the phenomena of the disease.

Such is the progress of the symptoms when left to nature, and neither retarded nor forwarded by medicine taken internally or used by application to the parts first infected; but if a yaw-sore, for example on the leg or foot, be treated as a common ulcer, or the patient continue to work or stand as in health, it soon assumes an unhealthy appearance, the neighbouring parts become inflamed, its edges are ragged and turn back like those of cancerous ulcers; its surface looks foul and is covered with small specks and sloughs; the discharge is ichorous, black, and extremely offensive, and the patient's strength is wasted and worn out with pain. Under such circumstances, the eruption of the yaws is retarded, and, when it appears, is of long continuance, especially if mercurials have been employed too early.

The fungous excrescences break out also in the soles of the feet and palms of the hands, where, from walking barefooted as the negroes commonly do, and from hard labour, the integuments are excessively thickened. Hence, the eruption of the yaws is very painful, and the excrescences are sometimes so large as to extend over a great part of the sole of the foot. In this situation they are called by the negroes in the West Indies, "tubba" or "crab yaws." These, unless skilfully treated, are apt to continue troublesome for a number of years. Like corns, they are frequently affected by different states of the atmosphere, but more particularly by rainy weather. When the yaws have been repelled by the too early use of mercury, or, as was frequently the practice in the ships employed in the slave-trade for the fraudulent purpose of enhancing the price of the damaged commodity, by various external applications, as the sulphate of copper and corrosive sublimate, the risk has been considerable to the life of the sufferer. If the eruption have been thus suspended for any length of time, it has subsequently recurred with redoubled violence. In some it has caused the most obstinate and ill-conditioned ulcers, in others erosions of the nose and palate, bone-ach, and distortions of the limbs: occasionally the whole cellular substance has been infiltrated with serum or even purulent fluid, and the wretched sufferer has fallen a victim to the injudicious treatment; in many instances, it is to be feared, instigated by a murderous cupidity. A glossy smoothness of the skin where this peculiar eruption commonly makes its appearance is often an indication that the disease has been suspended only by the means already adverted to. It is a singular fact with regard to the manifestation of yaws, that if a person with a large ulcer be infected, he may pass through the disease without any eruption,—at a certain time the sore begins to acquire a new granulated appearance, and becomes elevated, the edges assume their characteristic form, and a constant discharge is kept up. If an attempt be made to heal the sore and is successful, an eruption of yaws follows in the regular manner; otherwise it goes on and generally remains as an ulcer for life. The practice always to be pursued is to endeavour to heal the sore as soon as infection is suspected. (Dr. Thomson on Yaws, Edin. Med. and Surg. Journal, vol. xv. p. 325.)

To some of the eruptive diseases of the inferior animals in the West Indies, the appellation yaws has been indiscriminately applied; but comparison has sufficiently disproved the identity of their nature, and repeated experiments have served to show the incapability of the disease in question being transferred by inoculation beyond the human species. Desportes asserts, and Alibert has taken it for granted in support of his idea of the dependence of yaws upon unwholesome nutriment, that he has seen it declare itself in some of the Gallinaceæ of St. Domingo, especially Guinea fowls and turkeys, after feeding entirely on the seeds of the holcus spicatus. But although we know by sufficient experience that the exclusive use of similar and equally unwholesome food has been conducive to the eruption of lepra, pellagra, and other diseases of the skin, it is the peculiarity of yaws in the human species to be propagated only by contagion; hence we are entitled to infer that the correspondence did not exist.

The identity of many of the phenomena, as well as of the original signification of the names of the disease under our consideration, with sivvens or sibbens, (Sibbens in the Erse dialect signifies a raspberry,) a malady well known in the western parts of Scotland, renders it a matter of interest if not of importance that we should notice their characteristic distinctions. The sivvens, it is remarked, at first seizes the throat and nose; the yaws never, until after a length of time or improper treatment. The eruptions in sivvens are watery, of a dirty hue, and of intolerable fœtor; those of the yaws are at first as small as a pin's head, hard, and without any peculiar odour. In sivvens boils appear here and there, forming deep and ill-disposed ulcers, a character which does not belong to yaws. In sivvens itchy tetters break out in form of ringworms, and occasion either a deep ulcer or a scabby large spot with inflammation; the yaws have no such appearances. The sivvens

rarely affect the bones, the yaws always unless well managed. In the yaws the excrescences succeed the pimples as well on the face and body as on the axillæ and pudenda; in sivvens the fungi appear on the groin and perineum in a very advanced stage of the disease. The sivvens is highly contagious without sensible inoculation, the only mode, as it appears, by which yaws is propagated. The sivvens may be cured early by mercurials, but mercurials in the yaws, at least in the early stage, are pernicious. In constitutions otherwise healthy the yaws will usually run a definite course, be spontaneously exhausted, and terminate in health even without medicine; but if speedy and effectual means be not used to counteract sivvens, it will almost certainly proceed to a fatal issue.

The yaws and syphilis have frequently been considered as modifications of the same disease, but a comparison between the descriptions of the two will at once establish some important distinctions. It is true that the yaws will affect the bones, the cartilages of the nose, and the palate, like syphilis, and will admit of cure by similar means; but in primary syphilis neither eruptions nor fungi appear as in the yaws, except on the pudenda, and then only in the form of warts. Syphilis will never cease spontaneously, like yaws, and, unlike yaws, it may be and is contracted repeatedly. Persons who are suffering from the yaws may contract gonorrhœa, and even syphilis; and it is very remarkable that the former may be cured independently of the yaws, but that the latter cannot until the yaws have begun to decline.

If the patient be a person of a previously healthy constitution, and be judiciously and carefully managed, even under the most formidable appearances of yaws, it is rarely attended with danger; but if otherwise, and there has been much preceding debility, by whatever causes induced, if the eruptions have been repelled, or if mercury have been used in the early stages, it is liable to a tedious if not dangerous protraction, and often proves fatal under the best-directed efforts. When there has been any tendency to hereditary disease, yaws will always excite it into action, and the probability of its issue will of course be materially influenced by the nature and effects of the former, whatever it may be.

It has been imagined that the seeds, as it were, of yaws are implanted in the negro constitution, and that they must necessarily be developed at some future period without any obviously exciting cause. It need scarcely be observed that reasons are wanting in support of this hypothesis, and it has been denied by Dr. Wright and others that the habits and circumstances of negroes predispose them more than Europeans to receive the specific infection. Alibert has advocated the more popular belief, and accounts for a superior susceptibility of this and other cutaneous diseases in negroes by the circumstance of their dermoid tissue being endowed with a larger share of sensibility. He considers, also, in accordance with the commonly accredited assertion, that the diet of the negroes contributes in a great measure to the ready propagation of yaws amongst them, their food, particularly in Guinea, being of a nature little accommodated to the wants of the system, naturally untractable by the organs of digestion, and scarcely rendered less so by the very imperfect modes of cookery to which it is subjected. It is obvious that the circumstances of the climate, the customs, and domestic habits of this uncivilized race must very powerfully co-operate with the diet above noticed in inducing as well as in keeping up disorder of the cutaneous surface; but in the West Indies we are informed that the negroes, though well fed and healthy, are as readily affected by this morbid poison as the puny and debilitated; that the diseases of the former are often of the inflammatory kind, and are advantageously treated by repeated bleedings, the blood being generally firm and buffy; whereas the diseases of white people in the same locality mostly partake of the remitting fever, in which, if the lancet is at all used, the greatest caution is requisite, and the blood is generally loose, discoloured and watery.

Of the immediate operation of the virus of yaws on the animal economy, we know nothing more than the effects already detailed; the progress of its operation, unlike that of small-pox, is very variable in different individuals; but from the experiments of Dr. Thomson it may be inferred that from seven to ten weeks is the usual period which elapses between the insertion of the virus and the development of the eruption. In one instance, however, for which we have the authority of Dr. Adams, the interval appears to have been ten months. It has been remarked that the blood of yaw patients does not differ in appearance from that of healthy persons, and that, when used for inoculation, it fails to communicate the disease; moreover, that the infected are as liable to other diseases as persons in a healthy condition. (Edin. Med. and Surg. Journal, vol. xv.)

Treatment.—The prevention of yaws may be, and is almost always, successfully accomplished by the simple observance of avoiding the sources of its contagion, principally by an entire and distant separation from the infected, and by the strictest care in not participating with them in the use of any articles of clothing or domestic utensils through the medium of which the virus might by any possibility be conveyed. The intervention of authority, however, is often absolutely necessary to enforce the requisite precautions on the negroes, who, reckless of the consequences, would rarely avoid even the most familiar intercourse with the infected. The adoption of the usual means for the maintenance of the general health, such as good clothing, wholesome food, and usage otherwise conducive to mental content and cheerfulness, doubtless imparts considerable power to the constitution, if not of resisting the contaminating influence of the virus, of very much mitigating the consequent injury to the constitution, and shortening the duration of the disease.

On well-grounded suspicion, or the earliest appearance of yaws, its extension should be guarded against by the removal to a distance of the infected from the healthy, and by cutting off entirely all intermediate communication. In the best regulated of the West India estates a house is provided in a convenient situation for the reception of the infected negroes. The planter selects for its management a careful and discreet matron, who is insusceptible of the contagion, by having experi-

enced the disease at some former period. He provides them with plenty of good food and raiment, and takes care that they have easy work, as weeding and cleaning their own provision grounds, watching a cane-piece, or following sheep and cattle. Thus they are prevented from indulging, as they otherwise would do, in sloth and indolence, and their attention is diverted from brooding over the affliction they labour under. Their health also is improved by the same means. He further insists on the most strict attention to personal cleanliness and neatness of apparel.

During the eruptive stage, according to Dr. Thomas, who had considerable experience of its management, (and such appears to have been the line of treatment generally recommended by the West India practitioners,) the efforts of the system should be assisted by some mild diaphoretic, and with this view precipitated sulphur, contrayerva in powder or infusion, decoction of China-root, or infusion of sassafras, and vapour or warm baths have commonly been resorted to.

When the eruptions begin to dry off, a course of the compound decoction of sarsaparilla is found to be of great service, and other tonics of the vegetable kingdom, such as contrayerva, sassafras, guaiacum, &c., are occasionally used. Towards the decline, says Dr. Wright, if the disease do not go off kindly, mild mercurials may then, and not till then, be given with safety and advantage, so as to act as alteratives, and not occasion a ptyalism. Minute doses of a solution of the oxymuriate of mercury, have generally been preferred, together with the use of the compound decoction of sarsaparilla. When erosions of the cartilages of the nose and of the palate, obstinate foul ulcers, bone-achs, &c., have taken place, the most appropriate counter-agents will be a generous diet, and a plentiful use of sarsaparilla, both in decoction and powder.

With regard to ulcerations from the yaws, it is to be remarked that simply unctuous dressings and warm fomentations are rarely serviceable. Washing them with cold water and certain vegetable applications will often have a good effect. If the ulcers are small, it will be sufficient, says Dr. Wright, to cover them with a leaf of the cissus cicyeides or snake-wyth, commonly called the yaws-bush, or with a leaf of the iatropha curcas or English physic-nut. If the ulcers are large, a poultice of these leaves beaten and mixed with a little sugar, or with the pulp of roasted Seville oranges and sugar, forms an antiseptic well adapted to the purpose for which it is required. To the master yaw, which is apt to degenerate into a troublesome ulcer, the ung. hydr. nitrico-oxydi is often a good application. A combination of carbonate of iron with citric acid and prepared lard is also much employed in the West Indies for the same purpose, and is said to be very efficacious.

When the excrescences proceed from the soles of the feet, the thickness of the cuticle there occasions a resistance to the discharge, which leads to extensive ulceration, very difficult to heal, but best treated by a poultice of the fresh cassava-root, a plant possessed of a narcotic quality, and well known in every West India island.

Hard swellings of a very painful nature, which do not suppurate, sometimes appear in the soles of the feet as a consequence of the yaws, and occasion lameness. To remove them the patient should bathe his feet in warm water until the swellings are softened; they should then be seared with a hot iron, which produces an eschar. The consequent sore is readily healed by dressing it with some mild escharotic. (Practice of Physic, by R. Thomas, M. D. 8vo. p. 645.)

Under all the usual circumstances of yaws, and in every stage except the primary febrile one, it is necessary that the patient's strength should be supported by a generous diet, including a full allowance of animal food, with a due proportion of wine or of diluted spirits.

The liability of persons in yaws to other exanthemata, as measles and small-pox, is a feature which has been taken advantage of for the purpose of expediting the cure of the first-named disease: by inoculating for the small-pox when the yaws are on the decline, the latter will entirely subside, or if perchance any of the excrescences should re-appear, their continuance will be of short duration.*

It has been proposed also, as in small-pox, to inoculate the unaffected with the specific virus of the yaws, in order that the symptoms may be rendered milder in their nature, and quicker in their progress; but the inducements, if there be ground for the anticipation, which is very doubtful, are by no means equivalent to those of the analogous process in the former disease, as the latter is infinitely more easily avoided, never proves fatal when judiciously treated, and even after the operation, under the most favourable circumstances, is often many months in going through its regular course.

In some instances it is to be remembered that after every appearance of the yaws shall have passed away, even for months, and all possible care has been taken of the convalescent, the disease will break out afresh. The separation, therefore, of the diseased from the healthy should be continued for some time subsequent to the last appearance of an eruption or ulcer, be either apparently ever so unimportant.

W. Kerr.

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* "All this is perfectly analogous to what has been traced in other morbid poisons. It is probable that the irritation from small-pox and measles being greater than that from yaws, may interrupt the latter at any time. But the laws of that poison requiring a certain course to be pursued, if the new irritation is induced before that course is completed, the disease must return as that new irritation ceases. If, on the contrary, that irritation has not been induced till the course of yaws is completed, and nothing remains of it but an habitual ulceration, the new irritation will not only supersede the old action, but by breaking the habit, very much expedite the cure."—Adams on Morbid Poisons, p. 212.

GENERAL INDEX.

THE END.

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Philadelphia, January, 1845.

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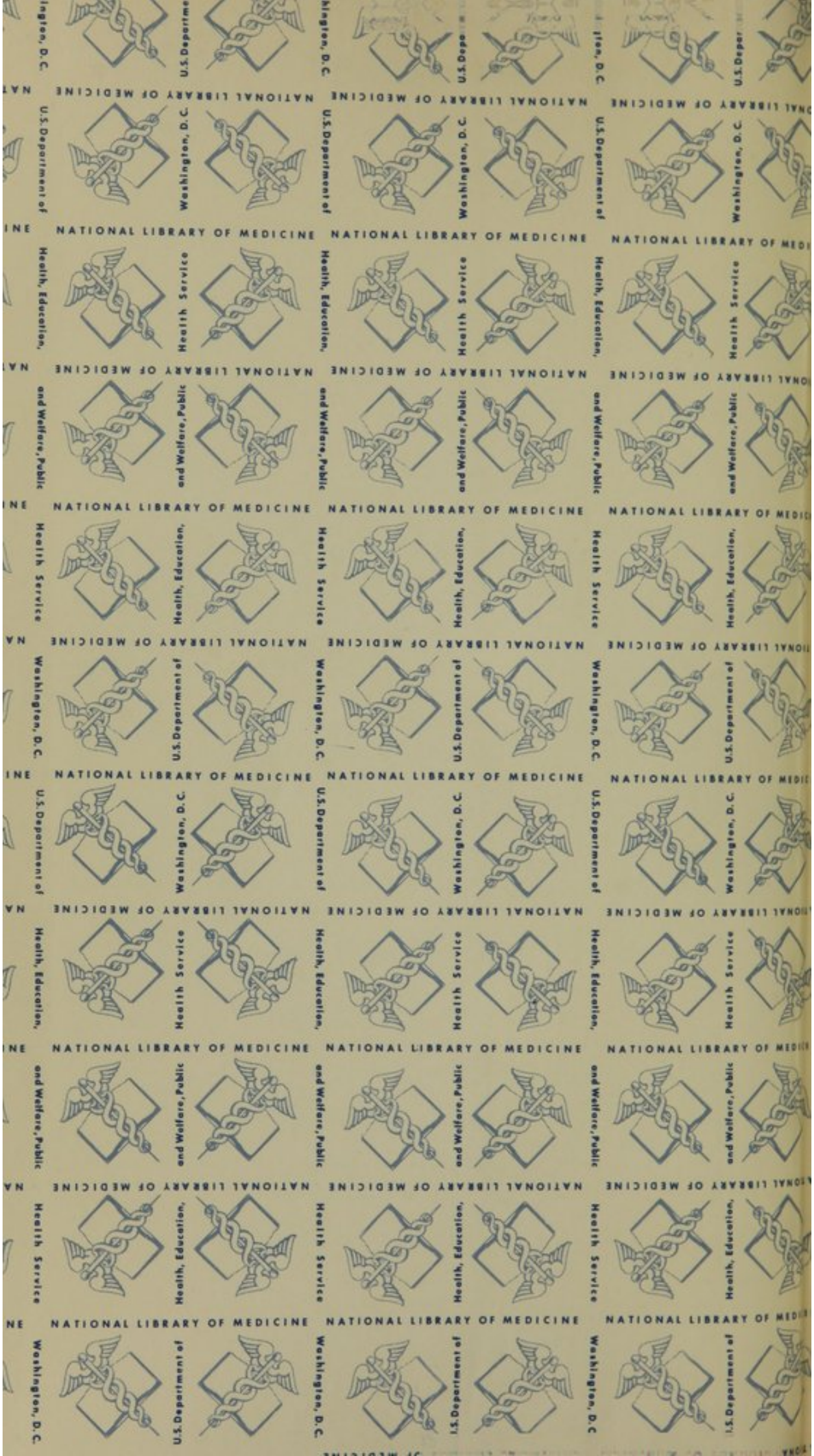
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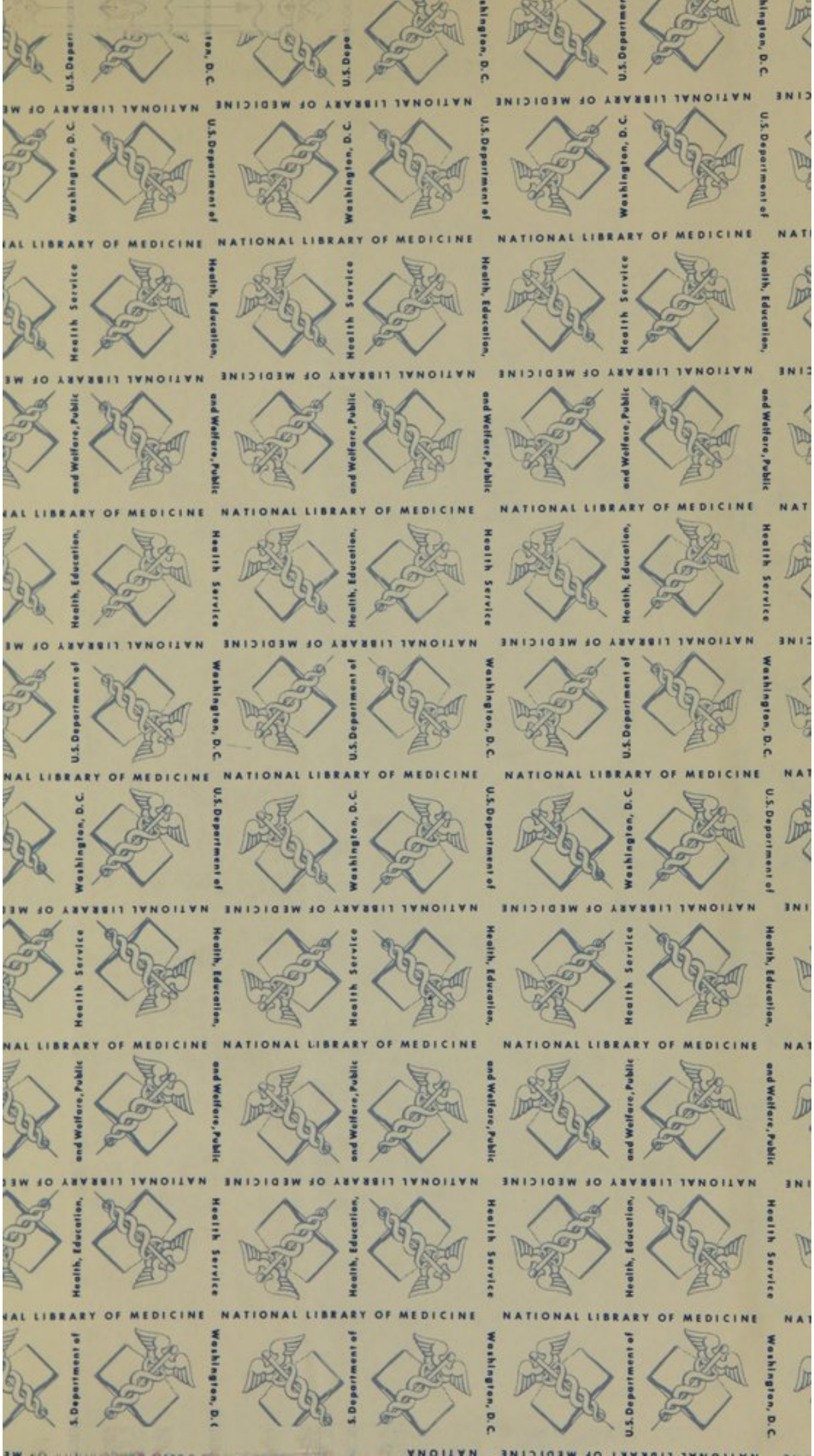
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