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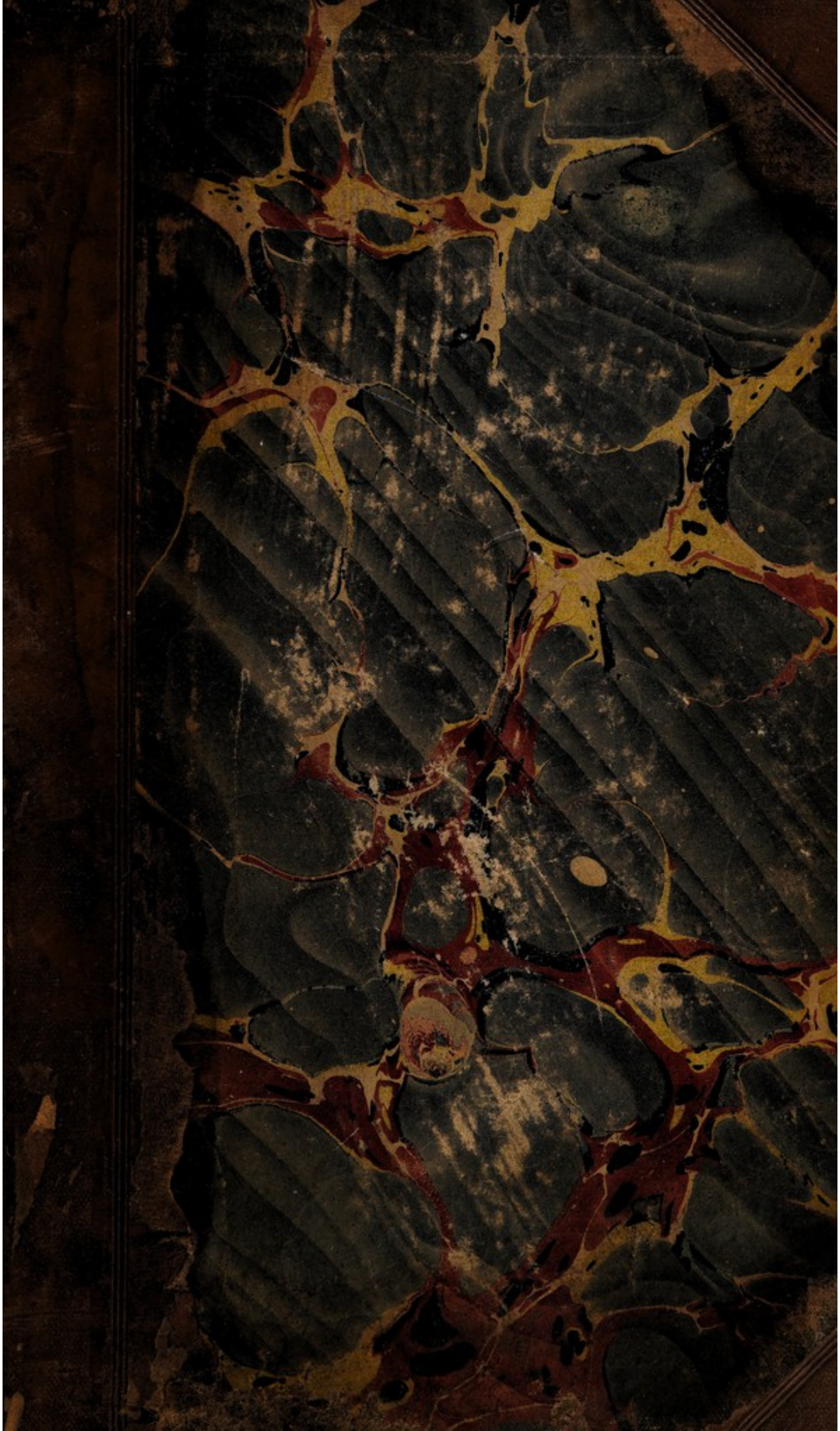

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ELEMENTS

OF

MATERIA MEDICA

AND

THERAPEUTICS;

INCLUDING THE

RECENT DISCOVERIES AND ANALYSIS OF MEDICINES.

SECOND EDITION.

BY

ANTHONY TODD THOMSON, M.D. F.L.S. AND G.S.

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PROFESSOR OF CHEMISTRY IN THE UNIVERSITY OF LONDON,
ETC. ETC.

AS A PUBLIC TESTIMONY

OF

RESPECT FOR HIS SCIENTIFIC ACQUIREMENTS

IN ONE OF THE MOST INTERESTING AND USEFUL BRANCHES

OF NATURAL SCIENCE;

AND

AS A TRIBUTE OF THE HIGH ESTIMATION WHICH

THE AUTHOR PLACES UPON HIS FRIENDSHIP,

THIS VOLUME

IS

AFFECTIONATELY INSCRIBED.

PREFACE

TO THE FIRST EDITION.

THE intention of the following pages is to present a condensed view of the branch of medical science of which they treat. The extent and nature of the subject has been too little considered, and the preliminary acquisitions requisite for its proper acquirement most unaccountably overlooked, in the course of studies prescribed by the incorporated medical bodies in this country. Instead of commencing his medical education by attending lectures on Materia Medica, which is an obligation imposed upon him by the existing regulations, the student should previously attend, at least, one course of Natural History, Botany, Chemistry, Anatomy, and Physiology; and not till then can he be expected to comprehend the doctrines delivered in a course of Materia Medica, far less those relating to Therapeutics. The Author flatters himself that the contents of the following pages will render evident this mistake in medical education; and, consequently, effect its correction.

The Author has adopted that arrangement of his subject which he thinks the best calculated to make the work useful, both to the student and the junior practitioner; and, by collecting in one point of view all the discoveries with which modern Chemistry has enriched the field of Materia Medica, and those practical facts which clinical medicine has furnished for elucidating the doctrines of Therapeutics, he hopes that it may not be considered unworthy of the attention of the experienced practitioner. He has lost no opportunity of availing himself of the labours of the Continental Chemists and Medical Writers, as well as those of our own country,

and our transatlantic brethren. He has, indeed, had recourse to every original source of information within his reach ; and he trusts that the composition of the work will demonstrate that his diligence has not been misapplied.

Although the greatest portion of the work can be regarded only as a compilation, yet, the Author has introduced into its pages the results of thirty years of attentive and close observation in the treatment of diseases. With an enthusiastic love and a veneration for his profession, which he is anxious to impress upon those who are commencing the study of its principles, he has endeavoured to trace the nature and the phenomena of morbid action, and to ascertain the actual influence exerted by remedial agents in effecting its removal. What he has observed he has faithfully recorded ; and he has distinguished, as far as his experience has enabled him to verify the statements of others, facts from conjectures, and truth from misrepresentation. Still, however, the ample field of Materia Medica remains imperfectly cultivated : if the following pages only excite those calculated to draw forth the riches of the soil to lend their aid to the task, the Author will rest satisfied with the result of his exertions.

3, *Hinde Street, Manchester Square,*
25th September, 1832.

PREFACE

TO THE SECOND EDITION.

In presenting a new edition of this work to the notice of the Profession, the author has merely to remark, that he has endeavoured to correct any errors which had occurred in the first edition, and to collect as much new information to enrich the pages of the present as his opportunities have afforded. The intimate dependence of Materia Medica upon Chemistry renders it, like that highly interesting branch of Science, liable to constant fluctuations; because every day is presenting new materials, and affording facilities of analysis which have not previously existed. The Author has taken advantage of these, and has consulted every new work, both foreign and domestic, connected with his subject, which has appeared within the last two years; and he trusts that the results of his industry, in the pages of this volume, will be sufficiently apparent to his readers. With this hope he commits the present edition to the press; and on the judgment of the Profession he relies for that reception of it which its merits shall be thought to deserve, and beyond which he has no desire to claim either favour or patronage.

3, *Hinde Street, Manchester Square,*

26th February, 1835.

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ELEMENTS

OF

MATERIA MEDICA AND THERAPEUTICS.

PART I.

SECTION I.

DEFINITIONS.—MEDICAL AGENTS: GENERAL CIRCUMSTANCES CONNECTED WITH THEIR ACTION ON THE LIVING BODY.

MATERIA MEDICA is that branch of the Medical Science which relates to Medicines. It comprehends a knowledge of these agents, both in their natural state, and as productions of the pharmaceutical art; and also of the physiological effects which their administration produces on the living body.

THERAPEUTICS is a knowledge of those phenomena of the animal body which follow the administration of medicines, and precede the restoration of health.

Medicines excite actions in the living system, and cause changes in its condition sufficient to overcome any unnatural state of one or more of its functions, which may constitute disease; thence, they are calculated to favour the return of health. Their influence is greatly modified by the condition of the body: the medicine which agitates in health may sooth in disease. They are derived from both the *organic* and the *inorganic* kingdoms of Nature. The greatest number are vegetable substances; those of a mineral origin are less numerous; those which are animal productions are comparatively few.

Medicines of an animal and a vegetable nature differ from food, in containing some active principle not adapted to repair the waste of the body; which resists the digestive powers, and often governs them: their other components, namely, resinous, albuminous, gelatinous, saccharine, oleaginous, feculaceous, and

gummy matters, undergo digestion. The medicinal properties of organic bodies vary at different periods of their existence. In animal bodies they are most active during the exercise of some peculiar function; for instance, that of generation in Cantharides: in vegetables they often remain latent, or are not formed until the plants have attained their full growth and are capable of exercising their reproductive faculties; as in the Lettuce, which is scarcely narcotic when young. The medicinal properties of mineral substances are always the same, the circumstances of the habit under which they are administered being equal.

Medicines operate only on the living body: indeed, they may be regarded merely as means of affecting the vitality of the animal solid, whether that exhibit itself under the phenomena of *contractility*, *irritability*, or *sensibility*, or those that follow *volition* and *association*. To produce their effects, they must be in immediate contact with some sensitive or irritable part of the body:—as a preliminary step, therefore, to an enquiry into the objects of the Materia Medica, it is requisite to obtain correct ideas respecting the general manner in which medicinal agents operate on the living body; and, also, a knowledge of those states of the habit, constituting *health* and *disease*, by which their operation is greatly modified. Thence the intimate connection between Materia Medica and Therapeutics.

Health is that condition of the body, in reference both to its component matter and its functions, which enables it to preserve its integrity as a whole and in all its parts; and to assimilate and appropriate to its own nature things foreign to itself; and to resist the impulses of others that would prove hurtful. But, besides this harmony and equilibrium in the physical part of the system, it is also essential that the mind should be as sound as the body. It would be out of place here, to endeavour to explain how the body is affected by the mind, or the mind by the condition of the body: it is sufficient to know that the healthy condition of each is reciprocally affected by the state of either: the harmony and equilibrium of both in the same person being necessary to constitute health. But as the condition termed health necessarily differs according to age, sex, mode of life, custom, and other circumstances, these variations must be kept in view. In the healthful state of the habit, the stomach is an active organ; it is therefore capable of resisting the influence of many medicines, which would operate powerfully upon it in the opposite or diseased state of the system.

Disease is that condition of the body in which its vitality is either so diminished or impaired, that some, at least, of the animal and the vital functions are imperfectly performed. But in affirming that vitality is diminished or impaired, it must not be supposed that any change takes place in the principle of

vitality; on the contrary, this continues the same, although the organs, in a diseased state of the body, are less sustained by its influence. As the system, therefore, cannot, in this condition, resist the influences of common matter acting by its own laws, the power which, as it were, holds the different parts of the body together, gives way, and, at length, the whole becomes the victim of the ordinary laws of the affinity of its components, or, in familiar language, death ensues. In the state of disease, also, substances taken into the stomach, instead of being properly digested, undergo the changes that they would suffer, cæteris paribus, out of the body, and obey those laws which regulate the chemical affinities of their components; at least, such is the case in a great degree. The stomach consequently ceases to be an active organ; for, like the rest of the system, the weaker it is, the more it is under the influence of physical agents: and many substances received into it operate as medicinal agents, which would be resisted in a state of health. The stomach, in truth, is in a condition which may be termed *active*, in health, and *passive* in disease; and, consequently, it is variously affected by the same substances in these different conditions. A reference, however, to the morbid state of the body is not essential to constitute any substance a medicine; for, although many substances, in moderate doses, or such as operate actively as remedies in disease, do not affect the *healthy* stomach, yet there is no substance deserving the name of medicine, that does not, in larger doses, more or less, make some impression upon that organ in health. If we adhere to facts, we shall find that substances which fully undergo digestion, rarely, if ever, operate as medicines. This conclusion is not necessarily at variance with the fact, that a substance may be partially digested, and yet exert a medicinal influence upon the body. Indeed, as Cullen justly remarks, "with respect to vegetables, and also some animal substances, it is often a certain portion of them only that can be subjected to our digestive organs, while the medicinal part of the same is hardly affected: and, therefore, it may be alleged, that their operation on the interior parts is not prevented by the powers of digestion*." To illustrate this by an example, let us suppose that a substance is swallowed, which contains a very active medicinal principle involved in a large quantity of mucilaginous or amylaceous matter; for instance, *Veratria*, in the bulb of Colchicum *autumnale;* the Fecula undergoes the action of the digestive process whilst the Veratria remains unaltered: but, being set free, it now exerts its full influence upon the stomach, and, through it, upon the rest of the system. It is therefore evident that, although the digestive function interferes, more or less, with the

* Treatise on the Materia Medica, 2 vols. 4to.

operation of medicines taken into the stomach, and the condition of that organ modifies their influence in a certain degree, yet we may strictly affirm that a medicine is neither digested nor assimilated. Having settled this point, and understanding by the term "Medicine," a substance which is capable of altering the state of the body, whether in health or in disease; we have next to enquire in what manner medicinal agents operate upon the living body?

There are five distinct modes in which medicines act upon the living body: 1, they may act by a direct impression upon the surface to which they are applied, the effect being confined to the part: 2, by an impression upon the nerves of the surface to which they are applied, and the effect be extended to the other parts of the system: 3, they may be conveyed by absorption, undecomposed, into the system, and influence the habit through the medium of the circulation: 4, they may be decomposed and operate only by one or more of their constituents: 5, they may operate by counter irritation or revulsion: 6, they may exert a chemical action on the tissues.

a. DIRECT ACTION OF MEDICINES; THE EFFECT BEING LOCAL.

When a medicine is taken into the stomach, or is applied to any part of the living surface, its direct and sole operation may be confined to a physical change impressed on the tissue of the organ; and, although the function of the part, if weakened, may be thus restored to a state of healthful energy, and the entire system benefited by the change, yet, the influence of the medicine can only be regarded as strictly affecting the condition of the vital surface to which it is applied. This mode of action is well illustrated in the influence which astringents, whether taken into the stomach or injected into the rectum, exert in checking diarrhœa depending on a mere relaxation of the intestinal canal; and in the effect of collyria applied to a blood-shot eye. It is the simplest kind of medicinal action.

b. ACTION OF MEDICINES ON THE NERVOUS ENERGY*; THE EFFECT BEING GENERAL.

When the influence of medicines, acting on the stomach, extend to the whole of the system, it is evident that their impression must be made upon the sensible and irritable parts of the

* Nervous energy is that power inherent in the nervous system, including the brain and the spinal marrow, which renders the body susceptible of impressions both mental and material.

organ; in no other manner can we account for the sudden changes produced upon distant organs and parts of the body, soon after a medicine has been introduced into the stomach. How is this to be explained?

That every medicine which operates on the living solid exerts its influence, either directly or indirectly, upon the nervous system, can scarcely be denied. Even when we admit that a medicine, which is absorbed and taken into the circulation, causes chemical changes in the circulating mass, still we must refer its ultimate effect to the nervous system, unless we suppose that the secretions are mere chemical changes in the fluids, altogether independent of the vital principle—an idea which is totally devoid of support. Chemical changes in the fluids, however, can be more readily explained, on the supposition that, a new action being excited in the secreting organs, a change in the nature or the proportions of the components of these fluids is the result, than on that which presumes that the medicine penetrates the vessels and acts chemically upon their contents. When a medicine enters the blood-vessels, and is conveyed to a particular organ, this is excited in the same direct manner as the surface to which the medicine was first applied: but, at the same time, phenomena occur in distant organs that can only be referred to nervous sympathy.

If we admit the principle that medicines can only affect the body through the medium of the nerves, when their operation extends beyond the stomach, or the part to which they are directly applied, there is no difficulty in understanding the manner in which the impression is propagated to distant parts, or over the entire system. The Physiological discoveries of Sir Charles Bell* have so far unravelled the intricacies of the nervous system as to enable us to comprehend how impressions are communicated along certain sets of nerves, while other sets remain inactive; and, thence, to understand those associated changes which almost simultaneously occur in distant parts. From his investigations we learn that all the nerves of sensation originate in the same medullary tract, in the spinal marrow and brain; that a similar medium of communication unites the nerves of motion or volition; and a third, those of respiration. Now, if an impression be made on a nerve belonging to any of these sets of nerves, it is communicated to the whole set to which the affected nerve belongs, by the common medium that conjoins them. Thus, if a violent pain be felt in the great toe, as occurs frequently in gout, and is allayed by a large dose of Opium taken into the stomach, we do not suppose that the Opium is absorbed, and conveyed by the blood-vessels to the

* An Exposition of the Nerves, &c. 8vo.

toe, in order to produce this effect:—the impression of the Opium is first received by the sentient extremities of the nerves of sensation of the stomach; the new disposition given to them is propagated to the connecting tract in the spine, and the sensorium commune, and thence to the part which is suffering. There is, then, a simultaneous action of some of the nerves in the most distant parts of the body—a fact which is proved by those associated impressions which are so often observed in disease; and there is equal reason for admitting that the same power regulates the operation of remedies. Let us take an example in illustration of this position. We are informed by a patient that he is suffering under palpitation of the heart; we find, upon laying our hand on the region of the heart, that this organ is labouring violently, and is in the most irritable state; and, yet, we can detect nothing which authorizes us to suppose that this disturbance depends upon any organic disease or change in the structure of the organ. We refer it, therefore, to the stomach, which we discover to be out of health; and we say that the heart associates or *sympathizes* with the morbid action of this viscus. No remedies are, in this case, administered with the view of *directly* influencing the heart; but those are prescribed which we know will allay the morbid irritability of the stomach; and, as this is effected, the heart, also, becomes quieter, and recovers its healthy action.

It may be properly demanded, what proof is there that medicines act through the medium of the nerves, independent of absorption? Two or three facts may be mentioned in support of this opinion. Rhubarb, when taken into the stomach, can be soon afterwards detected in the urine; we have, therefore, no difficulty in ascertaining whether it have been absorbed. Now, if we apply a poultice made with a strong decoction of Rhubarb to the abdomen of a child, purging is excited; but the presence of the medicine cannot be detected in the urine by the most delicate tests. If the skin of the head be bathed with a strong decoction of Tobacco, vomiting will be produced; but no absorption of the decoction of Tobacco takes place. These proofs are conclusive: but the following, of a more direct kind, may also be mentioned. M. Dupuy having divided the nerves of the eighth pair in a horse, two ounces of Nux-vomica, in the form of a bolus, were introduced into the stomach of the animal; no injurious consequences followed, although another horse, equal in size and strength to the former, in which these nerves remained entire, died in a few hours in violent tetanic convulsions, after swallowing the same quantity of the poison.

The rapidity, also, with which some medicines—Hydrocyanic acid, for example—act, when taken into the stomach, renders it, at least, doubtful whether their effects can be ascribed

to absorption. Narcotic substances, also, which act powerfully when applied to the cuticle, prove narcotic if introduced into the stomach. Thus, when extract of Belladonna is applied to the eyelid, in order to dilate the pupil, we have no reason for thinking that the Belladonna is absorbed; and although, when it is taken into the stomach, there is a probability that absorption may take place, yet the proofs of it are not satisfactory. Upon the whole, there is abundant evidence to prove that many medicines produce their effects by acting directly on the nervous energy, altogether independent of absorption. It is not essential that we should be able to demonstrate in what manner this communication with distant parts of the body is effected by the nerves. The attempt to explain the phenomenon is as vain as that respecting the vital principle; we find ourselves out of our depth, and the struggle only convinces us that we are in an element which does not belong to us.

In stating these facts, however, it must also be mentioned, that, in an experiment in which all nervous communication was destroyed, by severing the leg from the body of a dog, whilst the circulation was maintained by means of quills passing from the vessels of the body of the animal to those of the separated limb, poison introduced beneath the skin of the severed member, produced all its effects upon the animal—a circumstance which can be referred only to absorption.

In whatever way this nervous communication is accomplished, there are three surfaces upon which the impressions can be advantageously made, and whence they are propagated: —the stomach and alimentary canal;—the skin;—and the organ of smelling.

1. The first of these, the stomach, is known to be a highly irritable organ, and amply furnished with nerves; whence the sympathy which exists between it and the other parts of the system, and the advantage of administering medicines through its medium. When labouring under diseased irritation, it is the centre of perceptions felt over the whole system, and is extremely susceptible of the impression of medicines; whereas, in its healthy state, it resists them powerfully.

The larger intestines, supplied with nerves connected with the great sympathetic, communicate the impressions of medicinal agents to the general system nearly in the same manner as the stomach, but with less energy: thence, larger doses of medicine and more acrid substances can be thrown into the rectum, with impunity, than into the stomach. Medicines, also, thrown into the rectum, operate, except in degree, nearly in the same manner as those taken into the stomach.

2. The skin, the general integument of the body, is largely supplied with nerves and endowed with great sensibility; and although the cuticle, which is devoid of sensation, is interposed

between the true or sensitive skin and any substance applied to the surface, yet, the skin is readily excited, and communicates a sympathetic action to the rest of the system. That it is capable, therefore, of communicating impressions of medicinal agents is undoubted. We may mention, in confirmation of this fact, the influence of Hydrocyanic acid, and Sulphuretted Hydrogen gas, as well as that of Rhubarb and Tobacco, already noticed, when applied to the unbroken surface: indeed, it is highly probable that no medicinal agents applied to the skin, when the cuticle is entire, except to a small portion of the surface, are absorbed: they exert their influence altogether through the medium of the nerves.

The third medium for receiving the impression of medicinal agents on the nervous system, is the organ of smelling. The effect is chiefly produced on the first and the fifth pairs of nerves distributed over the Schneiderian membrane lining the nostrils, the adjoining sinuses, and the convoluted bones so beautifully contrived to extend this surface in a limited space. Many odours cause nausea, vomiting, and rigors; and, therefore, it is not surprising that volatile medicines should effect the general system through the same medium. Many substances which are supposed to enter the system by pulmonary absorption, such as the fumes of Alcohol, Tobacco, and Ammonia, affect the habit solely by impressions made on the nervous centres through the organ of smelling. Dr. Rousseau of Philadelphia made numerous experiments upon this subject; he states, "that they warrant the conclusion that, by simply closing the nostrils, either by compressing them with the fingers, or by filling them up, the fumes of ardent spirits, or of a strong decoction of Tobacco, or an infusion of Opium, may be inhaled for an hour without any unpleasant effect; whereas, if the precaution mentioned be omitted, the consequences are proven to be most distressing."

Such are the principal media by which medicines affect the living system through the nerves. In possessing a knowledge of these facts, we are led to consider—1, the nature of the impression which any medicinal agent makes on the surface receiving it: 2, the relative connexion between that part and the principal organs: 3, whether the influence of contiguity depends upon a nervous connection?

c. ACTION OF MEDICINES ABSORBED IN THEIR ENTIRE STATE.

A medicine may be conveyed undecomposed into the circulation, and influence the general system.

There are three ways by which medicines may be conveyed into the circulation:—namely, by absorption from the intestinal

tube;—by absorption through the skin;—by absorption through the lungs.

1. The proofs that medicines are absorbed from the intestinal canal are numerous; but a few only require to be noticed. Nitrate of Potassa, the salts of Iron, and Hydrocyanate of Potassa can be detected in the urine a few hours after they have been swallowed. This also happens when the substances are not taken into the stomach: seven minutes after injecting a solution of the Hydrocyanate of Potassa into the bronchial cells, the presence of this salt has been demonstrated in the urine*; in which case the salt must have entered the circulation undecomposed; and the same is true respecting the Nitrate of Potassa, and the Salts of Iron, before they could have appeared in the secretion of the kidneys. That such medicines do not pass, however, in the manner of digested matter through the lacteals, is probable, since they have very rarely been detected in the chyle of the thoracic duct, or in the blood, by the most delicate tests; although they have been found when introduced into the circulation through other organs than the stomach. Dr. Meyer injected Hydrocyanate of Potassa into the lungs, through an opening in the trachea of a dog: after some time, he found it in the blood, on testing that fluid with Sulphate and Hydrochlorate of iron. Dr. Chapman, an American writer on Materia Medica, supposes that these substances are decomposed in the stomach; that their components enter the circulation under the influence of the vital energies, which prevent them from recombining; but that, as soon as they reach the secretory or or excretory organs, they are thrown, as it were, beyond the sphere of these energies; and their chemical affinities being brought into play, they recombine, and the substance is thus again rendered perceptible, or can be detected by tests in the excretions. But however ingenious this hypothesis may be, it is utterly destitute of probability. What secretion is beyond the sphere of action of the vital energies?

The surfaces that receive the impression of medicinal agents in the intestinal canal, are all furnished with absorbents opening upon them, by which the medicine is taken up: but it must be in immediate contact with the absorbing mouths of these vessels opening upon the part. Plethora diminishes the facility of getting medicines into the system by these channels; bloodletting and other depleting measures increase it.

2. The absorption of medicines by the *skin* is not easily demonstrated. The true skin is furnished with innumerable absorbent vessels and nerves; the resemblance between it and the mucous lining of the internal, open, tubular, cavities of the

* Traité Elementaire de Mat. Med. par J. B. G. Barbier, &c. vol. i, p. 69.

body is so great, that many anatomists consider the mucous membrane as a prolongation of the skin, modified to suit the function of the part which it covers. The skin, however, differs in several particulars from the mucous membrane: it is covered with the cuticle, whilst the mucous membrane is defended solely by its secretion; the vascular stratum of the cutis is not separable from the thick sub-stratum which supports it, whilst in the mucous membrane these are easily separated. A question arises, does the skin actually exercise the function of absorption?

The observations and experiments of many celebrated physiologists, among whom are Drs. Klapp, Rousseau, Dangerfield, Chapman, Dr. John Gordon, and M. Seguin, tend to disprove the existence of general cutaneous absorption whilst the cuticle remains entire: but, on the other hand, experiments, as conclusive in support of the opposite opinion, are detailed by Keil, Haller, Home, Cruickshank, Watson, Ford, Abernethy, Dr. Kellie, Dr. W. F. Edwards, and others. Experiments upon the lower animals would, indeed, lead us to adopt that opinion which supposes that the skin absorbs fluids placed in contact with it; but it is from reasoning upon these analogically, that the assertion of the power of the human skin to absorb, when covered with the cuticle, solely rests. In the experiments of Seguin*, although that philosopher concludes that there is no absorption, yet, it was evident that the human body, when immersed in water above 90° of Fahr. lost nothing in weight beyond that which is usually exhaled by pulmonary transpiration; and that at 72° 5′ neither transudation nor absorption takes place. But this may have arisen as well from the cutaneous perspiration being checked, as from absorption; and such is more likely to have been the case, as no increase of weight followed. In the experiments of Drs. Currie and Gerard, in which the body was immersed in hot water, no loss of weight was suffered during the immersion; but Dr. Kellie argues in favour of absorption, from these experiments, remarking that, although the body was doubtless wasted by the pulmonary and cutaneous discharges, yet its weight continued unchanged; or, where a loss was observed, this was constantly less than is experienced during the same interval in the air†. The most singular facts in favour of cutaneous absorption, are related by Keil and Dr. Percival: the former says,—"27 Decemb. hac nocte octodecim humoris uncius ex acre ad se somnians (corpus) attraxit:" the latter relates the case of a horse-jockey, whose weight increased thirty ounces, although in the interval he had taken nothing but one

* La Medicine Eclairée, &c. tom. iii.
† Edin. Med. and Surg. Journ. vol. i, p. 182.

glass of wine. That absorption occurs to a certain extent, there can be little doubt; but it is a question—whether this is a function of the whole skin, or of a part?

From some experiments instituted by Dr. Rousseau of Philadelphia, there is reason for thinking that the function of absorption is enjoyed only by certain portions of the skin; that space, for instance, which extends between the middle of the thigh and the hip; and that between the middle of the arm and the shoulder. It is not easy to explain this fact, as no anatomical peculiarity is obvious in the cuticle of these portions of the skin. Dr. Rousseau also demonstrated that Garlic, Spirit of Turpentine, and some other substances which have been supposed to find ready access to the habit through the skin, enter by pulmonary absorption. When he breathed through a tube, which passed from the room in which he was placed, and opened upon the external air, although the body was bathed with the juice of Garlic, or immersed in an atmosphere of Spirit of Turpentine, yet, these fluids were not detected either in the breath or in the urine.

The cuticle is the chief obstacle to cutaneous absorption; yet experience has demonstrated that some medicines pass into the system, even when the cuticle is not abraded: for example, the habit may be affected by immersing the body in a bath of very dilute solution of Corrosive Sublimate, at a temperature of 70° of Fahr.; or by exposing it to mercurial fumigation. The effect, however, is more certain when friction is employed to abrade this covering, or when it is removed by vesication; the skin then absorbs freely, and thus medicines have been introduced into the system by cutaneous absorption. This is, nevertheless, a very uncertain method of introducing medicines; and there is much truth in the remark of M. Barbier, that it does not fulfil all which it seems to promise*.

3. The third way by which a medicine may enter the system undecomposed, and exert its influence through the medium of the circulation, is absorption through the lungs.

The experiments of Dr. Rousseau, already noticed, are sufficient to prove that some volatile substances are very rapidly absorbed by the lungs, and taken into the course of the circulation. There is no reason for supposing that any decomposition of the medicines occurs in these instances. Although the air is the vehicle by which these substances are conveyed into the lungs, and although it undergoes a chemical change in the bronchial cells, yet, this does not affect the volatile matters held in solution by it when it is inspired: these are taken up by the absorbents opening on the mucous membrane of the bronchial tubes; whence they are

* Traité Element. de Matière Medicale, vol. i, p. 60.

carried into the circulation, and again excreted by the kidneys and the skin. In their passage, they powerfully stimulate the nervous system, and, occasionally, produce as decided an influence on the body as if they had been taken into the stomach.

The difference between the mucous membrane of the bronchial tubes and the skin or cutis, consists in the medium interposed between them and the air: in the skin this medium is the cuticle; in the lungs it is a fine epithelium, which certainly is more likely to permit imbibition than the cuticle. It is possible that, in this manner, and not, strictly speaking, by vascular or lymphatic absorption, some volatile matters admitted into the lungs are conveyed into the system.

d. ACTION OF MEDICINES DECOMPOSED IN THE STOMACH, AND AFTER ENTERING THE SYSTEM.

The decomposition of medicinal substances may take place in the stomach;—or in the blood;—or in some secreting organ.

1. A medicine may be decomposed in the stomach, and one or more of its constituents be detected in some part of the system; or in one or more of the excretions: or a medicine, thus decomposed, may act on the nervous system by one or more of its constituents.

The first of these positions is demonstrated when some substances containing colouring principles are taken into the stomach. Thus, if a few drops of Liquor Potassæ be added to the urine of a person who, a few hours before, has swallowed a dose of Rhubarb, a lake colour is produced, shewing the presence of the colouring matter in the urine: and if madder be mixed with the food of an animal, the colouring matter will be found deposited in the bones.

With respect to vegetable medicines, their decomposition is effected in the same manner as that of alimentary substances. Many experiments have ascertained the fact, that all simple aliments, such as *albumen*, *gelatin*, *fibrine*, *caseous* matter, *vegetable mucus*, *sugar*, *starch*, and *gluten*, are soluble in the gastric juice; and that all compound aliments, containing these substances as constituents, are also dissolved by it, under certain conditions connected with the structure of the compound substances. A substance, for instance, the components of which are, when separate, readily soluble in hot water, is very quickly dissolved in the gastric juice. It is less quickly dissolved if the components, separately, require the assistance of acids for their solution; as those, for instance, which contain much *gluten*, *concrete albumen*, *fibrine*, and *caseous matter*: and the gastric juice scarcely acts at all upon the *husks of grains*, the very *hard fibres of woody plants*, *hairs*, *feathers*, and sub-

stances of a very compact texture. Now, as all vegetable substances are components of some of these simple aliments, and are more or less susceptible of solution in the stomach, it is evident that all vegetable medicines must undergo digestion to a certain extent: although it is probable that some of them previously act upon the nerves of the stomach. The decomposition, however, is generally first effected, and the active principle, being thus extricated from the digestible matter, operates either *directly* upon the nerves of the stomach, or escapes into the circulation. It is to this circumstance that we may ascribe the time which elapses after swallowing some medicines, and the period when their operation becomes apparent. Thus, if a full dose of the powdered root of Ipecacuanha, or the seeds of Strychnos *Nux-vomica*, be swallowed, from ten to thirty minutes generally elapse before the influence of the *Emetina* or that of the *Strychnia* be displayed—a circumstance which we may fairly attribute to the envelopment of these active constituents in the *Wax*, *Gum*, *Starch*, and *ligneous* matter of the powders, so that they cannot exert their influence until extricated from these by the process of digestion. The decomposition of medicines in the stomach is not, however, confined to vegetable matters; the Acetas Potassæ, and some other salts in which vegetable acids enter as components, are liable to undergo the same process; the acid is digested, whilst the alkali passes into the circulation, and is excreted by the kidneys. Whether this may be ascribed to a galvanic influence exerted by the organic agent, deserves consideration. Be this as it may, it is evident that the decomposition is effected by the vital powers of the stomach; and that the active principle of the medicine, thus eliminated, either acts *directly* upon the stomach, extending its influence by nervous sympathy to distant parts of the system, or that it is absorbed and carried, in the course of the circulation, to those organs on which its appropriate action becomes apparent, whether *diuretic*, *sudorific*, *expectorant*, or otherwise.

These remarks are not at variance with the fact, that medicines taken into the stomach are also decomposed by chemical means. The acids existing in the stomach are chiefly the Acetic* and the Hydrochloric or Muriatic; and the quantity of these is more or less augmented by the state of the stomach, and the stimulant quality of the food. Pepper, or any spice, for example, greatly increases the secretion of these acids. Many morbid causes, particularly those which augment the irritability of the stomach, increase also the secretion of these acids; and, from their superabundance, they become prominent

* Dr. Prout believes that the Acetic acid, when present, is always derived from the aliment.—*Phil. Trans.* 1824.

symptoms of that diseased state of the digestive organs which constitutes *Dyspepsia*. If, during this condition of the stomach, any alkaline Carbonate be swallowed, a chemical action immediately takes place in the stomach between this Carbonate and the acids of the gastric juice; the Hydrochloric acid, having a greater affinity for the alkaline base of the Carbonate than the Carbonic acid has, unites with that base, and, setting free the Carbonic acid in a gaseous state, forms a new salt with the base of the Carbonate. In this instance, the chemical decomposition of the medicinal substance is effected exactly in the same manner as in the laboratory of the chemist, at a temperature equal to that of the living stomach; one of the components (the Carbonic acid) is immediately rendered active; whilst the new compound, produced by the union of the alkaline base with the acid of the stomach, the Hydrochloric, or with the Acetic if present, varies in its operation according to the chemical nature of the Carbonate employed. If the alkaline base be *Soda*, the new salt generally passes out of the stomach undecomposed, and operates as a purgative; if *Potassa*, and an Acetate be produced by the chemical process, this is again almost immediately decomposed by the digestive function: the acid mingles with the chyme; whilst the Potassa, eliminated, is taken into the circulation, and, being carried to the kidneys, stimulates these organs to increased action, and promotes the excretion of the urine. Whatever is the base of the saline body employed, the Carbonic acid always plays the same part, producing a direct tonic impression upon the stomach at the moment of its extrication: whilst the base passes into the circulation; and illustrates the fact, that a medicine may be decomposed in the stomach, and operate by one or more of its components.

3. A medicine may be absorbed entire, and be afterwards decomposed, either in the course of its circulation in the blood-vessels, or in some particular secreting organ, and operate on the nervous system by one or more of its components.

This proposition is by no means so easily demonstrated as the former, although there are results following the administration of some medicines which can only be explained on the supposition of a decomposition, such as it describes. If Mercury, for example, in the state of an oxide, be taken into the stomach, or introduced by any other means into the system, the medicine is first absorbed, undecomposed, into the circulation; but, after some time, according to the state of the habit of the body of the person employing it, as soon as its constitutional influence is perceptible, it appears to be decomposed in the system; gold, carried in the pockets of the person taking it, becomes whitened in the same manner as if an amalgam were formed by rubbing metallic mercury upon its surface. It is true, that although this proves that the Mercury

escapes from the body through the exhalant pores of the skin, yet, it does not inform us of the state in which it is thrown out; or whether it have suffered reduction, and is exhaled in the state of mercurial vapour. But if direct experiments are insufficient to satisfy our enquiries on this point, the fact that metallic Mercury has been detected in the bodies of those who have died*, after being fully under its influence, affords some ground for supposing that the mercurial preparations employed as medicines, unless they quickly pass off by the bowels, are decomposed either in the course of the circulation or in the secretory organs; and if this be actually the case, it is probable that they operate, not in their entire state, but by one or more of their components. This reasoning is also supported by phenomena attending the employment of the preparations of some other metals; more especially the Nitrate of Silver, a salt composed of Oxide of Silver and Nitric Acid. If this salt be internally administered in small doses, it produces a powerful tonic effect upon the system; and, in some instances, it leaves a permanent tinge of a leaden hue upon the skin. Now, it is evident that this effect could not take place if the Nitrate of Silver were not taken into the circulation in an undecomposed state; for, if the Nitrate were decomposed in the stomach, and converted into Muriate of silver, this is an insoluble salt, and, consequently, not fitted to be taken up by the absorbents. But if we admit that the Nitrate of Silver is taken into the circulation in its undecomposed state, we can readily explain the manner of its decomposition by the capillary vessels of the skin, and its deposition in the rete mucosum, in the state of an insoluble Muriate, which would necessarily render any tinge communicated by it to the skin, permanent; thence the leaden hue of the complexion which has unfortunately, in several instances, followed the administration of Nitrate of Silver. From these facts there can be no doubt that there are medicines, which, after being taken into the circulation, in an entire state, are decomposed in their progress through it.

e. REVULSIVE OR COUNTERIRRITANT ACTION OF MEDICINES.

The influence of new diseased actions, for instance those produced by cutaneous eruptions, in relieving even inveterate functional diseases, is familiar to every one who has observed the effects of either the therapeutical efforts of the constitution,

* The authors who have borne the most accurate testimony to this fact are Fallopius, de Morbo Gallico, c. 76; Johannes Fernelius, de Luis Vener. Cur. c. 7; Mayerne, Praxis, l. i, c. 8; Wepfer, de Apoplexia, p. 303; Fontanus, Resp. et Cur. Med.; Lentilius, Miscell. Med. pr. vi—i, p. 74; and Mr. Brodfelt, Mem. of Med. Soc. of London, vol. v.

or of the means employed by the physician. Medicines also operate in this manner and change the seat of irritation, setting up, as it were, a new centre of morbid perceptions; and, according to the law of the system, by increasing the sensibility of one part, we diminish that of neighbouring parts, and the blood is directed in greater quantity to the part thus acted upon; or, in the language of the ancients, a revulsion is produced.

The beneficial effects of many medicinal agents can be readily explained upon this principle; as, for instance, those of rubefacients, vesicants, and escharotics: thus, an incipient inflammation of the tonsils is often rapidly removed by the application of a liniment, composed of Ammonia and a fixed Oil, to the fore part of the neck: an attack of gout in the stomach, by the application of boiling water to the pit of the stomach: and deep-seated pains, by the operation of caloric in the form of the actual cautery. But the benefit of counterirritant action is not confined to external applications. The advantages derived from the use of purgatives, in affections of the head and chest, are justly referred to their counterirritant influence: even sudorifics and diuretics operate as revulsives, and the benefit derived from their employment is the result of the same counterirritation, set up on the skin, and in the kidneys.

This mode of action is employed for one of two purposes: either to change the irritation or excitement from the viscera to the skin; or to transfer it from the viscera of one cavity to those of another. But much caution is requisite in the employment of this description of medicinal action: it may augment the general excitement to a degree sufficient to aggravate rather than to diminish the disease for which it is employed. Thus, as I shall particularly prove, in treating of vesicants, the application of blisters so considerably quickens, and so much increases the force of the general circulation, that they are unfit remedies in the early stage of extensive acute inflammation. It is, however, necessary to distinguish between this state of excitement and that general irritability of the system, which is often accompanied with fugacious pains, and a small, quick pulse; in which the application of a local remedy, acting upon the principle now under consideration, seems to bring the irritation, as it were, into a focus, and thus to relieve the system.

f. CHEMICAL ACTION OF MEDICINES.

Medicines sometimes operate by combining chemically either with the substance of the body itself, or with the contents of the stomach and the first passages.

1. Some medicines when applied to the surface of the body enter into chemical union with the animal matter of the skin,

destroying the vitality of the part to which they are applied, and forming with it a new chemical compound. This fact is undeniably established as far as refers to the local action of some substances: for example, the pure Alkalies, the affinity of which for the components of the animal solid is so great, as completely to overcome the resisting powers of the vital principle, and to produce with it a saponaceous compound.

When the same medicinal agents are introduced, in a less concentrated form, into the stomach, changes in the nature of the contents of that organ take place; and changes, frequently also, follow in the secretions and other fluids of the body: thence the question suggests itself—"Is this owing solely to the chemical influence of the substances employed?"—The answer may be safely given in the negative: there is no reason whatever for supposing that these changes always depend upon any direct chemical influence of the medicines upon the fluids themselves: but, on the contrary, they are frequently the result of new actions induced in the secreting organs which produce them. Some medicinal substances, or their components, indeed, have been detected in several of the secretions; but, in these instances, the substances are merely mingled, not chemically combined with the secreted fluid. There can be little hesitation in asserting, that no chemical change is ever effected upon the blood, or on the secretions, by medicines acting chemically; that is, changing the affinities and altering the chemical characters of these fluids. It is the vitality of the system, extended to the fluids, which prevents chemical changes being produced in them by the affinities of chemical agents taken into the stomach; for were it otherwise, there would be hourly, and even momentarily, such changes taking place as would completely interfere with the harmony, and soon destroy the integrity, of the system.

SECTION II.

GENERAL EFFECTS OF MEDICINES ON THE VITAL SOLIDS AND FLUIDS; AND ON THE FUNCTIONS.

HAVING acquired some knowledge of the manner in which medicinal agents act on the living body, our next object is to ascertain what are the effects resulting from their action. These are conspicuous either on the living solid;—or on the fluids;—or on the functions of the principal organs.

a. EFFECTS ON THE LIVING SOLID.

It is not easy to define what the living solid implies, nor is it essential for our purpose. It is sufficient to know that the term is employed to express an indefinite idea of what we suppose to be the ultimate fibril of the organic tissues, whether cellular, muscular, or nervous: and it is probable that the change in the condition of any organ, produced by a medicinal agent, is owing to some change in condition or arrangement which the medicine impresses on this fibril. Thus the action of the heart is augmented after a dose of alcohol has been taken into the stomach: we can form no other idea of the cause of this, unless we suppose that either the nervous fibrils in the stomach, from the contact of the alcohol, undergo some change in their condition, which is followed by a corresponding change in the contractile fibres of the heart; or, that the alcohol carried into the circulation is applied to the tissue of the heart, and effects the same change by the immediate application of its particles to the ultimate fibrils of which that tissue is composed. But neither the nature of the fibrils, nor of the change which they suffer, is capable of demonstration: we found our belief of both solely upon the effects which we observe invariably to follow the internal administration of a dose of alchohol. These are a sensation of warmth in the gastric and thoracic regions, a more forcible action of the heart, and an increased momentum of the blood, inferred from the state of the pulse, compared with that which existed before the alcohol was taken. All medicines producing effects similar to those referred to the alcohol we regard as *stimulants;* whilst those, the administration of which is followed by diminished action, a preternatural decrease of the general momentum of the blood, and a lowering of the animal temperature, are regarded as *sedatives.* The general primary effect of every medicinal agent upon the living solid may be, therefore, said to be either stimulant or sedative. This, however, is not the prevailing view of the subject:—the primary influence of every medicine on the living solid is regarded as stimulant; whilst the sedative effect is supposed to be altogether negative, the result of the prior stimulant impression; or, in other words, that any sedative effect, which follows the administration of a medicine, is a state of collapse succeeding a previous stimulant action on the nervous system. This reasoning is undoubtedly in perfect accordance with the law of the system, that all impressions made upon nerves have a direct tendency to exhaust their energy, and an indirect tendency to lower the power of the system in general; but, nevertheless, the same train of reasoning which admits of the conclusion, that the effects which follow the administration of certain medicines are

the result of a stimulant impression on the living solid, authorizes, on the other hand, the assertion, that the diminished momentum, and other phenomena indicative of an abstraction of power, which immediately succeeds the administration of other medicines, are as truly the result of a positive change of constitution in the living solid which may be termed *sedative*.

The influence of medicinal agents on the living solid is greatly increased during general disease; and even in the diseased states of different organs. The effect of a stimulant, which is scarcely perceived in a healthy state of the organs, becomes strikingly obvious when they are diseased; and greatly exasperates all the symptoms. Disease, also, in augmenting the sensibility of parts, bestows on substances medicinal properties which they seem to lose as soon as the nervous system recovers its natural condition: on the other hand, it sometimes lessens the sensibility of parts.

In observing the general effects of medicines on the vital solid, during disease, it is important not to confound them with those salutary processes of the constitution which are frequently exerted to free the system from conditions of its organs altogether inconsistent with the due performance of its general functions.

b. GENERAL FFFECTS OF MEDICINES ON THE FLUIDS OF THE LIVING BODY.

The most important of the fluids, and that from which all the others are formed, is the blood. The chyle, which is constantly pouring into the blood-vessels to supply the waste of their contents, is assimilated to the blood in these vessels; not by simple agitation or motion, but by an organization; for, although sanguification has begun before the chyle reaches the subclavian vein, into which it passes from the thoracic duct, yet, it is perfected only in the course of the circulation. If this be admitted, it is easy to conceive that every variation in the circulation may produce some difference in the state of the blood; but this, if it be the effect of medicines, can be attributed only to their influence on the living solid, not to any chemical union or combination of the medicinal agent or its components with the principles of the blood. The blood may be mingled with medicines which have been taken into the stomach, and have passed into the circulation either in whole or in part: but, during life, we see no reasons for believing that any material alteration, even of the physical properties, of the blood occurs from this cause. Some late experiments of Dr. Stevens, on the effect of saline substances upon the blood, seem to be at variance with this opinion: but these are too little understood to be brought forward as opposing the opinion which has been advanced.

What has been stated of the blood might be regarded as applicable also to the secretions and excretions; but some of these, in particular the urine, display chemical differences of composition, after some medicinal substances have been administered: this forces us to pause before asserting, positively, that no chemical changes are effected by medicines on the secreted fluids. It is probable, however, that many of the changes in the nature or the proportion of the components of the secreted fluids, are the results of a new action excited in the organs secreting them, rather than of any chemical action of the medicines which produce these changes.

c. GENERAL EFFECTS OF MEDICINES ON THE FUNCTIONS.

In treating of these, it is scarcely necessary to refer to the connection between the organic tissues, on which medicinal agents directly operate, and the functions of the organs of which these tissues form the physical components. An unusual impression is made on the nervous tissue of an organ; and a modification or change of function is the result. This effect of medicines becomes apparent in changes displayed not only in the state of the cerebro-spinal system, as indicated by the condition of the organs of the senses; the functions of the circulation, respiration, animal temperature, digestion, nutrition, secretion, perspiration; and the aptitude of the muscles for exerting their various movements; but, also, in the state of the mental faculties, perception, attention, memory, the power of abstraction and judgment; and the appetencies, comprehending both desires and aversions. The observation of the changes or modifications in each or all of these faculties, during the action of a medicinal agent on the body, affords the chief means of determining the therapeutical character and value of medicinal agents. It is of great importance, however, not to confound the functional modifications which are the result of medicinal action, with those which occur from natural causes; such, for instance, as will often augment or diminish the force and frequency of the pulse, hasten or delay the digestive process, produce variations in the respiratory function, increase the insensible perspiration to sweating, or vary the natural excretory functions of either the intestinal canal, the kidneys, or the uterus. Thence the necessity of distinguishing those temporary modifications of the functions which may occur, independent of medicinal agency, even during the administration of medicines: for it is well known that many morbid states—for instance, convulsions, palpitations of the heart, or cough—may cease after the administration of a medicine, and, nevertheless, these salutary effects not result from the influence of the remedy. On

the other hand, it is undoubted that medicinal agents exert a decided influence on the vital functions; and, consequently, in altering the condition of diseased organs: a fact, the proof of which rests upon correct and careful observations, that the same effect is always observed, all things being equal, to follow the administration of the same medicine. A single example only, is necessary to illustrate this fact. The liver becomes defective in its secreting function; and Calomel, being prescribed, passes into the circulation, and, exciting the whole capillary and glandular system, stimulates the languid pori biliarii, which are supposed to secrete the bile from the blood of the extreme branches of the venæ portarum, and renews their secreting function: Colchicum is then administered, and stimulates the orifices of the common duct; and this excitement extending to the liver and the pancreas, the bile and pancreatic juice flow abundantly, and restore the process of chylification. It is scarcely necessary to add that, the nutrition of the system being improved, the stomach, in common with all the other organs, acquires fresh vigour; whilst the bile, acting as a stimulus to the intestines, restores the peristaltic motion necessary for the due performance of their function.

It only remains to point out the distinction between the physiological and the curative, or therapeutical effects of a medicine. The first are the most important to be understood by the physician, as they depend upon the immutable and constant influence of the active principle of the substance operating upon the organic tissues; whereas the second are modified by a variety of circumstances connected with the state of the body, and the nature of the diseases against which the medicine is employed. To illustrate this by a familiar example:—a solution of Acetate of Ammonia is prescribed to produce perspiration, the patient remains in bed, and the intention of the prescriber is fulfilled: but if, instead of remaining in bed, the patient expose the surface of the body to cool air, no perspiration flows; the action of the kidneys is increased, and the discharge of urine considerably augmented. Under both circumstances, the primary or physiological influence of the medicine is the same; its operation upon the cutaneous capillaries is favoured by external warmth, and continues as long as the surface is kept warm; but, when the body is exposed, the action on the superficial capillaries is immediately transferred to those of the kidneys. Again—the physiological effects of a purgative are an increase of the intestinal secretions, and an acceleration of the vermicular and peristaltic movements of the canal: the therapeutical effects are the improvement of the digestive function, the removal of headache, and of many uneasy feelings which depend on the protracted retention of the fœcal matter in the intestines; and the derivation of blood from the head or the chest, by the

counterirritation exerted on the mucous membrane of the alimentary canal. The physiological phenomena always more or less follow the administration of the drug; the impression is made on the organ, although it may not be adequate to produce the usual or expected result:—the Therapeutical, on the contrary, depend on a variety of circumstances, which may or may not aid the removal of the diseased state for which the medicine is prescribed. The therapeutical efficacy of a medicine, however, may be justly anticipated with more or less certainty by observing the degree of energy which the medicinal agent exerts in its primary action on the organic tissues: to be enabled however to do so, requires the closest observation, unbiased by theory, and investigation unfettered by authority.

The following conclusions may be drawn from the foregoing remarks:—1. That medicines exert no specific influence in curing diseases: thence the terms febrifuge, antispasmodic, antiscorbutic, and such like, are merely conventional, to announce a secondary result consequent upon the appropriate action of some medicinal agent upon the vital solid. 2. That medicines may operate on the general habit by an immediate impression on the stomach and alimentary canal, either in their entire form or in a state of decomposition. 3. That medicines entering the circulation may affect the general constitution of the fluids; and produce changes in their qualities, independent of any chemical influence. 4. That medicines passing into the circulation, and being conveyed to distant parts, either entire or decomposed, may there exert certain peculiar energies: and, in doing so, they seem to possess a power of selection which enables the physician to prescribe one medicine for emptying the stomach, another to expel the contents of the intestines, and a third to bathe the skin with a flood of perspiration: and these effects follow with a degree of regularity sufficient to authorize the prescriber to prognosticate their effects.

SECTION III.

CIRCUMSTANCES MODIFYING THE GENERAL ACTION OF MEDICINES.

MANY and very different circumstances modify the operation of medicines. Some of these are connected with the original conformation of the body; others with the age and the sex of the individual; some with the situation on the face of the globe in which he is placed, as influencing his system by climate,

temperature, diet, and habit; others, again, with the state of society, its customs, superstitions, and even political relations; and, lastly, some with the condition of the mind, temper, and intellectual attainments.

1. ORIGINAL CONFORMATION.

It is justly said that no two men are formed exactly alike. The state of the simple solid varies at birth in the connexion and cohesion of its parts, producing a natural difference in the strength, excitability, and sensibility of the frame; and in its contractility and aptitude for motion under the power of the will. The relative proportion of the parts also varies; but, in the greatest number of instances, the disproportion is not so great and so varied as to cause any very striking diversity of action in individuals. The approximation, however, to the same state, depending upon disproportion of parts, in several individuals, is sufficient to constitute classes; and the correct observation of the influence of this disproportion in producing predisposition to disease, and in modifying the operation of medicines, even in a limited number of instances, may lead us to predicate with confidence its effects, as a general cause of such differences. It is this diversity in original conformation which constitutes *symmetrical peculiarity*, *Constitution*, *Temperament*, and *Idiosyncracy*.

a. Symmetrical peculiarity. Whatever may be the *height* of any individual, there is a standard of relative proportion as far as regards the *head*, *extremities*, and *trunk* of the body to one another, which enables us to compare these parts in different persons, and which produces an immediate and general acknowledgment of their disproportion when that occurs. Sculptors and painters have taken advantage of this feeling, to fix a measure of height, in proportion to the size of the head, which they regard as characteristic of the perfection of the human figure. I shall not stop to examine the accuracy of this standard; it is sufficient for our purpose, that such relative proportions exist, and that certain deviations from these indicate states of the body which render it more or less prone to disease.

Thus the pulse, cæteris paribus, is more frequent in short than in tall persons; yet, such individuals are not more liable to diseases of excitement; on the contrary, the *irritability* is greater in tall than in short persons, and even the upright posture, in tall persons, accelerates the pulse from twelve to twenty beats. It has also been remarked, that men who have suffered from diseases depending upon a full or plethoric state of the vessels of the head, and in whom such diseases have frequently returned, have larger heads and shorter necks, in

proportion to the size of the body, than other men ; and, therefore, the physician ventures to predict a predisposition to similar diseases in all those in whom this disproportion is conspicuous. Now, with regard to the modification which this peculiarity exerts on medicines, administered to such persons, it may be readily supposed, that whatsoever increases the flow of blood to the head will prove injurious.

Dr. Cullen has remarked, from his personal observation, that men of short hands and feet, in proportion to the rest of the body, are liable to a plethoric state of the lungs. It would be extremely difficult, were it necessary, to account for this curious effect of the external conformation of such distant parts upon these important organs: but the knowledge of the fact, and of the influence of many other disproportions—for example, the small capacity of the chest in reference to the rest of the trunk of the body, the flatness of the cranium, and consequent diminished size of the cerebral organ, and natural deformities affecting the distribution and circulation of the blood, in modifying the operation of medicines—is valuable to the physician in regulating his choice of remedies for such individuals.

It is a curious fact, that some of these disproportions, even the most striking, can scarcely be regarded as congenital. Thus dwarfs, who have generally large heads in proportion to the rest of the body, are born of the same size, and display the same relative proportions, as other children ; but, after a few years, when they cease to grow, the head has already acquired the dimensions proportionate to a larger body. But, although these disproportions, be not congenital, yet the same effect is produced upon the constitution of the individuals who display them ; and, consequently, influence the operation of medicines prescribed for their complaints.

With regard to the whole frame, even when there is no disproportion of parts, we find that the natural delicacy and robustness of the body in different individuals of the same age ; that an unusual deposition of fat in the cellular tissue, whether less or more than the ordinary proportion ; and the general shortness or the tallness of the body ; are also circumstances, connected with original conformation, that in a great degree affect the functions of the body ; and, necessarily, the action of the medicinal agents upon it. Thus some persons grow rapidly very tall ; and although there may be no disproportion of parts, yet there is generally great irritability of the nervous system, and debility of the muscular frame, so that impressions, which would scarcely be felt by an individual happily possessed of a well-adjusted constitution, become causes of morbid excitement, of pain, and inordinate action in the giant of premature age ; and he soon dies, exhausted, as it were, by

the common stimulants of life. It is scarcely necessary to affirm, that this state of frame must influence and modify the operation of medicines.

b. Constitution.—External conformation, and the proportion of parts to one another, have undoubtedly a considerable influence in determining the *constitution*, or that original condition of the system, which is peculiar to individuals, and is the cause of the difference of susceptibility to external impressions observed in different persons.

For, whatever may be the cause of nervous energy, men certainly possess it in different degrees—a diversity which produces not only a predisposition to disease, but also tends to modify the operation of medicines. Persons of much nervous sensibility are greatly affected by atmospheric changes: they feel enervated and depressed in humid air, and under a clouded sky; and as much reanimated in serene and cloudless weather. This constitution of body displays itself, also, by the various effects which powerful emotions produce on different individuals. It is recorded of Julius Cæsar, that he was subject to Epilepsy on the eve of a battle; yet, the courage of Cæsar was undoubted; and, therefore, these attacks can only have arisen from over mental excitement of a highly susceptible nervous system. On the same principle, we must account for the fact connected with the constitution of the immortal author of the Novum Organum, Bacon, who, we are informed, fell into syncope every time the moon was past its full. Many men cannot feel the sentiments of joy and admiration without tears immediately starting into their eyes. Dr. Parry states, that he knew a lady, who had long ceased to nurse, in whose breasts a copious secretion of milk was produced at any time by hearing a child cry*. There are persons in whom great surprise always causes a violent vomiting of bile; and it is well known, that libidinous thoughts generate a copious secretion from the mucous membrane of the genital organs in both sexes. This state of the nervous system has even led many men of strong minds to believe in the existence of supernatural beings; and the morbid impressions, thus excited, have sometimes been productive of fatal effects: it is therefore not wonderful that this state of constitution should greatly modify the operation of medicines.

This state of inordinate susceptibility in the nervous system, as it affects the moving fibre, influences, more or less, the circulation of the blood; and, when it is considerable, produces what may be termed a febrile predisposition. The habit of body is thus, as it were, wasted down by the excitement which almost every impression, whether mental or corporeal, pro-

* Elements of Pathology and Therapeutics.

duces upon the nervous system ; " such men be never at heart's ease." On the contrary, the opposite state, or diminished sensibility of the nervous system, favours the deposition of oily matter in the adipose membrane; and the increased bulk and rotundity of the body afford a conspicuous indication of the greater necessity for more stimuli to rouse the energy of the system*. No state of the bodily frame modifies so powerfully the operation of medicines as that which renders the nerves exquisitely susceptible of impression. It is not always, however, the consequence of original conformation ; but it is often the effect of disease ; and, in some instances, it is the most striking characteristic of the malady. In Hydrophobia, the nerves which supply the sensibility of the skin, are in this condition. They are so susceptible of impression, that the least motion of the air, even the breath of another person, is felt on the skin, and becomes a source of acute feeling and of great irritation. In those who possess a morbidly irritable condition of the nerves, not only external agents and powerful mental affections interfere with and modify the operation of medicines, but even volition, here, exerts an extraordinary sway, working either for or against their efficacy, and sometimes completely counteracting their usual effects. Many anecdotes might be detailed to illustrate the controul of the mind over the operation of medicines, in such states of the constitution. A lady was labouring under an affection of the bowels, attended with severe pain and the most obstinate costiveness. She was bled ; the warm bath and fomentations were frequently resorted to ; and purgatives and various anodynes freely administered, but without the least effect upon the bowels, and without either sleep or relief from pain being procured. At length, the physician in attendance was informed that she had expressed her conviction that her usual medical attendant, in the country, alone understood her constitution, and was the only person who could relieve her. This gentleman was accordingly sent for ; and, although no change, either of measures or of medicines, was resorted to, yet, the bowels were quickly moved, sleep and a cessation of pain followed ; and in a few days the patient was convalescent. I have witnessed also frequent illustrations of this influence of mind in modifying the effects of medicines in the treatment of cases of Gonorrhœa, contracted by married men ; and, also, by young men who possess a

* These two opposite states are thus correctly described by our immortal dramatist, in the remarks of Cæsar on the character of Cassius, indicated by his appearance :

" Let me have men about me that are fat,
Sleek-headed men, and such as sleep a-nights :
'Yond Cassius has a lean and hungry look,
He thinks too much ; such men are dangerous."

high feeling of moral rectitude. The anxiety of such persons to be speedily cured, causes a constant direction of the mind to the seat of the disease; a vascular fulness of the mucous membrane, and a state resembling chronic inflammation, are, in consequence, superinduced, which resist the influence of medicines that would readily cure the disease in those in whom it is a matter of less anxiety and little mental reflection. Such are the differences, depending on original conformation, circumstances that are often hereditary, and which produce those states of the body that constitute that peculiar disposition of the frame in every individual which is termed his constitution.

c. Temperament.—Upon the same basis the ancients founded the doctrine of Temperaments; intended to classify those states of the constitution which distinguish certain individuals from others. The name *Temperament*, applied to these states, originated in an hypothetical idea that organized bodies were formed of different elements, so associated together as to *temper* or exactly balance one another—an idea as fanciful, it has been justly observed, as that of the standard of beauty. If, said the ancients, all the elements are in just proportion, the temperament is *perfect*; if disproportioned, but yet compatible with health, it is *mixed;* if disproportioned in a degree incompatible with health, it is *imperfect.* As there is little satisfaction derived from detailing the particulars of a doctrine which depends almost wholly upon conjectural reasoning, I will merely enumerate the external appearances which characterize the four *temperaments* established by the ancients, and which are, in some degree, acknowledged by modern physicians.

1. That temperament which the ancients designated *Sanguine*, is distinguished by the hair being of a pale, chesnut-colour, passing into one or other of the lighter shades of red, soft and uncurled; the eyes blue, lively, and sparkling; the skin smooth, white, moist, and soft; the habit plump, slightly disposed to obesity, and readily perspiring under exercise; the different members of the body are well proportioned, the movements consequently easy; the pulse undulatory and free; and the strength of the body moderate; but, whether this depends on the relative proportion of the fluids exceeding that of the solids, as presumed by Dr. Cullen and others, is uncertain: all the physical functions are performed with facility; the nervous system is highly sensible, the mind acute and cheerful, very susceptible of pleasure, but irritable and unsteady. This temperament is more frequently perceived in women than in men.

2. The *Phlegmatic* temperament is characterized by light or sandy-coloured hair; light-grey eyes; a pallid whiteness of skin, almost free from hairs; small blood-vessels; a weak, slow

pulse; cold surface; and a general defect of energy, both in the animal and physical functions.

3. The *Choleric* temperament is known by the hair being black and curling; the eyes dark; the complexion swarthy, yet somewhat ruddy; the skin thick, rough, and hairy; and the pulse strong and full.

4. The fourth temperament, the *Melancholic* of the ancients, is distinguished by the hair being black, hard, and straight; the eyes dark and deep set; the complexion sallow; the skin coarser than usual, and of a dun hue; and the habit of body hard and meagre; the extremities long in proportion to the trunk of the body; the pulse slow and hard; the gait measured and circumspect; and the strength considerable. In this temperament the mind is slow, cautious, and timid, disposed to gravity, tenacious of all emotions once excited, and, therefore, steady. But, along with steadiness, there are great obstinacy, a continual feeling of inquietude, a suspicious and jealous imagination, and a desire of revenge which never leaves the mind until it is satisfied. This temperament is seen more frequently in men than in women.

As these states actually exist, there can be only one opinion respecting the influence which they are likely to exert in modifying the operation of medicines. Thus, in the *sanguine* and the *choleric* temperaments, as the nervous system is highly susceptible of every impression, and the body predisposed to inflammatory action, stimulating medicines must be prescribed with caution; while, on the contrary, in the *phlegmatic* and *melancholic*, the same class of remedies require to be freely administered, and at a much earlier period in the progress of a disease than is admissible in the opposite temperaments.

d. Idiosyncracy.—In drawing inferences from *Temperament*, in prescribing medicines, it is of great importance to distinguish clearly between temperament and character: the first depends on natural circumstances; the second, not unfrequently, is the result of education or adventitious circumstances. It is, also, requisite not to confound temperament with those congenital peculiarities depending on the original conformation or composition of the frame which occasionally occurs in individuals, and are, therefore, termed *Idiosyncracy**.

Idiosyncracy cannot, like Temperament, be recognized by exterior signs; and can be known to the physician only by an intimate acquaintance with the constitutions of those in whom it occurs. It ought to be discovered by the physician; otherwise the most important and even dangerous results may follow

* From the Greek words ἰδιος, which signifies "peculiar," and συνκραςις, which signifies "composition."

the use of medicines, which, although in general they operate in a manner well known, yet, in peculiar idiosyncracies, produce effects the most opposite to those which might be anticipated.

These peculiarities display themselves in various manners. Sometimes the idiosyncracy exists in the organs of the senses; at others, in the digestive organs. Thus, some individuals cannot touch certain articles without suffering a rigor and having their teeth set on edge. In instances such as these, there is probably some peculiar state of the pulpy pencils, the extremities of the cutaneous nerves, which terminate in the papillæ of the Corium: but what that state is, no dissection can demonstrate: and this is not extraordinary, when we reflect that even the actual manner in which these nerves terminate in the papillæ of the Corium has, hitherto, eluded observation.

The sense of smelling is also sometimes the seat of Idiosyncracy. Thus, some individuals cannot bear the smell of cheese without experiencing nausea and an inclination to vomit: others are affected by severe dyspnœa, or difficulty of breathing, by the odour of Ipecacuanha; and some experience the most distressing effects even from the most agreeable scent of different flowers: whilst, by others, the most offensive smells are preferred to the most delightful.

How far we may regard such examples of Idiosyncracy as connected with Imagination, cannot easily be determined. Rousseau calls smell the sensitive organ of the imagination: and there is much truth in the remark; for, by its means, not only do we receive the most delicate and agreeable impressions, but no sensations are recalled to the mind in so lively a manner as those associated with peculiar odours; and it certainly exercises a powerful influence upon the sensorium commune. It is of importance to know these facts, in order to avoid, in the administration of remedies, the production of effects which may altogether destroy, or at least counteract, the intention for which the medicines are exhibited. The causes of these symptoms are, however, more frequently inherent in the body, than dependent on impressions made on the mind by some external agent.

But Idiosyncracy displays itself most remarkably when certain substances are taken into the stomach. Few things, for example, are more easily digested and less stimulant than white of egg; yet, in some persons, whether it be eaten in its raw and fluid, or its boiled and coagulated state, it causes sickness, or an eruption on the skin similar to nettle-rash. Some wholesome and excellent fruits operate as poisons on some habits, causing syncope, succeeded by a petechial efflorescence of the skin; even coffee or sugar cannot be taken by some persons without vomiting. There are people who can digest beef and the stronger meats easily, but who cannot eat the tenderest

chicken without suffering from indigestion. Numerous instances of a similar kind might be mentioned; but these are sufficient to shew the influence of Idiosyncracy in modifying the effects of the ordinary articles of diet upon the frame; and if such be the case with regard to food, there is, certainly, less reason for wondering that medicines should be equally under its controul.

Other of the vital functions, as well as those of digestion and assimilation, display similar singularities. In some persons the pulse is more regular in disease than in health. I knew an instance in which the pulse was always less frequent in fever than in health: yet the patient was a man seven feet in height, proportionately robust, and of great muscular power. In a state of health, his pulse never exceeded forty-five beats in the minute; and, when he was feverish, it fell to forty. The pulse of Napoleon Bonaparte never exceeded forty-four, in a state of health. Dr. Heberden, in the second volume of the Transactions of the College of Physicians, mentions a woman, of fifty years of age, who had always an intermitting pulse; yet, after her death, an able anatomist could discover nothing unusual either in the structure or the condition of the heart, or of any part of the vascular system.

A question here presents itself—on what do these instances of Idiosyncracy depend? That they are inherent in the constitution is evident; but it is uncertain whether the action of the substances producing the phenomena be immediate upon the nervous system, which, in those persons displaying Idiosyncracy, is supposed to be in a different condition from that in which it is usually found; or whether the substance be received into the blood, and operate secondarily upon the nerves. There can be one opinion only respecting those cases in which the Idiosyncracy is displayed in the organs of touch and of smelling; and, it is probable, that it is the nerves also which are in fault, when the substance is taken into the stomach. This opinion is founded chiefly upon the fact, that the morbid effects have often been immediately removed by clearing the stomach with an emetic, which would not be the case were the offending matter absorbed and carried into the circulation before they are produced.

Another question arises—is it the nerves of sensation only which are affected; or do the nerves of motion, also, share the morbid impression? It is impossible to seek for a reply to this query in any examination of the state of the nerves in the affected part; but a probable hypothesis may be hazarded. If it be admitted, that the nerves of sensation must be, in every instance, primarily excited before the motor nerves can act (that is, that the impression made upon any part must be communicated to the brain before the moving organs of the part

can be called into action), then, whenever there is any unusual condition of the nerves supplying the vital organ, which is directly acted on by the substance producing the effect which constitutes the evidence of the Idiosyncracy—for instance, the stomach, when Rhubarb causes convulsions—it may be also admitted as probable, that the impression made upon the sensitive nerves of that organ, being either too acute, or different in kind from that experienced in the usual condition of the nerves, may become too sensible to the brain. Under these circumstances, therefore, a change may be superinduced upon the organs of volition, very closely resembling that which follows volition, only irregular; and those movements may follow which constitute convulsions or epilepsy. In such cases there is some resemblance to Chorea, in which the movements commence in volition, but become irregular. On the other hand, in that state of nerves existing in some Idiosyncracies, the substances may exert an atonic influence on the sensitive nerves; and this being extended to the general system, swooning may occur. But, as I have already said, this attempted explanation is purely hypothetical.

Whatever may be the true explanation of Idiosyncracy, its power of modifying the operation of Medicines is undoubted, and is confirmed by every day's experience: it is, therefore, of the utmost importance, that the physician, in prescribing a medicine for the first time to any patient with whose habit he is not well acquainted, should endeavour to ascertain what effect it may have produced when previously administered.

2. EFFECTS OF AGE IN MODIFYING THE ACTION OF MEDICINES.

The effects of age upon the form and functions of the animal body are sufficiently striking. In some of the lower animals in particular, the changes that take place cannot be overlooked by the most cursory observer. Thus, the Pea-hen and the hen Pheasant acquire the plumage of the males as they become old. The various states of the human body, also, at different periods of life, display striking characteristic changes, which exert a very considerable power in modifying the operation of medicines. In infancy, the general susceptibility of impression, and the mobility of the frame, are greater than in adult age, as demonstrated by the production of convulsions from the irritation of teething, and the irritation of the bowels by crude or indigestible food. The blood circulates, also, more rapidly in childhood than in the after periods of life, as indicated by the pulse, which is generally forty or fifty beats quicker in the first year of any person's age than at the period of pu-

berty. In the newly born infant, the pulse is usually one hundred and forty in a minute: before the first year is completed, the pulsations at the wrist are seldom less than one hundred and twenty in the same space of time: after the first, and before the termination of the second year, they are reduced to one hundred: between the second and fourth, to ninety-six: and at puberty to seventy.

As the period of puberty advances, the habit of body, in both sexes, undergoes a remarkable change. In the male, the beard appears, the voice becomes more grave, the mind less vacillating, and the whole corporeal functions are performed with greater vigour and constancy. In the female, the menstrual discharge shews itself, the bosom enlarges, consenting with the change in the functions of the uterine organs: the mental character is not less altered than in the male. In both sexes, as soon as the reproductive organs are adequate to their functions, the sexual appetite is awakened, and all the powers of the body and the mind ripen into full perfection.

If we trace life forwards, we find the vigour of the corporeal frame gradually declining after a certain age: the animal heat lessens with the diminished energy of the nervous system: the power of the heart is weakened; the pulse seldom, even in the healthy state, exceeding sixty beats in the minute: many small vessels become impervious, owing to the blood not reaching the capillaries, consequently the surface appears dry and wrinkled: menstruation has already long ceased in the female, and the sexual appetite gradually declines in the male.

In these different periods of life, the same medicines produce very distinct effects. In childhood, when the absorbents act feebly, much larger doses of Calomel can be borne with impunity than in adult age: but, owing to the greater susceptibility of the nervous system, full doses of Narcotics cannot be administered without the greatest caution. In infancy, also, the acescent state of the stomach modifies greatly the action of some medicines, rendering those acrid and severe in their operation, which are mild in other conditions of the digestive organs.

But as it is not, strictly speaking, the age of the patient, so much as the alterations in the state of the system, at the different periods referred to, which influence the operations of medicines, these must be attended to at whatever time they happen. Marks of puberty have, sometimes, displayed themselves at a very early period. Many remarkable instances of this are recorded. Pliny* mentions a boy of Salamis who had attained puberty at four years of age. Craterus is stated to have seen a person whose span of life did not exceed seven

* Hist. Nat. l. vii, c. xvii.

years; nevertheless, in that period he had attained adult age, had been a father, and before death displayed all the marks of old age*. At Willingham, near Cambridge, a boy of the name of Hall died in 1747, in whom all the signs of virility were apparent when he was a year old; and, before he was six years of age, he died with every symptom of advanced age†. Several other instances might be quoted. In the female, also, instances of premature puberty have occurred‡. Menstruation has been known to continue to the seventieth year. In all these instances, either of premature puberty or of a protraction of the menstrual discharge, long beyond its usual period in females, the same rules regulate the operation of medicines as if those conditions of the habit occurred at the ordinary periods: these variations, therefore, must be kept in view, both in prescribing and in reasoning upon the effects of remedies.

EFFECTS OF SEX IN MODIFYING THE ACTION OF MEDICINES.

The differences in external conformation and in the strength of the bodily frame, which distinguishes the sexes, are sufficiently obvious to the most casual observer; but there are, also, functional distinctions less evident. Both are likely to influence the operation of medicines.

In children, the general figure of the body is scarcely distinctive of the sexes; but the distinction becomes more and more obvious as the age of puberty advances; when the muscular, robust figure of the youth is strikingly contrasted with the delicacy, softness, and comparatively diminutive stature of the maiden. In the osseous system, the cylindrical bones of the female are more slender, the flat bones thinner, and all smoother than in the male. In the muscular system, the fibres are paler, less dense, and, consequently, weaker: and, with the exception of the glutei, the psoæ, and a few others, the muscles are proportionably smaller. The skin of the woman is more delicate than that of the man, and whiter, owing to the large quantity of fat deposited beneath it, filling up the interstices between the muscles, and producing that beautiful roundness which is characteristic of the sex. Except on the head, on which the hair is commonly in greater quantity and longer in the woman, the parts of the skin covered with hair in men, are either entirely devoid of this appendage, or less hairy, or covered with a delicate down, in women. The capacity of the abdomen and that of the pelvis is greater; but that of the thorax is less in the woman than in the man.

Such are the chief distinctions in the conformation of the

* Phlegon. de Mirab. c. xxxii. † See Phil. Trans. 1744—5.
‡ Medico-chirurg. Trans. vol. xi. Gall sur les Fonctions du Cerveau, p. 260.

frame in the two sexes. Among the functional differences, we may observe, that the female body is more excitable than the male. The circulation is carried on more rapidly; and the pulse is, cæteris paribus, more frequent in women than in men: the growth of the body is, therefore, in general quicker; puberty and adult age occur earlier; and, when the former arrives, the proportional quantity of blood passing to the abdomen is greater. The nervous system of females is more mobile and susceptible of impression: consequently, they display more sensibility both of body and of mind than men.

But the chief distinction between the sexes is undoubtedly displayed in the functions of the genital organs. In the male, at the age of puberty, the new action taken on by the testes is accompanied by a corresponding change in the whole system: the susceptibility of the nerves is greatly augmented; and this is powerfully excited by the sexual appetite, which is now first awakened. Much of the future condition of the system depends on moderating the influence of this passion: its abuse is soon followed by permanent languor, sometimes by nervous apoplexy. A much more serious consequence, however, results from the excitement of the generative organs without sexual communication: the degree of languor and debility is greater than that which follows the act of coition; the whole nervous system becomes morbidly susceptible of the slightest impression: and a violent paroxysm of mania is a frequent result of the indulgence of this propensity.

In the female constitution, the commencement of the functions of the uterine system produces changes of a magnitude and importance much greater than those connected with puberty in the male. The menstrual discharge, which, in this climate, commences about the fifteenth year of the age of the maiden, is usually preceded by sensations of plethora and fulness in the head, heaviness in the chest, tension in the loins, and lassitude of the limbs. After it has taken place, and is fairly established, the energies both of the body and the mind seem to have received a fresh impulse: the eyes brighten and swell with moisture; the cheek is spread with a fresher bloom; the voice is more harmonious; the hips and breasts expand and enlarge; the movements and attitudes of the young female become more graceful; her mind ceases to engage in childish pursuits; and, as in the youth, those desires are awakened which have been implanted in our nature for the continuance and increase of the species.

The effect of impregnation on the other functions of the female system are still more striking. The blood is sent in greater proportion than usual to the mammæ and the uterus. At this time, also, the vascular system of the female takes on an inflammatory or febrile action; the blood, when drawn

from the veins, displays that appearance, characteristic of inflammation, which is called the buffy coat; the stomach becomes highly irritable; the countenance appears altered; the eyes seem larger, the mouth wider; and every feature is sharpened. Giddiness, dimness of vision, palpitations of the heart, vomitings, great inquietude, and, occasionally, convulsions, are the symptoms indicating the increased nervous susceptibility of the whole frame. Even the temper is so often changed, that the gentlest, the most amiable of the sex become impatient and irrascible, to a degree sometimes almost bordering on Insanity, which, in those hereditarily disposed to it, is easily roused, in this condition of the female system. After parturition has taken place, and the womb, having relieved itself of its burden, has returned to its ordinary condition, the secretion and excretion of milk maintain a state of the habit considerably different from that which is natural to the female who is not performing the duties of a mother.

It is necessary to examine in what manner those conditions of the habit, depending on sex, exert a powerful influence in modifying the operation of medicines. In a youth just arrived at the age of puberty, when the nerves vibrate to every impression, and the blood circulates with an almost febrile rapidity; when the muscles are strung, as it were, to their utmost tensity, and the mind is elevated to the highest pitch of enjoyment; if any thing occur to bring on disease, medicines will produce effects different from those that follow their administration in another condition of the body. In prescribing, therefore, even for a male patient, at this period of life, the influence of sex in modifying the operation of medicines is not to be overlooked.

In the female, whatever may be the cause of that periodical determination of blood to the uterus which is termed menstruation, or whatever may be its ultimate intention, its presence, or its absence, produces a very considerable difference in the operation of the same kind of medicines. In pregnancy, also, the remedies which relieve diseases in females who are not pregnant, cannot always be employed with safety. In the unimpregnated female, the irritable state of the stomach, which is accompanied with heartburn and vomiting, may be judiciously managed with sedatives; such, for instance, as the Hydrocyanate of Potassa; but, in the pregnant state, as this salt, when given to the mother, has been detected in the fœtus, much injury may accrue to the unborn infant from its administration. Opium, also, when given in large doses, if frequently repeated, for the relief of cramps or inquietude in the mother, is ultimately injurious to the fœtus. To the mother, also, these medicines may prove hurtful, from their action being modified by the disturbed state of the functions of the brain, which so often occurs

during the period of pregnancy. For the same reason, some stimulants which may prove highly beneficial in palsy, in the ordinary state of the body, often increase the complaint, and even tend to produce a fatal termination of that affection, in the pregnant female. Indeed, no violent medicines can be safely prescribed for a pregnant female.

In the nursing female, the course of the circulation is different from that in the virgin and in the woman who is not nursing. The blood is sent to the breasts in much larger quantity in a given period; the uterine functions are suspended; menstruation rarely occurs; and impregnation seldom takes place at this time. As the breasts also become excretory organs in this condition of the habit, the exhalant function of the skin, and the excretory of the kidneys, are necessarily greatly diminished; whilst the absorbents act more powerfully: and thence, the female who has an abundant supply of milk, becomes thin in the direct ratio of the quantity. In this state, those medicines, which, in females who are not suckling, pass into the circulation, and are thrown out of it by the kidneys, are found in the urine in much less quantity than usual; and, therefore, it has been presumed that they are excreted by the mammæ, and *might* be detected in the milk. That odorous substances enter the milk, is well known by the peculiar smell and flavour communicated to it, in the cow who is fed upon decaying turnip-tops and grains; but, as I have already said, I am not aware of any experiments that have detected in the milk, either *Alkalies*, or *Rhubarb*, or *Iodine*, or any other substances, the presence of which has been detected in the urine; nevertheless, it is not impossible that they may be found in the milk after they have been taken into the stomach of a nurse; and, therefore, some caution is required in prescribing, for nursing females, medicines that are of a nature likely to injure the health of the child, in the event of their being absorbed and carried into the circulation of the mother. Were the medicines numerous which are thus absorbed and excreted by the mammæ, an easy and safe method of acting upon the infantile system, in many diseases, would be afforded.

EFFECTS OF CUSTOM IN MODIFYING THE ACTION OF MEDICINES.

Nothing is more remarkable than the influence of *Habit* or *Custom* over both the *mental* and the *corporeal* functions in man: its controul over the action of medicinal substances is not less wonderful, and, therefore, it is necessary to examine the manner in which it operates.

If the vital principle be not simply a quality of matter, there can be no doubt of the distinct existence of the *Soul* or *Mind*—

an essence which exists independent of organism, which, in every form and state of the body, in deformity, in defectiveness of parts, in disease, in age, in the almost total wreck of the corporeal frame, displays itself entire and unimpaired, triumphing over the frailties of our grosser nature. But in admitting this truth, we must also admit that the mind is so intimately connected with the animal functions—those of the *brain*, of the *spinal cord*, and the *nerves*—that, without these parts of the frame, it has never displayed its energies, and every *idea* is thence necessarily preceded by and dependent upon some corporeal change; nevertheless, the immediate cause of the *idea* thus excited is, in every instance, an affection of the immaterial mind. The nerves are the media of connection between the mind and the exterior world. Stimulants applied to the body produce, by the impressions which they make upon the nerves, certain effects which the mind perceives or takes cognizance of; and thus it becomes furnished with *ideas*. As these impressions, however, are not all alike, either as regards intensity or kind, *Memory*, or the principle of previous association, operates to retain and recall the marks of those already perceived, and *Judgment* to compare and examine their relations with those which are new or are to come. By means of these two faculties of the mind, therefore, man becomes fully acquainted with the external world, and exerts his influence over it. Now, it might be supposed that as long as the organs of the *senses* and the mental faculties remain entire, Reason could not err in deciding upon the evident qualities of objects of sense, those in particular which we perceive by *touch* —as, for example, *figure*, and whether a body be *hot* or *cold;* or those which we examine by our muscular frame—*hardness*, *softness*, and *ponderosity*. But even over this decision, habit exercises a powerful controul, and often leads us to pass a judgment contrary to the conviction of our senses. This influence of habit upon the judgment modifies the operation of medicines, occasioning frequent disappointments to the physician, who, nevertheless, may sometimes take advantage of it for the benefit of his patient.

The immediate controul of habit over the body is still more evident than its influence through the medium of the mind. Its power in diminishing the sensibility of the nervous system has been frequently observed; and it is well illustrated by a fact mentioned by Boerhaave, that when Hungary water was much in vogue, many women in Holland lost their sense of smell by the too great use of this water. But it is more difficult to explain how the vital or organic sensations, those which, in the ordinary condition of the healthy body, are independent of the will; namely, the circulation of the *blood*, *respiration*, the evolution of animal heat or *calorification*, *digestion*, *nutrition*, and *absorption;* are

influenced by habit: but the fact is undoubted. In an individual who is unaccustomed to take *exercise*, the circulation is quickened by every slight exertion; but, if the person daily exercise himself, this effect ceases to follow even a much greater effort. In respect to the respiration, the power which pearl divers possess of remaining under water is truly astonishing. No man who has not been trained to diving can live under water, when the respiration is completely suspended, for more than half a minute, unless fainting have previously taken place, in which case the submersion can be sustained for upwards of a minute with impunity. The power of remaining two or three minutes under water is, nevertheless, frequently acquired by the oldest divers, in the bay of Naples, and proves in a remarkable degree the influence of habit. We have also daily instances of the high temperature which the body can acquire the power of supporting. Not to mention the individuals who have occasionally exhibited themselves, we may refer to the writings of Du Hamel, who mentions, among other instances, that the young female servant of a baker at Rochefoucault had acquired the habit of resisting heat so effectually, as to go into an oven heated at 276°, and to remain in it for twelve minutes. In general, the hot bath cannot be borne at a higher temperature than 106°; but the Russian, who is in the daily habit of using it, can support it at 116°; and when a vapor is employed instead of water, habit enables the Russian to bear it as high as 160°. The same power enables cold to be sustained without danger. Thus, we see women of the most delicate frame, with the shoulders and chest exposed in a manner that could not be borne without great risk by the strongest men unaccustomed to it. The male peasants in the north of Europe go with their bosoms bare in the coldest winter weather; and the companions of Captain Parry in his voyage to the North Pole, after some time, used to walk on the shore when the thermometer was 49 degrees below Zero. With regard to digestion—the Siamese are fond of rotten eggs, and digest them readily; although I need scarcely say, that nothing would be so likely to disorder the stomach of any one who has not acquired the habit of relishing such food. In this manner we might trace the influence of habit over every vital function.

In modifying the direct effects of medicinal agents upon the body, the power of *habit* is equally conspicuous. If the same medicine be daily administered for some time, instead of being followed by the result which at first displayed itself, the system remains unsusceptible of its impression; and yet, the properties of the medicine remain unimpaired, and the condition of the parts upon which it acts remains also unchanged. This is rendered evident by substances applied to any other part; for example, the substance which has ceased to act on the stomach

will still operate briskly if administered as an Enema; and it will not require a larger dose of Arsenic to destroy an opium-eater than any other person. But even poisons are rendered inert, if their administration be carefully regulated, by commencing with small doses, and daily augmenting them, watching their effect, lest the increase should be too rapid. Many persons have thus brought themselves to swallow Opium in large quantities without feeling its narcotic effects. I have known instances in which two drachms of solid Opium, or five fluid ounces of Laudanum, have been taken in twenty-four hours; yet the same individuals could not have swallowed many grains of it without danger when they commenced the baneful use of the drug. In this same manner, habit renders the nerves of smelling callous to some odours, while they retain the greatest susceptibility to others. Thus, Baron Haller was not at all affected by the stench of a dissecting room, yet he was peculiarly sensitive in distinguishing, even at a distance, a fœtid perspiration, when it was scarcely sensible to any other person. If we attempt to account for the effect of habit in the instances just described, by saying that the repeated application of the same stimulus to the body diminishes its power on the sentient extremities of the nerves, owing to these retaining for a certain time the change which the impression of the stimulus produces—and, therefore, the application of the same substance, unless in greater quantity, becomes incapable of altering this condition, but rather confirms it—thence the repetition of the impression will ultimately cease to produce any effect, even in degree—what do we say more than merely state the fact? We do not advance one step in raising the veil which obscures the cause from our perceptions. The knowledge of the simple fact, however, is sufficient for our purpose: it convinces us of the power of *habit* in modifying the operation of medicines, independent of the mind; and demonstrates the necessity of enquiring into the habits of a patient previously to prescribing any medicine from which much is to be expected. Thus, if a person, who is in the habit of taking Opium in large quantities, is labouring under a disease in which pain and watchfulness are symptoms, although it would be useless to prescribe Opium, yet the indication might be answered by a moderate dose of another narcotic. Illustrations of this fact more frequently come under the observation of the physician in reference to purgatives and some other classes of remedies than to narcotics. In persons, for example, who are in the custom of taking pills composed of Colocynth and Aloes, or similar articles, the largest doses of these purgatives occasionally fail, under disease, to produce the action of the bowels; whilst a dessert spoonful of Castor Oil, or a teacupful of sea water, will produce copious and numerous evacuations.

In stating these facts, it must also be mentioned that habit does not always lessen the susceptibility of impression to the same stimulus; for this results from those stimuli only, with the exception of a few, the action of which falls short of inflammation. A man may take a large quantity of diluted Alcohol, day after day augmenting the quantity, and yet scarcely feel its effects; but one glass of pure Alcohol would produce inflammation in the stomach, which would be farther increased by a repetition of one tenth of the original dose. No habit can reconcile the body to impressions which at first produce a state of disease.

I have said that some stimuli, the operation of which falls short of actual inflammation, are exceptions to the general rule, and, instead of producing a diminished effect by repetition, have their influence augmented. This augmentation of effect, however, is extremely irregularly displayed: a fact which is well illustrated by the administration of large doses of Tartar emetic. It is, also, demonstrated in another manner during the use of Castor Oil. After this medicine has been taken for some days regularly, in the full dose, the quantity may be gradually diminished without impairing its effects, until, from six drachms, the dose is decreased to as many minims. In prescribing Castor Oil, therefore, in cases of habitual costiveness, we must ascertain whether the patient have been in the habit of taking the medicine; as the dose which would, in ordinary cases, be a very moderate one, might, in the instance of a person habituated to the use of the medicine, prove of serious disadvantage.

On account of the influence of habit, it is often necessary to suspend for a short period the use of a medicine; so that, when it is again employed, the impression may be renewed with sufficient energy.

INFLUENCE OF CLIMATE IN MODIFYING THE ACTION OF MEDICINES.

The influence of climate, in modifying the action of medicines, operates in two ways:—1. By the change which climate causes in the animal frame: 2. By the changes which it occasions in medicinal agents of a vegetable origin.

1. *Effects of climate on the animal body.*—Man is the only animal that can live in every climate: but, although he can live, yet changes are effected on his frame and constitution of the most striking kind, by removal from one part of the globe to another part; and these are not temporary, but are continued through many generations, constituting the varieties of the human race. In employing the term *varieties*, it is right to men-

tion, that naturalists are divided upon this question. Some, among whom is the justly celebrated Buffon, make one species only of man; others maintain that there are several species; whilst a third set, steering a middle course, suppose that, although there be not distinct species, as of the lower animals, yet, that there are distinct *races*. The most celebrated of modern naturalists, M. Cuvier, maintains the last of these opinions: indeed, every fact in the history of mankind, with which I am acquainted, tends to confirm the belief, that *man is of one species*, and that the *whole* of the human genus is descended from the *same original parents*. The proof of this may be deduced from the agreement of the traditions of almost all countries concerning the birth place of the first parents of our species. Moses fixes it in the south of Asia; the Hindoo traditions state that their progenitors came from the north-west; the Scandinavian, that theirs travelled from the south-east; and the Chinese assert that their ancestors came from the west; all concurring to fix on the spot pointed at in the Mosaic writings.

It might be very plausibly asserted, that man came perfect from the hand of his Creator; and that the *races* and *varieties* of the species are the result of various causes operating a *degeneration*, or *deviation* from the original standard. Before proceeding, it is proper that the meaning of the words *race* and *variety* should be clearly understood. *Kant*, the German Metaphysician, regards the term *race*, as strictly applicable only to a character produced by degeneration, and such as to become, by propagation, necessarily and inevitably *hereditary;* as, for instance, the sexual intercourse of a *white* man with a *Negro* woman produces a distinct race, the *Mulatto:* on the contrary, the term *variety* is applicable to such variations as occur when *fair* individuals, connected with *brunettes*, propagate *dark-eyed* children. When *races* have been continued through a long series of generations, they almost acquire the fixed characteristics of distinct species; and it is this which has involved the question of the human family in so much obscurity. The cause of the degeneration, spoken of, are chiefly *climate*, *food*, and the *modes of life* of associated mankind. Thus, if the tall and symmetrical *Georgian* be transported to the *Arctic* circle, in a series of generations his progeny would dwindle into the diminutive and stunted *Esquimaux;* in the same manner as the noble tree, spreading forth its luxuriant branches in the valley, appears of dwarfish stature and little more than a shrub when its seed, carried by the wind, or from other accidents, vegetates on the heights of the mountain. The proofs which support the opinion of the mono-species of mankind, besides being derived from Scriptural History, are supported on the physiological characters common to all the races; on the facility with which these pass into one another; on the power of the mixed progeny of

any two of the races to propagate; and on the diversities of the races being in all respects analogous to those deviations from a common type which mark varieties in the progeny of a single race. It is, nevertheless, probable, that the changes which constitute the races are not altogether accidental; but that there is, as Dr. Prichard remarks, "an *intentional* relation to climate in the distribution of the different races." It is in the form of the head or skull, that these distinctions are chiefly observable: thus, the great breadth of the head in the Asiatics, compared with the narrow flattened head of the Negro, and the oval skull of the European, is obvious to the most cursory observer; and upon this feature, some philosophers have attempted to arrange all the races of the human species. Blumenbach, following Lacepede, makes five distinct *races*, the limits of each of which can be easily traced upon the map of the world. Two of these races, however, may be regarded as varieties of the other three: in noticing them, I will not enter into the peculiarities that distinguish each, beyond a general outline.

1. The *Caucasian*—named from Mount Caucasus, in the neighbourhood of which the Georgians and Circassians, the finest races of man, are found—is distinguished by the skin being white and the cheeks florid; the hair long, soft, and undulating, varying in colour, from a nut-brown to the deepest black; the head nearly globular, with the forehead moderately expanded; the cheek bones narrow; and the front teeth of each jaw placed perpendicularly; the face oval; the nose narrow and prominent; the mouth small; the lower lip turned out, and the chin round. This variety is supposed to be the standard of the human race; and some authors have devised means of determining its perfection. It comprehends all Europeans, except the Laplanders and the Finnish race, takes in the western Asiatics as far as the Obi, the Caspian sea, and the river Ganges, and the people of the north or Mediterranean coast of Africa.

2. The *Mongolian*—or Tartarian, marked by the skin being pale olive; the hair thin, black, stiff, and straight: the head square; the cheek-bones prominent; the eyes far apart, the eyelids half closed and apparently tumid, with the arch of the eyebrow scarcely perceptible; the osseous nostrils narrow, and the chin somewhat projecting; the face broad and flattened; the cheek projected outward and nearly globular; and the nose small and flat.

This race embraces the remaining Asiatics, except the Malays; it includes the Finnish races of the north of Europe; the Laplanders and the Esquimaux.

3. The *Æthiopian*—distinguished by the skin being brown, black, and yellow, and the hair black and crisp. The head is compressed laterally; the forehead arched; the cheek-bones

projecting, and the nostrils dilated; the malar fossa, behind the infra-orbitar foramen, deep; the jaws are lengthened forwards; and the front teeth obliquely prominent, with the lower jaw large and strong. The cranium is thick and heavy, and comparatively less capacious than that of the Caucasian race, as its cavity will not hold so much fluid as that of the skull of an European, by from four to nine fluid ounces. Thence it is maintained that the intellectual faculties of the African are less than those of the European, in proportion to the capacity of the brain; but such an opinion is not tenable. The face is narrow and projecting at its lower part; the eyes are prominent; the nose is broad and flat: the lips, particularly the upper, are thick; the chin is receding; and the facial line differs greatly from that of the Caucasian.

This race is spread over the whole of Africa, with the exception of the northern shores.

4. The *American*.—The skin in this race is of reddish-tan, or copper-colour; and the hair thin, black, stiff, and straight. The forehead is short; the cheek-bones are broad, arched, and round; the orbits are deep; and the cranium is light; the face is broad, with distinctly marked prominent cheeks; the eyes are deep-seated; and the nose is only moderately projecting.

It comprehends the Indians of the whole of the continent of America, except that portion which is occupied by the Esquimaux.

5. The *Malay*—is distinguished by the skin being tawny, or a clear mahogany, or chesnut-brown; by the hair being black, soft, curled, and very abundant. The head is somewhat narrow; the forehead slightly arched: the parietal bones more prominent; those of the cheek flat; and the upper jaws projecting; the face is broader than that of the Æthiopian, but the features viewed in profile are more distinct; the nose is full, broad, and knobbed at its point; and the mouth large.

It embraces the inhabitants of the whole of the islands of the Pacific ocean, of the Marian, Phillipine, Molucca and Sunda Isles, and of the peninsula of Malacca*.

This division of the Human Species into five Races, is ingenious, but it is liable to exceptions. The different varieties run so insensibly into one another, that it is impossible to mark out the exact boundaries of the commencement or the termination of any of them. I cannot avoid quoting a striking remark upon this subject from the works of Drs. Martius and Spix on the Brazils. "The physiognomy of the Chinese colonists was particularly interesting to us," observe these gentlemen in

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* Cuvier acknowledges three races only: the *white*, or Caucasian; the *Negro*, or Æthiopic; and the *yellow*, or Mongolian. I prefer the division of Blumenbach.

their account of Rio Janiero; "and was in the sequel still more so, because we thought we could perceive in them the fundamental lines, which are remarked in the Indians." These they describe, and then add, "In comparing the Mongol physiognomy with the American, the observer has opportunity enough to find traces of the series of developments through which the Eastern Asiatics had to pass, under the influence of the climate, in order, at length, to be transformed into an American." Indeed, to the attentive observer, in any part of the world, the characteristics of several of the races are often found in the same individual. There are many Europeans who closely resemble the African or the Mongol, in every respect except colour: nor is this resemblance of individuals of one race to other races peculiar to countries in which opportunities for mixing and crossing breeds exist; but it is observed also in those parts of the globe which are cut off, as it were, from all the rest of the world. Captain Cook, in his voyage round the globe, saw many nations of the Friendly Islands, who are of the Malayan race, with complete European faces; and some even with Roman noses.

These varieties are regarded as the effect of climate; by which is not implied merely the geographical locality in reference to the latitude on the surface of the globe, but the elevation also of that locality above the mean level of the surface of the earth. Temperature, in this respect, operates almost as powerfully as it does in the relative position of a spot as far as regards its proximity to the equator. The inhabitants of a region elevated a thousand feet above the level of the sea live in a very different climate from those who inhabit its margin; although both places may be in the same degree of latitude. Temperature, therefore, arising from the direct and the radiated beams of the sun, influenced by *latitude* and *altitude*, constitute climate. We feel all the varied degrees of temperature in passing from the equator to the pole; and we feel them also in ascending from the valley to the summit of a lofty mountain. It may be proper to state here, that the heat or coldness of a climate is generally determined by taking the mean annual temperature, not merely as displayed by the thermometer, but by the temperature of deep lakes, which is considered as indicating nearly the mean annual temperature of the latitude in which they are found. According to tables constructed by Mr. Kirwan, the mean annual temperature at the equator is 84° of Fahrenheit, that at the poles 31°, and that of London 52°; but the mean annual temperature is varied by many circumstances, such as vicinity to the sea, the elevation of the land, and culture; and thence the mean annual temperature of places, in the same latitude, differs. Thus, for example, New York, in

North America, is in the same latitude as Lisbon; but its mean annual temperature corresponds to that of the North of Germany.

It is not easy to determine upon what other local circumstances those alterations, of which I have spoken in the human body, as produced by climate, depend: yet it is not altogether upon the temperature, even as far as colour is concerned; for many facts may be brought forward to prove, that, after a considerable lapse of years, men who have migrated from the temperate regions of the earth to intertropical climates, have not become of so dark a hue as the natives of these countries. A race of Jews, which is known on the coast of Malabar by the name of white Jews, and who, from documents in their possession, appear to have emigrated to India soon after the destruction of the Temple of Jerusalem by Titus, in the year 490, still resemble European Jews in features and in complexion.

With respect to the influence of either casual or permanent varieties of the species on the operation of medicines, there can be no doubt. The slender and delicate Hindoo, who lives entirely on vegetable food; the Esquimaux, who gorges himself with the flesh of the seal or the blubber of the whale, until he is unable to move; the Otomac of South America, who, during the period of the inundations, appeases his hunger with unctuous clay; and the English yeoman, who satisfies himself daily with beef and porter, to his heart's content; will all be variously affected by the same medicines. But climate, independent of these variations, effects a change of the constitution of the same individual, and thus, also, influences the operation of medicines.

Dr. Davy, in his travels in Ceylon, states, from his personal observation, that, on first landing in a tropical climate, the standard heat of the body of a European is raised two or three degrees; and febrile symptoms occur, which require temperance, the avoiding every cause of excitement of the vascular system, and the use of aperient medicines. All authors, and indeed every observing person who has visited the torrid zone, agree that, along with the languor and exhaustion resulting from the high temperature of the atmosphere, there is a greatly increased mobility of the nervous system. The action of the cutaneous vessels in Europeans, who visit equatorial countries, amounts to disease, and produces that eczematous or vesicular eruption of the skin, known by the name of prickly heat. On the other hand, this function of the skin is so much weakened, almost paralyzed, when the climate from which a person is passing is dry and bracing, and that into which he has passed is humid and relaxing, that congestions of the blood take place in the larger vessels; the body becomes susceptible of the least

impression of marshy exhalations ; and agues and similar diseases are produced.

It may be also mentioned, that the diseases of the Torrid Zone are those of *irritability* and *sensibility ;* the diseases of the Frigid Zone are the reverse, arising from the deficiency of the stimulus of external heat, and a lack of *excitement* in the whole system. In this state of habit, the powers of the stomach are impaired ; and, therefore, stimulants are taken with impunity. In the Torrid Zone, also, or countries bordering upon it, the peculiar currents of the air greatly affect the human system. Thus, the sirocco, the wind which blows from the great Sahara or African desert, seems to leave behind it a portion of the *oxygen* of the atmosphere ; for, during the blowing of that wind, in Egypt, and even in Italy, fires do not burn well, the breathing of animals is oppressed, vegetation languishes, and so much debility is caused in man that, during its continuance, the use of sedatives is absolutely prohibited.

Although man is the only animal who can live with impunity in every climate, yet this refers only to the adult, who has been nurtured to manhood in the climate peculiar to his variety of the species : his progeny, when he removes to another climate, may fall victims of the removal. Thus, the children of European parents, born in intertropical climates, seldom live to attain adult age if they remain in the country ; although, when one of the parents is a native, they do not suffer. I cannot avoid noticing, in this place, a curious fact recorded by Volney, the elegant historian of Egypt, that neither the Mamlouks, who were a *Caucasian* race, nor the *Turks*, who are Mongolians, unless they married native women, which the Mamlouks never did, could continue their race in Egypt ; all their offspring perishing in the first or second generation.

The effect of climate on the progeny of those who migrate to distant countries is well illustrated by many instances affecting our own countrymen. Thus, the Creoles of the West Indies, the inhabitants of the United States of America, and the settlers in New Holland and Van Dieman's Land, are all derived from the same English stock, and yet all their progeny differ from it in some particular feature. The *Virginian* and the man of *Carolina* are tall, lank, and gaunt ; the West Indian Creole is distinguished by a singular configuration of skull ; and, in New South Wales and Van Dieman's Land, the children of even diminutive European parents grow up tall and spare ; and, nevertheless, the natives are a short race of mankind. In moist climates, obesity and laxity of frame are induced—a fact which was very early observed. The effect of situation upon the state of the habit may, in some degree, depend also on the gravity or weight of the atmosphere, connected

with locality. When the barometer is high, we feel vigorous and cheerful; when it sinks, languor and low spirits oppress us. Asthmatics on this account, sometimes, breathe with more freedom in a dense atmosphere, and, therefore, they find comfort near the sea.

Seeing the influence of climate in producing such alterations as those I have described on the aspect and habits of the human species, it will be easy to form an idea of the power which it is likely to exert in modifying the operation of medicines. The late Dr. Harrison found that *Narcotics* act with greater force, even in smaller doses, at Naples than in England. He instances the Extract of Henbane, which, in doses of three grains, thrice a day, in Naples, produced a temporary *amaurosis* or *nervous blindness*, that disappeared and recurred on the alternate suspension and administration of the medicine. This effect of the Extract was observed in two patients, who had often taken similar doses of the same remedy in England, without any unpleasant result—an effect which Dr. Harrison correctly refers to the increased nervous susceptibility of impression of the patients, in the warmer climate; for there was no difference in the extract;—that which was administered in Italy having been procured from London. Dr. Harrison found, also, that Nitrate of Silver and Nitrate of Mercury are more active in Italy than in England; and that, in general, the doses of medicines ordered in this country, are too large for the climate of Italy. It does not, however, always follow that the doses of medicines require to be reduced in warm climates: on the contrary, in India, a scruple of Calomel and a grain of Opium are frequently administered, and repeated at short intervals, after depletion in dysentery; but few physicians would venture to prescribe this active remedy, in such large doses, in this climate.

But even the state of the weather and the season of the year will, sometimes, alter the action of a medicine, in the same country. Thus, Mr. Annesley, in his work on the Diseases of India, informs us that, in the subsidiary fever of Nagpore, the Cinchona Bark, although the grand remedy in the cold season, yet generally fails in the rainy season; at which time Calomel and Antimony prove beneficial.

The neglect of observing the effects of the influence of climate in modifying the action of medicines has led to many of the discordant accounts of remedies by different writers, and the rejection of many valuable medicines. Many medicines, also, have been unjustly depreciated from having been administered at improper seasons of the year, or from no allowance having been made for the power of local circumstances over their action in the animal œconomy. In treating of the different articles of the Materia Medica, I shall have frequent opportunities of illustrating the truth of this remark. In pre-

scribing for those who have lately arrived in a country of an opposite climate to that from which they have come, and who have not had time to be naturalized to it, the knowledge of the above-mentioned facts will be found useful. Thus, in the case of a person who has arrived in a hot from a cold climate, the susceptibility of impression being greatly augmented, the habit acquires a febrile tendency, and will not admit of the same doses of stimulant medicines that may be given with advantage to natives of the place, and to those accustomed, from long residence, to the climate.

2. *Effects of Climate upon the medicinal properties of plants.*— It is supposed by Dr. Prichard "that the vegetable creation was originally divided into a number of different provinces. Each country, perhaps each chain of mountains, had its peculiar tribes of plants, which at first existed not elsewhere;" and that from these, as from a centre, each kind spread in various directions over the surface of the globe. There is much ingenuity in this supposition; but, as the same plants are, also, found in very distant countries, in the same latitudes, it is as probable that they were originally scattered over the globe, in bands within certain latitudes, adapted by temperature to their nature, and by soil to their nourishment. Some plants, indeed, have an entirely isolated and local existence; being found naturally on some particular spot and never elsewhere. In whatever manner they were originally disposed, or have been since naturally diffused, man, endeavouring to bend Nature to his controul, has naturalised plants to climates very opposite to those in which they were originally found. In this attempt, however, plants, like animals, feel the influence of climate; and, consequently, medicines of a vegetable origin have their active powers more or less changed, if removed from the spots where Nature had planted them, to be cultivated in foreign soils. This is, indeed, an almost insurmountable obstacle to the naturalization here of medicinal plants of latitudes greatly different from that of England. In general, the virtues of the plants are diminished, if not totally destroyed, by the transportation.

The effect of climate upon the medicinal properties of plants is strikingly illustrated in the history of the Meadow Saffron, Colchicum *Autumnale*. In England and many other countries, the Colchicum always contains an acrid, alkaline, bitter principle, *Veratria*, of great importance as a remedy, and a virulent poison when overdosed. At some seasons of the year, the bulb of the Colchicum, in this country, is more active than at other seasons; but, during the whole year, it contains a sufficient portion of medicinal principle to render it a very hurtful substance if eaten as food: yet in other parts of the globe it may be eaten with impunity at some seasons. Kreterhvill, a German author, in his work "de Colchico," relates instances in which entire

bulbs were eaten without any bad effect being produced on the habit. Krapf, another German writer, says that he has eaten the bulb with impunity in autumn, and that it is then eaten in Carniola and Istria: yet autumn is the period of the year when the bulb is most active in this country. The celebrated Haller, also, avers that it is both tasteless and inert in autumn. Now, to what are we to ascribe those peculiarities in the Colchicum of the countries in which these writers lived, except to climate and local circumstances? For the same reason, Senna transported from Upper Egypt and grown in the South of France, varies both in the external characters of the leaf and in its purgative properties: the leaves are more obtuse, less bitter and less nauseous when chewed, and much less purgative than the Egyptian Senna. The tree named Myrospermum *Frutescens*, when it grows in New Grenada, yields *Balsam of Toulu;* but when it grows in Peru, it yields a very different Balsamic substance; which, from the place of its production, has been named *Balsam of Peru.* I may also mention that Mint, and many other plants which yield an essential oil, afford it of a much less penetrating odour in the South of Europe than in England: and, it is a curious fact, that almost all strong smelling plants lose their odours in a sandy soil.

From these facts, it is obvious that the nature of the climate in which medicinal plants are cultivated should be known. Indeed, so very important is it that medicines should always be as nearly as possible the same, that a medicine coming from any other part of the world than that from which it was originally obtained, ought not to be trusted in the cure of diseases, until a set of comparative experiments have determined its affinity in every respect to the original drug.

3. *Cultivation* has a close resemblance to climate in its effect upon the medicinal properties of plants. Few plants which are medicinal, admit of cultivation, although edible vegetables are greatly improved by it. In the cultivation of edible plants, the object is to increase the proportion of feculent and farinaceous matter in roots, in tubers, and in bulbs; and, consequently, if any acrid or active principle which they may contain be not proportionably augmented, the same weight of the root, tuber, or bulb, must necessarily be less active, in the direct ratio of the diminution of the quantity of the medicinal principle in proportion to the farinaceous part. Another object of the horticulturist is to convert the simple flowers of nature into the more showy inhabitants of the parterre by doubling them, as it is termed; that is, converting the generative organs into petals; or, in compound flowers, the disk or tubular florets into what are termed ligulate. In this manner the Chamomile, Anthemis *nobilis*, is often doubled; but as the medicinal virtue resides chiefly in the disc florets, the conversion of the natural

flower into the double variety greatly deteriorates the strength of the remedy.

Besides the modifications in the properties of medicinal plants produced by climate and culture, other circumstances contribute to vary or alter their powers. Thus many medicinal plants do not acquire their active qualities until they have attained what may be termed adult age: even poisonous plants may be eaten with impunity when they are young: some, again, have their active principles suddenly developed at a fixed period of their existence: the Lettuce, for example, when merely in leaf, possesses scarcely any of the narcotic principle which constitutes the Lactucarium of the Pharmacopœias, although it is abundantly secreted at the flowering season. In the Poppy the narcotic principle is scarcely apparent until the petals fall and the germen enlarges. The soil also, its dryness or its moisture, the degree of exposure of the plant to heat, light, and air, all contribute to modify its medicinal qualites; and thence it happens that plants collected in one year may display great activity, whilst in the next they may appear almost inert. A plant which grows naturally in a dry or an absorbent soil, is generally less active when it is found growing in a humid or a marshy situation: another, which is the ordinary inhabitant of an exposed spot, and requires the invigorating influence of the stimulus of much light, heat and air, languishes and loses its medicinal virtues when it rises accidentally in the forest; whilst others, again, only acquire them in the shade. It is, indeed, these circumstances, in a great measure, which distinguish climates, and which augment the remedial properties of vegetable bodies that owe their activity to volatile oil, resins, and the balsams. The knowledge of these facts is of great importance to the collectors of medicinal plants; who should be able to determine the period in the life of a plant, the nature of the soil, and the degree of exposure, and the season of the year most favourable to the development of it active properties.

INFLUENCE OF MENTAL AFFECTIONS IN MODIFYING THE ACTION OF MEDICINES.

In examining the influence of the mind in modifying the action of medicinal agents, the questions—What is mind?—What is matter?—naturally present themselves to our attention. To reply to these queries involves enquiries of much difficulty, and uncertain utility; and to attempt to treat either of them metaphysically, would be out of character with the object of this work. Indeed, to venture to form any decision as to the real nature of either mind or body displays only that presumption which has always characterized attempts to re-

solve problems which from their nature seem placed beyond the grasp of human reason.

If we discourse of *matter*, we cannot demonstrate that we have a positive perception of substance; but we perceive its qualities—*extension*, *figure*, *colour*, *solidity:* and this, as Dr. Reid expresses himself, from the constitution of our nature, leads us to refer to something which is extended, figured, and coloured. In the same manner, although we have no distinct evidence of the existence of mind, yet we are conscious of *sensation*, *thought*, and *volition;* and this at least implies the existence of something which feels, and thinks, and wills. Every man feels that his sensations, thoughts, and volitions belong to a part of himself which is distinct from his body; for, if he lose a leg, or an arm, or both, or all his legs and arms, this feeling, thinking, and willing part of his being is as vigorous as ever: he has a clear demonstration, therefore, that it is not a material substance, nor the result of material organization, since it is not liable to be impaired by the loss or mutilation of many of his organs; nor even when his nervous system is deranged. It may, however, be said that we have not so strong an evidence of the existence of mind as of body; but a little reflection will convince us that this is an error, since, to use the language of the eloquent Dugald Stewart, "the one is suggested to us by the subjects of our consciousness, and the other merely by the objects of our perceptions." If this be correct, the establishment of the distinction between mind and matter requires no process of metaphysical reasoning; our notions of both are merely relative: "we know the existence of body, of *matter*, only by such sensible qualities as *extension*, *figure*, and *solidity;* that of mind, by such operations as *sensation*, *thought*, and *volition:* both are known to us only by qualities and attributes; of the essence of either we must confess we are totally ignorant." Having these remarks before us, let us now examine how far the operation of medicines on the body is influenced by this *feeling*, *thinking*, and *willing* part of our being.

The powerful influence of mind over the functions of the body is well known to every observing physician. The facetious author of Tristram Shandy strongly expresses this fact when he compares the body and soul to a coat and its lining; "if you rumple the one, you rumple the other." This influence is exerted according to the nature of the passions; which may be all arranged into two classes: the *depressing* and the *exciting*. Among the former, we find *Vexation*, *Sorrow*, *Fear*, and *Terror;* among the latter, *Joy* and *Confidence:* it is necessary to be aware of the influence of both on the system of a patient; not only at the moment when the physician is about to prescribe for him, but in observing the effects of the medi-

cines prescribed. The body sympathizes with, or follows the affections of the soul more in disease than in health ; it acts as the soul feels, and thence the influence of mind in modifying the operation of medicines.

a.—*Vexation* disturbs the function of the stomach, altering its natural secretion, the gastric juice; and thus, by impairing the digestive powers, it becomes a very common cause of dyspepsia, or stomach complaint.

b.—*Sorrow* diminishes the energy of the nervous system, lessens the force of the circulation, impedes all the secretions, and finally induces organic diseases. The appetite and sleep become impaired, the blood is imperfectly changed, owing to its passing too slowly through the lungs; flatulence, colic, spasms, display the altered functions of the stomach; whilst that of the liver is evidently affected, as is displayed in the sallow, often truly jaundiced, countenance of the sufferer.

c.—*Fear* paralyzes the muscular powers of the body, weakens and even arrests the motion of the heart, so that a congestion of blood occurs in the central vessels, and the surface becomes pale. Indeed, so completely does fear sometimes exert its sedative effects, that Dr. Parry, in his Elements of Pathology and Therapeutics, remarks that he has seen it, in a few seconds, remove all the incipient symptoms of fever. Its effects upon the secretions are well known: it suppresses the catamenia, produces diarrhœa, sweats, and a sudden involuntary flow of urine: it also generally increases the danger and fatality of diseases. By lowering the powers of Nature, it so modifies the influence of remedies, as often to enable the disease to baffle the most judicious practice, and resist the most powerful medicinal agents. I have seen patients, recovering from acute diseases, suddenly thrown back by a sudden alarm regarding their condition : and, in more than one instance, death has followed soon after this feeling took possession of the mind.

d.—*Terror*, which is an augmented degree of *Fear*, acts so powerfully on both the secretions and excretions, that infants, imprudently applied to the breat when the mothers are still under the agitation of some serious alarm, are liable to be seized with convulsions, owing to the change which it effects in the secretion of the milk. I had an opportunity of witnessing, some years ago, the following striking illustration of the influence of mind over body. I was consulted by an officer in the army, a man of great personal bravery and a distinguished soldier, who was suffering in the last stage of *pulmonary consumption*. His love of the military profession, and that delusive hope of recovery which always accompanies this disease, led him to object strongly to the sale of his commission, although it was by such a measure alone that he could hope to leave his wife and his daughter, an only child, above the reach of absolute

poverty. His wife, who knew his situation, and the necessity for his disposing of his commission, was nevertheless so much swayed by her affection, that she would not join in the persuasion of his friends and myself to take the necessary steps for obtaining the consent of the war office to effect the sale; and, therefore, it was not until he began to feel the truth of his situation that our wishes were acceded to. At length, a petition to the Commander-in-chief was drawn up; and a will, in favour of his wife and child, having been made at the same time, I was requested to be a witness to his signature of both instruments. I saw the deeds executed, and left him seated in bed, apparently more comfortable than he had previously been for weeks; but, before many seconds had elapsed, I was recalled by the servant; and, on returning, found my patient dead. His wife was standing by the bed-side, erect but motionless. I spoke to her; she heard me not: I took her hand; the muscles were rigid and she felt not: there was no volition: her eyes were open, but they were staring upon vacuity; there were no obvious symptoms of respiration, no rising of the chest, no dilatation of the nostrils: she was warm, but the pulse was not perceptible: in short, she was in that state which is termed *ecstasis;* as inanimate as a statue; and, although living, yet as stiff and as rigid as a corpse. She continued in this condition for forty-eight hours; then recovered her power of volition and of speech; but she was not restored to her usual health for many months; during which her brain was seriously affected. Here, the torpidity of the body was the result of the sudden transition from satisfaction to extreme grief; the mental cause operating upon the nerves nearly in the same manner, but in a more extended degree, as the irritation of a wound when it produces tetanus.

e.—*Joy*, on the other hand, operates as a powerful and exhausting stimulus on the nervous system. Many instances of its fatal effects are recorded. I need scarcely recall to the mind of the classical student the fate of Sophocles, who died on being crowned for composing a successful tragedy in his old age; nor that of Chilon of Lacedemon, who, whilst embracing his son, when declared victor in the Olympic games, died in his arms; nor the stories of the Roman ladies, who died on seeing their sons return from the battles of Trasymenus and Cannæ. A fact nearer home, and more to our purpose, is that related by Dr. Mead, that, in the memorable year of the South Sea bubble, more individuals went mad who acquired sudden fortunes, than those who were ruined by that speculation. Much of this effect of Joy on the nervous system is connected with temperament; the impulse that kills one man, will often scarcely rouse the smile of another.

f.—*Confidence*, on the same principle, acts as a tonic to

the whole animal frame; whence we find "that the result of a medicine," as Dr. John Reid justly remarks, "depends much upon the respect which the patient feels for his physician." Faith will give a virtue to the most inefficient remedy; a distrust in the abilities of a professional adviser will often defeat the tendency of his most judicious and seasonable prescriptions.

g.—Imagination. The direct influence of the *Imagination* over the corporeal functions is no less obvious. The watering of the mouth, when we think on food which is agreeable, is a familiar illustration of this fact. The idea of disgust sometimes causes nausea and even vomiting. This is strikingly illustrated in the following anecdotes. "A respectable farmer in Scotland, when a young man, had sat up for a whole night with some companions, and drank ale and spirits until he became sick, and had most unpleasant sensations. For more than twenty years afterwards, he never came near, nor passed the house, without suffering sensations similar to those which he had experienced on the night of his debauch." I know a gentleman who cannot hear the description of any surgical operation without fainting: yet, he is a man superior to affectation.

The disease termed *Nostalgia*, or Home-sickness, a complaint to which the Swiss are peculiarly liable, is a striking instance of the power of moral causes to produce even organic diseases: for, in the dissections of these cases, as we are informed by Avenbruger, adhesions of the pleura, and appearances of inflammation having affected the lungs, are almost always observed. Very similar effects to those produced by home-sickness, are those which follow *disappointments* in *love* upon the female frame: the pulse becomes small and tremulous; the spirits dejected, as indicated by deep sighs; the stomach suffers; the appetite fails; cold sweats and watchfulness follow, which gradually terminate in consumption, sometimes in insanity. This is especially the case when there is a necessity for a concealment of the tender passion: like intense grief, it gradually undermines the constitution; hope flies the mind; the whole bodily powers fail; the menses are suppressed; and the leucophlegmatic aspect of the countenance soon points out that some secret cause preys upon the heart, disturbing all the operations both of the body and the mind*. In such a state, the influence of the most active medicines are scarcely felt upon the habit; the well-grounded expectations of the prescriber are frustrated; and the patient sinks, the victim of the influence of moral causes on the bodily functions.

In regarding these effects of the influence of mind upon

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* "She pin'd in thought,
And, with a green and yellow melancholy,
She sat like Patience on a monument,
Smiling at grief."—*Shakespeare.*

the functions and structure of the body, we cannot be surprised that the same agent should greatly control the operation of medicines. "Your faith has made you whole," is a phrase of Scripture, which has been properly understood as implying a miracle, in circumstances to which it alludes: but the expression is also applicable, as I have already hinted, to daily experience, without resorting for an explanation to supernatural aid. It is this which often renders the same medicine more successful in the hands of the practitioner who has acquired popular celebrity, than in those of others perhaps more conversant with the nature and treatment of diseases. "A similar remark," says Dr. Reid, adverting to this subject, "may be made with regard to medicines themselves. A new medicine will often obtain a fortuitous fame, during the continuance of which there is no doubt that it actually produces some of those salutary effects which are ascribed to it. But the fault of these new remedies is, that they will not keep. For as soon as the caprice of the day is gone by, and Fashion has withdrawn her protecting influence, the once celebrated recipe is divested of its beneficial properties, if it do not become positively deleterious; by which it would appear that its reputation had not been the result of its salutary efficacy, but that its salutary efficacy had been, in a great measure at least, the result of its reputation."

We acknowledge the powerful control of *Imagination* in the ordinary affairs of life; we say that it is the source of the most refined of our pleasures: it supplies the painter and the statuary with all the subjects on which their genius is exercised; it furnishes the poet with the materials which he combines; can we then be surprised that it should influence the body in disease; and, consequently, powerfully modify the action of medicines? It must be remarked, however, that it is only on minds of an inferior stamp, and we find these in every rank of society, that Imagination exerts its powerful influence over the operation of medicines: and it is a subject of curious inquiry, how it happens that, in this matter, Imagination operates more upon those who are less accustomed to exercise it, than on the more intellectual, who are in the hourly habit of indulging in and cherishing its visions? To answer this query, we must admit, that the chief mental difference between these two classes of individuals is displayed in the regulation of thought, or the possession of that power which enables us to dismiss or take up certain ideas at pleasure. Now, to the class to which I have alluded as being generally most influenced by imagination, in matters relating to disease and its treatment, although the mind is usually almost wholly absorbed with common-place perceptions and ordinary occupations, yet, when the Imagination is once excited, the objects of it cannot be dismissed as

they can be by a well-governed mind; they become, therefore, paramount for a period: the Imagination opens the mind of the patient to believe any thing: he arrives at a state of the most absurd credulity: nothing appears impossible to him; and his recovery from disease, the preservation of his life, even his death, depend altogether on the workings of his fancy. However well adapted a remedy may be to fulfil the indications for which it is prescribed, if the patient have no confidence in it, all that will result from its use will be disappointment; whereas his faith will render the most inert medicines powerful, and even bestow properties upon some the most opposite to those which they usually exert.

It is to the operation of this condition of the mind that we must attribute the few *real* cures recorded in the annals of modern Empiricism; and those well-authenticated instances of people dying at the exact time which they themselves had prognosticated. On the same principles, a physician should always cheer a timorous patient, and raise his confidence both in himself and in the medicine which he prescribes; for even, in such a state of mind, the very look of a physician, whose opinion the patient has been accustomed to regard with reverence, if it bespeak danger, almost pronounces the sentence; and too often it unhappily executes itself.

> "We are not ourselves,
> When nature, being opprest, commands the mind
> To suffer with the body*."

h.—Credulity. In medicine, this is not a modern folly: thirteen hundred years have elapsed since Ætius described and ridiculed the nostrums of his time, and the extravagant sums paid for them. The Collyrium of Danaus was sold at Constantinople for one hundred and twenty numismata, equal to nine pounds sterling, according to the present value of coin. Dr. Fauceby, physician to Henry VI, pretended to be an adept in the occult sciences, and obtained a commission from that king to discover an universal medicine, called *the Elixir of life*, for the cure of all diseases, wounds, and fractures, and for prolonging life, the health and strength of the body, and the vigor of the mind, to the greatest possible extent of time. Dr. Henry, the historian, who quotes this passage from Rymer's Fœdera, adds, with great simplicity,—"We have no account of the success of this undertaking." Credulity, however, has sometimes cured diseases.†

Credulity differs from *Superstition:* the former may be de-

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* Shakspeare.

† This was most strikingly exemplified at the time when Metallic Tractors occupied the attention and imposed upon the credulity of the public. Dr. Haygarth removed Rheumatic pains by Tractors made of wood, ivory, and even gingerbread.

fined a deficient state of the faculty of judgment, or a neglect of exercising it in particular instances; the latter an improper application of the faculty of judgment, a conviction that the event which is to be believed is impossible, as far as human means can effect it; but that it is nevertheless accomplished through supernatural agency. Thus, when we read that the Payes of the Indian tribes in Brazil, who are physicians, conjurors, and exorcists, cure diseases by sucking the part affected, and spitting into a pit, as if to give back to the earth the evil principle which they assert is the cause of disease and has been sucked out of the sick person, we have an example of credulity and also of superstition in those who believe them. It is *credulity* to believe that a disease can be thus extracted, as if it were a material substance: it is *superstition* to believe that disease is an evil principle, and can be conquered only through the medium of the priesthood. Superstition is more the companion of Ignorance than Credulity, although there are some men who are naturally incapable of weighing the preponderance of contrary proofs and testimonies: but, very often, Credulity arises from mere indolence of the reasoning faculty; and a man takes what is told to him upon trust, because it is too much trouble to ascertain the probability of the proposition.* In either case, when Credulity is wrought upon by knavery, it becomes a greater obstacle to the advancement of medicine than even Superstition: but, as its influence on the operation of medicine is undoubted, it becomes a question, how far an honest physician is authorized to call it into his aid in the treatment of disease? If the idea were correct that a physician degrades his profession by yielding to the tide of opinion, this question could only be answered in the negative: but a physician must be guided by his own judgment as to the propriety of such a step. He may see it necessary to respect a wholesome prejudice; and may honestly act upon his patient's credulity in order to secure his confidence in the powers of certain medicines; or, independent of medicines, he may take such an advantage to secure the relief of his patient from the pressure of disease: for, as has been remarked by an able writer, whose words I have quoted more than once, "It is of little consequence whether a man be healed through the medium of his fancy or his stomach."

Superstition.—The influence of *Superstition* over the operation of medicines is much more limited than that of Credulity; but it operates as a powerful obstacle to the advancement of medicine in those countries where it still exists. At an early period in the history of society, Superstition supplied many

* Two days ago (June 27th, 1832) I heard a barrister, one of the most distinguished ornaments of the British bar, declare in open court his confidence in the remedial power of Metallic Tractors.

articles of the Materia Medica; but as education advanced, these fell into disuse. The influence of Superstition arose from the characters of Priest and Physician being combined in the same person. This was the case with the Jews, as we learn from the Mosaical accounts of their early history. The priests of Esculapius were also the first physicians of the Greeks. The Druids were those of the Northern nations: and, in the history of our own country, we read that, after the Anglo-Saxons had embraced the Christian religion, the clergy were the only medical practitioners. The first medical book translated into the Saxon language was the work of Apuleius on the virtues of herbs; and on this the whole of the practice of medicine was founded until the tenth century, when the monks took up both the teaching and the practice of the healing art, and drew their information from the writings of Galen, Rhazes, Avicenna, and other Arabians, which were translated into Latin and deposited in the monasteries. In the eleventh century, the clergy applied themselves particularly to the study of Materia Medica. Richard Fitz-Nigel, who died Bishop of London, A.D. 1198, had been apothecary to Henry the Second: Roger Bacon, who flourished in the thirteenth century, practised physic, although a monk: in the same century, Nicolas de Farneham, physician to Henry the Third, was made Bishop of Durham: and many other doctors of medicine were, at various times, elevated to ecclesiastical dignities. It was even thought essential that physicians should remain in a state of celibacy; and it was not until the fifteenth century that they were permitted to marry in countries professing the Roman Catholic religion. In periods like these, Superstition held her sway over the credulity of the multitude, in matters relating to the cure of their diseases. It was easier for a crafty priesthood to work upon the weakness of the human mind than to investigate the nature of diseases and their remedies: thence, we find that charms, exorcisms, and other impositions were practised by the clerical physicians of that period. Little confidence was placed in medicines, even at a later period; for Burton, in his anatomy of Melancholy, informs us "that there was of old no use of physicke amongst us, and but little at this day, except it be for a few nice idle citizens, surfetting courtiers, and staufed gentlemen lubbers. The country people use kitchen physicke."

If we go back to the period of Scripture history, we find that the Jews had great faith in phylacteries—a species of amulets, which are still held in esteem in India and other Eastern countries. They consisted of portions of Scripture written upon vellum of a shape and size adapted to the part of the body on which they were to be worn. Thus, a phylactery for the head, preserved in the Duke of Sussex's library, con-

sists of four slips of vellum, with verses from Scripture written on each. These are separately rolled up, and placed in a small leathern bag, upon which is written the word *schin*. It is tied to the head by means of thongs of leather, so as to permit the bag to rest on the forehead. These phylacteries are called tephillin, shel-rash, tiffila of the head. Those for the arm are called sheljad: they are written upon a strip of vellum, which is rolled up spirally to a point, and enclosed in a case made of the skin of any clean beast. They are bound upon the arm, in a situation as near to the heart as possible, by a thong which must go seven times round the arm in a spiral manner and terminate by being wound three times round the middle finger. Coral, worn round the neck, was supposed to possess the power of driving away evil spirits*.

As Christianity advanced, the clerical physicians seemed anxious to render the dogmas of the existing religion subservient to medicine; and, consequently, relics were introduced into the Materia Medica. We read that bread, dipped in oil at the shrine of St. Anthony, at Rome, was believed to prevent Hydrophobia in those bitten by a rabid animal; that a ring, taken from the body of St. Remigius, and dipped in water, produced a drink very efficacious in fevers; and the following cure for Epilepsy in children is recommended by John of Gaddesden, Walter Gilbert, and others, who flourished in the thirteenth century. "When the patient and his parents have fasted three days, let them conduct him to the church. If he be of a proper age, and in his right senses, let him confess. Then let him hear mass on Friday, during the fast of *quatuor temporum*, and also on Saturday. On Sunday, let a good and religious priest read, over the head of the patient, in the church, the gospel which is read in September, in the time of vintage, after the feast of the holy cross. After this, let the priest write the same gospel devoutly, and let the patient wear it about his neck, and he shall be cured. The gospel is—'This kind goeth not out but by prayer and fasting.'"

It would be a waste of time to enumerate many of these absurdities: I shall notice one more only, because it descended almost to our own times; I refer to the royal touch for the cure of Scrophula. This superstition took its rise in the reign of Edward the Confessor; and nothing can demonstrate, more clearly, the powerful influence of the mind over the body than the effects which followed when it was employed. In 1349 Bishop Bradwardine wrote respecting it, in these strong terms: "Whoever thou art, O Christian! who deniest miracles, come

* It is melancholy to think that a relic of this superstition is still countenanced by the higher ranks of this country: beads formed of the root of Bryony are strung together, and sold under the name of anodyne necklaces for facilitating the protrusion of the teeth in the gums of an infant.

and see with thine own eyes, come into England in the presence of the king, and bring with thee any Christian afflicted with the King's Evil; and though it be very ugly, deep, and inveterate, he will cure him in the name of Jesus Christ, by prayer, benediction, the sign of the cross, and the imposition of hands*."

Queen Elizabeth exercised the touch for the King's Evil; and Laneham, in his "Account of the Entertainment at Kenilworth Castle," avers that he saw Queen Elizabeth cure nine persons "without other medicines than by touching and prayer." Even the great Bacon believed in the power of charming away warts. The doctrine of *sympathetic* indications and cures, indeed, would fill volumes; and although many of them are to be referred to *idiosyncracy*, yet not a few are altogether the work of *credulity*.

But the influence of credulity and superstition could not continue; and, although credulity still sways, in some degree, the multitude, and quackery flourishes, yet education has already opened the eyes of the ignorant and expelled the mummeries of *superstition*. It must, however, be admitted, that even the most absurd means of cure adopted by superstition were sometimes beneficial—a circumstance which we must attribute to the confidence they inspired, acting as a powerful tonic on the corporeal frame.

Upon the whole, there can be no doubt that imagination, credulity, and superstition, influence powerfully the operation of medicinal agents; and that their effects ought to be familiar to the physician. In knowing the extent of their influence, he is enabled to determine the real value of a medicine; how much is due to the workings of credulity, or superstition; and how much to the impression which the previous character of the medicine has made upon the mind.

INFLUENCE WHICH THE PERIOD OF A DISEASE EXERTS OVER THE ACTION OF MEDICINES.

It is easy to conceive that many circumstances connected with the progress of disease (the changes, for example, in the nervous irritability, in the force of the circulation of the blood, and in the temperature of the body) must tend to render the administration of a medicine which acts beneficially at one time less beneficial at another. A few examples will illustrate the truth of this position. If a drastic purgative be given soon after an ague has been checked by tonics, it is probable that the disease will return—a remark which was noticed by Syden-

* Bradwardine de Causa Dei, l. x, ch. x, p. 39.

ham and De Haen, both high authorities in all practical matters. Thus, also, at the commencement of *dysentery*, whilst inflammation of the mucous membrane exists in the large intestines, it would be extremely hazardous to administer stimulants; but, when the inflammatory symptoms have abated, when the debility, which is the result of that state, alone threatens the life of the patient, they may be perfectly admissible, and even requisite. In some diseased conditions of the habit, a purgative may prove even fatal, if administered at an improper time, independent of that state of great corporeal debility, which would prevent any sensible practitioner from prescribing a medicine the operation of which would only add to the already too greatly exhausted state of the body. Again, if Foxglove be administered, the influence of the period of disease in controlling its operation is very evident. In dropsy, for example, if it be given early, whilst the pulse is hard, quick, and incompressible, it produces no beneficial effects, the action of the capillaries is not increased, nor is the secretion of urine augmented; but, if the excitement be first reduced, whether by bleeding or any other means, the remedy then fulfils the indication of its administration; it stimulates the capillaries, increases greatly the secretion of the kidneys, and enables the absorbents to relieve the serous sac of the superabundant fluid which has been deposited in it.

Many salutary processes, also, occur in the progress of disease, which should not be checked by an improper administration of medicines. Thus, violent shiverings and tremors of the body, unaccompanied with coldness, and not followed by preternatural heat, occasionally relieve acute gouty pains; but, when these are interfered with, metastasis or a translation of diseased action occurs, and the inflammation, instead of remaining in the toe or the instep, may attack the head or the stomach. In the administration of local remedies, also, much caution is requisite; and every day's experience teaches us why many local diseases cannot be removed, or even checked, by local remedies, without the hazard of converting topical into general disease, or causing what may be termed a constitutional effort in some other part more essential to life than that which the attempt was made to relieve. In the administration of some *internal* medicines, also, the result may be a check to the salutary action of some local disease on the system, and thus, for a temporary and delusive suspension of present suffering, the most serious evil may follow. Thus, the shivering which often attends the passing of a gall-stone is supposed to operate like exercise, and to aid the propulsion of the extraneous body. Even convulsions sometimes may be regarded as salutary processes. Dr. Parry mentions the case

of a young lady who was long afflicted with headache, vertigo, and vomiting, which at length ended in total blindness, so as to induce a belief that she laboured under hydrocephalus internus; all the symptoms were, in a few hours, removed by a sudden fit of convulsions*. I have mentioned these instances to shew that the knowledge of the powers of a remedy does not constitute all which the physician ought to possess previous to prescribing it, even supposing he has taken into account all the circumstances which have been described as likely to modify its effects: he must, also, be convinced that no danger will result from its salutary influence in one part of the system, producing a translation of diseased action to another previously in a healthy state.

The nature of the symptoms of disease often greatly modifies the operation of medicines: large doses of opium may be swallowed with impunity, during violent pain or spasm, one half of which, in the ordinary condition of the habit of the patient, would prove highly injurious, if not fatal. In diseases connected with great excitement, also, opium is injurious in the commencement, although, in combination with other medicines which diminish its stimulant properties, no remedy is so efficacious after bleeding, purging, or any treatment which can bring down the hardness and lessen the frequency of the pulse. It is injurious in the hectic stage of pulmonary consumption, from its tendency to promote sweatings, although, in the early stages of consumption, it is highly beneficial.

In the same way, Cinchona Bark, or its active principle, Quinia, although the best remedy for intermittent fevers, when administered at the proper period of the disease, yet, if exhibited during the hot stage of the paroxysm, increases all the bad symptoms. In some local affections, also, symptoms closely resembling those of ague present themselves: as, for example, in stricture of the urethra, a fit of ague is induced by a debauch of wine, by the introduction of a bougie armed with caustic into the urethra, and by many other sources of irritation; yet, whilst Bark or Quinia, in such cases, generally does harm, a saline purgative removes every symptom of ague. Squill has been successfully employed as an expectorant and a diuretic; but its operation is much influenced by the period of the disease at which it is prescribed. If given, for instance, during the continuance of inflammatory action, it invariably proves injurious, and, therefore, either bleeding, purging, or some other means of diminishing arterial excitement, are essential, in order to secure the beneficial action of squills.

In this manner the influence which any substance possesses

* Elements of Pathology and Therapeutics.

in allaying disease, depends in some degree on the period of the disease, and the circumstances under which it is administered, as well as the condition of the body at the time, and the activity of the medicine itself. In truth, no substance, the mildest in its effects, can be given in improper doses or at improper times without proving hurtful; and, in some point of view, the most nutritious and wholesome articles of diet may be ranked, almost, among the class of poisons. Even in prescribing external remedies, it is of importance to attend to the period of the disease.

PART II.

SECTION I.

NATURAL CLASSIFICATION OF MEDICINAL AGENTS.

THE substances employed as medicines are found, in common with the other objects of Nature, every where surrounding us. They are either *natural*, that is, they are found ready formed on the surface of the earth or beneath it; or they are *artificial*, that is, changed from their natural condition, either by the abstraction of some of their parts, or by the addition of new parts. The natural substances consist of both simple and compound bodies, derived from the organic and inorganic kingdoms of Nature; the artificial are the productions of the Pharmaceutical Art: thence, the study of the nature of medicinal agents implies some acquaintance with Natural History and Chemical Science.

The medicinal agents which are the products of organization are of animal and vegetable origin: the organic substances are minerals.

ANIMAL SUBSTANCES.

The animal products are few. As objects of Natural History, I prefer arranging them according to the Classification of Cuvier, which is now generally adopted: and as, in describing them hereafter, I shall have occasion to make frequent reference to that system, I think it necessary to present here a brief sketch of it.

This system arranges the whole of the known animals under four principal groups.

1. VERTEBRATED ANIMALS.
2. MOLLUSCOUS ANIMALS.
3. ARTICULATED ANIMALS.
4. RADIATED ANIMALS, or ZOOPHYTES.

The VERTEBRATED ANIMALS, *Animalia Vertebrata*, which forms the first great division of the Animal Kingdom, are those

in which the body and its members are supported by a skeleton or osseous frame-work, consisting of numerous pieces articulated together, moveable upon one another, and affording points for the origin and insertion of the muscles, with which this frame-work is more or less completely covered. The brain, and the spinal marrow, the principal trunk of the nervous system, are contained in a cavity, composed of various bones forming a cranium and a hollow vertebral column. The vertebrata have all red blood; a muscular heart; a more or less voluminous liver; two horizontal jaws; distinct organs of seeing, hearing, smelling, tasting, and touching: and the sexes in two separate individuals. This division contains four Classes — *Mammifera*, *Aves*, *Reptilia*, and *Pisces*.

The first Class MAMMIFERA, named from the animals being furnished with mammæ which secrete milk for the nutriment of the young, is the only class of this division that contains animals yielding Medicinal substances. It contains nine Orders— namely—1, *Bimana*; 2, *Quadramana*; 3, *Carnivora*; 4, *Marsupialia*; 5, *Rodentia*; 6, *Insectivora*; 7, *Pachydermata*; 8, *Ruminantia*; 9, *Cetacea*. The first four contain no animals yielding Medicinal agents.

The fifth Order, *Rodentia*, is characterized by each jaw containing two strong, sharp, curved, cutting teeth, in front, with an empty space between them and the grinders on each side. The posterior extremities are, in general, longer than the anterior, which gives the animals an awkward gait. The intestinal canal is long, the stomach simple, and the cœcum very large. This order contains the Beaver, Castor *fiber*, an amphibious animal, which supplies the medicine named *Castor*.

The seventh Order, *Pachydermata*, contains animals with two or more toes on each foot, furnished at their extremities with nails closely approximating to hoofs, which cannot be used for grasping. They have no incisors; in some instances, no canine teeth; nor have they clavicles. In the second division of this order we find the Hog, Sus *scrofa*, from whose flanks *Lard* is obtained.

In the eighth Order, *Ruminantia*, of the same class, the chief characteristic, as its name implies, is the rumination of the animals—a faculty connected with the disposition of their stomachs, which are four in number. The first stomach is a mere recipient of the food, whence it passes into the second, where it is formed into small globular pellets, in which form it is returned into the mouth and remasticated before it descends into the third, where it is divided into thin flakes: and, lastly, passes into the fourth, which is the real digesting organ. The animals in this order have no incisors in the upper jaw: they are furnished with two hoofs, so placed in relation to each other that they resemble one cleft hoof, whence the name *cloven-*

footed. They are all phytivorous animals. In the division of the order containing animals *without horns*, we find the Musk Deer, Moschus *moschiferus*, the animal which yields the Musk. In the second division of the same order, containing animals *with horns*, and in the first subdivision containing animals who *shed their horns*, we find the Stag, Cervus *elaphus*, from the horns of which a nutritive gelatine is extracted: in the second subdivision, containing those whose *horns* are *permanent*, we find the Goat, Capra *hircus*, the sheep, Ovis *aries*, and the Bull, Bos *taurus*; all of great value in yielding demulcents and dietetic substances.

The ninth Order, *Cetacea*, contains animals which resemble fishes: they have no anterior extremities, but a tail fin, which is transverse: their head, which is large, is united to the trunk of the body by a very short, scarcely distinct neck; the anterior extremities resemble fins; the mammæ are placed on the breast, or near the anus. The Cetacea breathe by lungs, which obliges them often to rise to the surface of the water. They are warm-blooded animals. In this order we find the Spermaceti Whale, Physeter *Macrocephalus*.

The second Class, the AVES, comprehends six Orders; but one only, the *Gallinaceæ*, furnishes medicinal agents; namely, the Phasianus *gallus*, every part of the egg of which is either medicinally or pharmaceutically employed.

Some of the REPTILIA, the third Class of Vertebrata—namely, the Lizard, Lacerta *scincus*, and the Viper, Coluber *virosus*—were formerly employed as medicines; but they are now wholly rejected from the list of the Materia Medica in Great Britain.

Among the PISCES, the fourth Class, the Sturgeon, Accipenser *huso*, is still employed in yielding Gelatine, in the form of Isinglass.

The MOLLUSCOUS ANIMALS, *Animalia mollusca*, formerly supplied three medicinal agents, the Cuttle-fish, Sepia *officinalis*, which furnished a very pure Carbonate of Lime; the Vine-Snail, Helix *pomatia*, which yield a demulcent aliment; and the Oyster, Ostrea *edulis*, the shell of which, calcined, was administered as an absorbent: but all of them are now rejected from the British Pharmacopœias.

The ARTICULATED ANIMALS, *Animalia articulata*, the third great division in the System of Cuvier, are characterized by the successive joints or articulations which constitute their bodies; and which are, for the most part, horny or stony, although, in a few instances, soft. Their nervous system consists of two cords, united by ganglia, at certain distances, whence the nerves are given off. The Articulated animals breathe either by gills, or by lateral stigmata: and, in a few instances, by cellular cavities analogous to lungs. The organs of circu-

lation vary considerably: in some instances a heart exists, in others not: the organs of the senses, with the exception of that of sight, are little developed.

The chief characteristic of the first Class of this division, ANNELIDA, is, the body soft, and formed either of a great many rings, or segments of rings. Although the circulation is carried on both by arteries and veins, yet, there is no distinct heart. They have generally from two to three jaws; but in some instances the mouth consists of the open extremity of a simple tube. They breathe in general by gills, but, in some instances, by pores, and live chiefly in water.

The third Order of the Annelida, the *Abranchidea*, contains animals devoid of visible respiratory organs; and here Cuvier has placed the Leech, Hirudo *officinalis:* the propriety of this situation for the Leech is questionable, as I shall endeavour hereafter to demonstrate in treating of its remedial use.

The second Class of the Articulata, CRUSTACEA, is distinguished by the articulations being hard, crustaceous, or stony. The animals have a double circulation; they breathe by gills, variously situated. The nervous system consists of numerous ganglia, disposed in pairs. There are generally four antennæ or feelers; and the eyes are sometimes sessile, sometimes elevated upon an articulated pedicle.

In the first Order, *Decopodea*, we find the Cray Fish, Cancer *astacus.*

In the fourth Class, INSECTA, of this division, we find four medicinal orders. The class is well drawn; but its characters are so various, that it is unnecessary to describe them.

The fifth Order of the Class, *Coleoptera*, is characterized by the insect having six feet and four wings, the two uppermost of which are elytra or sheaths, horny, and always parallel to one another. The insects of this order undergo a complete metamorphoses. We find here the Blistering Beetle, Cantharis *officinalis*, and the Mylabris *variabilis*, both yielding the blistering principle, *Cantharidin*. The perfect insects are soft when they change from the chrysalis, but harden after exposure to the air.

The seventh Order, *Hemiptera*, contains insects with six legs and four wings, of which the upper are larger and stronger than the lower, and horny and firm at the root, but soft and membranous at the outer extremity. The head is depressed upon the chest; and although some of the genera have jaws, yet, the greater number are furnished with a proboscis. Here we find the Cochineal insect, Coccus *Cacti.*

In the twelfth Order, *Diptera*, the insects have six legs and two membranous wings, with winglets or poisers (halteres) attached behind them, situated on the thorax: in some, the sucking tube is hard and pointed; in others, it is a soft proboscis; and in others there is a simple mouth. This order contains

the Bee, Apis *mellifica*, the manufacturer of both the wax and honey employed in medicine.

In the fourth Division of Cuvier, RADIATA or ZOOPHYTA, radiated animals, the organs of motion surround a centre; there is no distinct nervous system; no particular organs of the senses, and scarcely any traces of circulation.

In the fourth Order of this division, *Polypi*, which closely resemble plants, each body consisting of an aggregate mass of animals, and reproducing by germs, we find only one medicinal agent, the Sponge, Spongia *officinalis*. The Coral, Isis *nobilis*, is now rejected from the list of the Materia Medica.

SECTION II.

VEGETABLE SUBSTANCES.

Although the Linnean or Artificial System be that which has hitherto been employed for classing medicinal plants, as objects of Botany, yet, the Natural System holds out so many advantages to Medical Science, that there can be one opinion only of its superiority in a practical point of view: it informs the medical enquirer not only of the botanical affinities of the plants, but also supplies him with a knowledge of their properties and qualities. This acquaintance with the properties of even one plant of any order enables him to form some idea of the remedial value of all the other plants in the same order, and, if needful, to substitute, upon fixed principles, any one of them for that which is more usually employed.

The great divisions of this System are *two*.

I. VASCULAR PLANTS, VASCULARES; plants having spiral vessels, both in the stems and leaves; cuticular stomata*; distinct flowers; and sexual organs†.

II. CELLULAR PLANTS, CELLULARES; plants chiefly composed of cellular tissue; and generally devoid of cuticular stomata; wholly devoid of spiral vessels and of sexual organs.

The first division contains, with a few exceptions, all the plants comprehended in the Materia Medica of the British Colleges. It is subdivided into two sub-classes:

1. DICOTYLEDONOUS PLANTS, or EXOGENÆ; plants with a more or less conical stem, composed of distinct pith, wood, and bark; reticulated leaves; and fruit having an embryo with

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* Stomata—organized pores, perhaps for breathing, like the spiracula of insects.

† Sexual organs comprehend the anthers and stigma.

two or more opposite cotyledons or seed lobes. The plants grow by new layers annually deposited on the exterior surface. All the plants of this sub-class are partly *Angiospermous*, or have the seeds enclosed in a *pericarpium;* partly naked or *Gymnospermous.*

2. MONOCOTYLEDONOUS PLANTS, or ENDOGENÆ; plants with no distinction of pith, wood, and bark, in the stem; with leaves displaying parallel veins; and fruit having an embryo with one cotyledon only; or, if there be two cotyledons, they are not opposite, but alternate. The increase of the stem is by internal additions. The seeds are, in the greater part of this sub-class, *Angiospermous*; but, in two orders, they are naked, or *Gymnospermous.*

Seven-eighths of the medicinal plants in the British Pharmacopœias belong to the first of these sub-classes; as will appear in the following arrangement of them under the orders.

A. DYCOTYLEDONS.

I. ANGIOSPERMÆ.

ARALIACEÆ.—Trees, shrubs, or herbaceous plants, with leaves sheathing at the base, and umbellate flowers: *calyx* entire or toothed: *petals* five or six, deciduous, valvate in æstivation: *stamens* definite, perigynous: *fruit* an inferior, polycellular ovarium.

Geographical position: Intertropical in both hemispheres.

Yielding a bitter principle:

Panax *quinquefolium.*

UMBELLIFERÆ.—Herbaceous plants, with fistular furrowed stems, and divided or simple leaves sheathing at the base: *flowers* in umbels*: the *calyx* entire or five-toothed: *petals* 5, alternate with perigynous *stamens* incurved in æstivation: *ovarium* didymous†, with two *styles* and a solitary pendulous *ovula.* The *seed-vessel* is traversed with vertical ridges; and has, in some instances, near the base, *vittæ*, or linear receptacles of oil. The *embryo* is minute in the base of fleshy albumen.

Geographical position: The northern parts of the northern hemisphere.

Yielding an aromatic volatile oil:

Carum *Carvi.*
Pimpinella *Anisum.*
Fœniculum *vulgare.*

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* Umbel—that form of inflorescence in which the subordiate stalks, rising on the summit of a common flower stalk, extend in rays.

† Two joined together.

Daucus *Carota.*
Coriandrum *sativum.*
Anethum *graveolens.*
Archangelica *officinalis.*

Ammoniacum:
Dorema *Ammoniacum.*

a fœtid gum-resin:
Opopanax *Chironium.*
Ferula *Persica.*
Ferula *Assafœtida.*
Galbanum *officinale.*

an acrid gum resin:
Cuminum *Cyminum.*

a narcotic principle:
Conium *maculatum.*

RANUNCULACEÆ.—Herbaceous plants, with divided opposite or alternate leaves, having generally a dilated half-sheathing petiole: *calyx* formed of 3-6 sepals*; *petals* 5-15, distinct in one or more rows: *stamens* hypogynous†, indefinite in number: *anthers* bursting by longitudinal slits: *pistilla* numerous on a torus: *fruit* distinct, simple carpella‡, containing albuminous seeds, without an arillus§: and with a minute embryo.

Geo. position: Europe, India.

Yielding a narcatic principle:
Aconitum *paniculatum.*

a purgative principle:
Helleborus *niger.*
Helleborus *fœtidus.*

an acrid principle:
Ranunculus *flammula.*
Ranunculus *acris.*
Delphinium *staphisagria.*

PAPAVERACEÆ.—Herbaceous plants with more or less divided, alternate leaves: *flowers* polypetalous, single, on long *peduncles: sepals* 2, deciduous: *petals* 4 or some multiple of 4: *stamens* hypogynous: *ovarium* one-celled, with narrow, partial placentæ: *seeds* numerous.

Geo. position: Europe, Persia, China, Japan.

Yielding a narcotic principle, Meconate of Morphia:
Papaver *somniferum.*

a colouring matter:
Papaver *Rhœas.*

CRUCIFERÆ.—Herbaceous plants with alternate leaves:

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* Parts of the calyx.
† Hypogynous—rising from a lower surface than the female parts.
‡ Carpellum—one of the seed vessels of a compound fruit.
§ Arillus—an expansion of the umbilical cord surrounding the seed.

flowers polypetalous; the *sepals* 4, deciduous and cruciate, alternating with 4 cruciate *petals:* 6 *stamens* hypogynous or rising from a lower surface than the female organs—2 short, solitary, and opposite, 4 long, pairs, opposite, generally distinct, but in some instances connate: *fruit*, a silique* or a silicule†. This is one of the most natural of the orders.

Geo. position: Temperate zones, tropics, and north frigid zone.

Yielding a volatile and pungent principle:

Cardamine *pratensis.*
Cochlearia *Armoracea.*
Cochlearia *officinalis.*
Sinapis *nigra.*
Sinapis *alba.*

MYRISTICÆ.—Trees with alternate leaves without stipulæ, entire, stalked, and coriaceous: the *flowers* in racemes‡ or panicles§, each flower having a short cucullate bracte‖. The flowers are diœcious and apetalous, with a three-lobed coriaceous *calyx* and columnar *stamens:* the *fruit* is baccate, dehiscent, and bivalved.

Geo. position: Tropics of India and America.

Yielding an aromatic volatile oil:

Myristica *Moschata.*

WINTEREÆ.—Trees or shrubs with alternate, coriaceous stipulate leaves, with transparent dots, and convolute, deciduous stipulæ. The *flowers* are hermaphrodite or unisexual, polypetalous, with hypogynous, short *stamens*, indefinite in number; and oblong, adnate *anthers*, bursting by longitudinal slits. The *fruit* consists of numerous, distinct, simple carpella.

Geo. position: Southern temperate zone.

Yielding a stimulant and aromatic oleo-resin:

Drymis *Winteri.*

LAURINEÆ.—Trees with entire, alternate leaves, devoid of stipulæ: *flowers* apetalous, with a 4-6 cleft *calyx*, and definite perigynous¶ *stamens*, three of which are generally abortive: *anthers* adnate, 2-4 cells, which open by recurved valves: *fruit* baccate or drupaceous**, containing seeds without albumen.

Geo. position: Both hemispheres, except in Africa.

Yielding an aromatic volatile oil:

Laurus *Cinnamomum.*
——— *Nobilis.*

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* Silique—a long, two-valved fruit with seed on both sutures.
† Silicule—a small silique nearly as broad as long.
‡ Racemes—individual flowers on a long axis.
§ Panicle—where subordinate stalks of a common stalk are subdivided.
‖ Bracte—a floral leaf.
¶ Perigynous—stamens rising from the same plane as the female parts.
** Drupe—a nut surrounded by a fleshy matter, as in the cherry.

Laurus *Sassafras.*

Yielding Camphor.

Laurus *Camphora.*

MENISPERMEÆ.—Flexible, twining, tough shrubs, with alternate, entire, mucronate leaves: small, polypetalous, racemose, unisexual flowers, with hypogenous *stamens*, opposite to the petals, supporting on their points adnate *anthers*. *Fruit*, a one-seeded drupe.

Geo. position: Tropics of Asia and America.

Yielding a bitter and tonic principle, Calumbina:

Cocculus *palmatus* (Calumba).

a narcotic principle:

Cocculus *suberosus.*

MALVACEÆ.—Herbaceous plants, trees, or shrubs, with alternate, more or less divided, stipulate *leaves*, covered with stellate pubescence. The *flowers* are polypetalous, with hypogenous, monodelphous *stamens*, and one-celled anthers bursting longitudinally: *ovarium* formed of *carpella* round a placental axis distinct or concrete: *fruit* capsular or baccate containing seed with crumpled cotyledons.

Geo. position: Temperate zone and tropics.

Abounding in mucilage:

Althæa *officinalis.*

Malva *Sylvestris.*

DIPTEROCARPEÆ.—Trees with alternate leaves, the veins of which run out from the midrib to the margin, and deciduous stipules: *flowers* polypetalous, with a tubular *calyx*, hypogynous *stamens*, indefinite in number, with subulate *anthers* opening near the apex: *fruit* coriaceous, surrounded by a foliaceous calyx, concrete *carpella:* an *ovarium* of several cells, and pendulous *ovules* in pairs.

Geo. position: Indian Archipelago.

Yielding Camphor:

Dryobalanops *Camphora.*

GUTTIFERÆ.—Trees or shrubs, occasionally parasites: *leaves* entire, opposite, without stipules: *flowers* polypetalous, with a persistent, imbricate, membranous *calyx:* hypogenous, unequal *stamens*, indefinite in number: adnate *anthers: carpella* concrete: an *ovarium* of several cells: *ovules* attached to the central placentæ.

Geo. position: South America, Madagascar.

Yielding a gum-resin:

Stalagmitis *Gambogioides.*

SALICARIÆ.—Herbs with opposite, entire leaves without stipules: *flowers* polypetalous, with a tubular, short-toothed *calyx:* perigynous *stamens;* adnate *anthers; carpella* concrete, and a superior *ovarium* with several cells.

Geo. position: Europe, America, tropics of both hemispheres.

Yielding an astringent principle ; Tannin ?

Lythrum *Salicaria*

MYRTACEÆ.—Trees or shrubs with opposite, entire leaves, covered with semitransparent dots: *flowers* polypetalous, with a superior 4-5 cleft *calyx:* indefinite perigynous *stamens*, with ovate *anthers* bursting lengthways: *carpella* concrete: inferior *ovarium* with several cells.

Geo. position: South America, East Indies.

Yielding an aromatic volatile oil:

Melaleuca *minor* (M. Cajuputi).
Caryophyllus *aromaticus.*
Eugenia *Pimenta.*

an astringent principle:

Eucalyptus *resinifera.*
Punica *Granatum.*

ARISTOLOCHIÆ.—Herbs with alternate, simple, petiolate leaves: *flowers* apetalous, with a superior, tubular, valvate *calyx:* epigynous *stamens:* many-celled *ovarium:* and indefinite *ovules.*

Geo. position: Europe, both Americas, India.

Yielding a stimulant bitter principle:

Aristolochia *serpentaria.*
——————— *Cytisinum.*
Asarum *Europæum.*

THYMELEÆ.—Shrubs with entire, exstipulate *leaves*, alternate and opposite: *flowers* apetalous, with a tubular four-cleft, coloured *calyx*: *ovarium* single, superior, one-celled: *fruit* indihescent: *ovules* pendulous.

Geo. position: Europe, Cape of Good Hope, New Holland.

Yielding an acrid principle:

Daphne *Mezereum.*

ROSACEÆ.—Herbaceous plants and shrubs with alternate, stipulate leaves: *flowers* polypetalous, with regular, perigynous *stamens:* lateral *styles:* superior, simple *ovaries:* exalbuminous, definite *seeds.*

Geo. position: Temperate zone.

Yielding an astringent principle, Tannin.

Geum *Urbanum.*
Tormentilla *erecta.*
Rosa *Canina.*
—— *centifolia.*
—— *Gallica.*

POMACEÆ.—Trees or shrubs with alternate, stipulate leaves: *flowers* polypetalous, with perigynous *stamens*, indefinite in number, adhering to the throat of the calyx: *fruit*, a one or five-celled pome*.

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* Pome—a capsule surrounded by a fleshy covering.

Geo. position. Europe, Asia, North America, India.
Yielding mucilage.
Pyrus *Cydonia.*

AMYGDALEÆ.—Trees with simple, alternate, stipulate leaves, glandular at the base: *flowers* polypetalous, with regular, perigynous *stamens*, indefinite in number: innate, two-celled *anthers:* a superior, solitary, simple *ovarium*, with a terminal *style: fruit* a drupe: *seed* exalbuminous, suspended: cotyledons thick.

Geo. position: Temperate zone.
Demulsive and laxative:
Amygdalus *communis.*
Prunus *domestica.*
——— *Persica.*
Tannin:
Prunus *spinosa.*
Yielding a sedative principle (Hydrocyanic Acid):
Prunus *Laurocerasus.*
Amygdalus *Amara.*
——— *Persica.*

LEGUMINOSÆ.—Herbs with alternate, stipulate leaves: *flowers* polypetalous, with perigynous *stamens*, monodelphous or diadelphous: *ovary* solitary, simple, superior: *style* terminal: *fruit* leguminous: *seed* exalbuminous: peritropal *ovules.*

Geo. position. Equinoctial zone and both hemispheres beyond the tropics, but chiefly in the north.
Yielding a saccharine matter:
Glycyrrhiza *glabra.*
acids:
Tamarindus *Indica.*
Gum:
Acacia *vera.*
——— *Arabica.*
Astragalus *Tragacantha.*
——— *verus.*
——— *Creticus.*
Cathartine—a purgative principle:
Cassia *Senna.*
——— *lanceolata.*
——— *obovata.*
——— *fistula.*
Oleo-resin:
Copaifera *officinalis.*
Myroxylon *Peruiferum.*
an acrid principle:
Geoffræa *enermis.*
Spartium *Scoparium.*
a mechanical acrid:
Dolichus *pruriens.*

an astringent principle ; Tannin?

Hæmatoxylon *Campechianum.*
Peterocarpus *Santalinus.*
——————— *Draco.*
——————— *Africanus.*
Acacia *Catechu.*

URTICEÆ.—Trees or shrubs with alternate, scabrous, stipulate leaves : *flowers* apetalous, solitary, or clustered : *stamens* definite, distinct, inserted into the tube of the *calyx* : *ovarium* superior, two-celled : *fruit*, a nut, indehiscent : *embryo* straight, curved, or spiral, albuminous or exalbuminous, with the radicle remote from the hilum.

Geo. position : General over the globe.

Yielding a bitter principle, Lupuline:

Humulus *Lupulus.*

ULMACEÆ.—Trees and shrubs with alternate, scabrous, simple, stipulate leaves : *flowers* apetalous, solitary, or loosely clustered, with definite *stamens* inserted into the base of the *calyx : ovarium* superior, with suspended *ovules: fruit* one or two-celled, indehiscent: *seeds* pendulous, exalbuminous.

Geo. position: Europe, Asia, North America.

Yielding Ulmin:

Ulmus *campestris.*

ARTROCARPEÆ.—Trees, shrubs, or herbs, with alternate, stipulate leaves covered with asperities, lactescent : *flowers* apetalous, in fleshy heads : *fruit* in a fleshy receptacle ; or covered with a succulent involucrum : *seed* suspended, solitary, with the *embryo* inverted, and its radicle pointing to the hilum.

Geo. position : Tropical climates.

Demulsive :

Ficus *Carica.*
Morus *nigra.*
Dorstenia *Contrajerva.*

CUPULIFERÆ.—Trees or shrubs with simple, alternate, stipulate leaves, with straight veins from midrib to margin : *flowers* amentaceous, diœceous, apetalous : *ovarium* inferior, enclosed in cupule, or coriaceous involucrum : *ovules* definite, pendulous, two or more in a cell : *fruit*, a horny or coriaceous nut.

Geo. position: Temperate zones.

Yielding astringent principles ; Tannin—Gallic acid ?

Quercus *Robur.*
——— *Infectoria.*
——— *pedunculata.*

SALICINEÆ.—Trees or shrubs with simple, alternate, sti-

pulate, frequently glandular leaves: *flowers* Achlamydeous*, amentaceous: *ovarium* superior, one or two-celled: *fruit* coriaceous: *seeds* indefinite, comose†.

Geo. position: Europe, Northern Asia, North America.

Yielding Tannin and a tonic principle:

Salix *fragilis*.
—— *Alba*.
—— *Caprea*.
Populus *tremula*.

EUPHORBIACEÆ.—Trees, shrubs, and herbaceous plants, with alternate, simple leaves: *flowers* apetalous, unisexual, axillary, or terminal: *ovarium* three-celled, with definite, suspended *ovules*: *seed* suspended, with an arillus: *embryo* surrounded with oily albumen.

Geo. position: Equinoctial America and Africa, Cape of Good Hope, a few in Europe and North America.

Yielding an acrid principle:

Euphorbia *officinarum*.
———— *Canariensis*.

an emetic principle:

Euphorbium *Gerardiana*.
———— *Ipecacuanha*.

purgative acrid oil:

Croton *Tiglium*.
Ricinus *communis*.

aromatic tonic principles:

Croton *Cascarilla* (Eluteria ?).

nutritive fecula:

Iatropha *Manihot*.

RHAMNEÆ.—Trees or shrubs with simple alternate leaves with minute stipules: *flowers* axillary or terminal, polypetalous: cucullate‡ *petals*; valvate *calyx*; perigynous *stamens*, definite in number: *ovarium* superior, with several cells surrounded by a fleshy disk: *seeds* erect, albuminous.

Geo. position: General over the globe, except in the Arctic zone.

Yielding a purgative principle:

Rhamnus *catharticus*.

VITES.—Climbing shrubs with tumid joints and stipulate leaves: *flowers* polypetalous, small, green, symmetrical, on ramose peduncles: *stamens* hypogenous, definite in number, with distinct filaments, and ovate versatile anthers: *ovarium* superior,

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* Flowers in which the *calyx* and *corolla* are absent.
† Comose—having appendages consisting of long hairs.
‡ Cucullate—surface of the petal deeply depressed.

entire, two-celled: *fruit* baccate: *seeds* albuminous, with an erect embryo.

Geo. position: Warm and temperate zones of both hemispheres.

Yielding a saccharine matter—acid:

Vitis *vinifera.*

MELIACEÆ.—Trees or shrubs with alternate, exstipulate leaves: *flowers* symmetrical: *calyx* imbricated: *corolla* polypetalous: petals cohering at the base: *stamens* hypogynous, definite in number, combined in a long tube; *anthers* subsessile within the orifice of the tube: *ovarium* of several cells, with a placental axis: *seeds* definite, apterous, exalbuminous, with a straight embryo.

Geo. position: East and West Indies, South America, Africa.

Yielding an aromatic principle:

Canella *alba.*

AURANTIACEÆ.—Trees or shrubs with alternate, often compound, sometimes winged leaves, dotted: *flowers* symmetrical, polypetalous, with an urceolate *calyx*, and *petals* inserted on the outside of a hypogynous disk: *stamens* hypogynous, definite: *style* single: *ovarium* entire, many-celled: *fruit* pulpy, without a woody axis, rind studded with receptacles of volatile oil: *seeds* attached to the *axis*, with a *raphe** and *chalaza*† distinctly marked, often containing two *embryos.*

Geo. position: East Indies, extending over the rest of the tropics.

Yielding an aromatic oil—acid:

Citrus *aurantium.*

——— *medica.*

BURSERACEÆ.—Trees or shrubs with pinnated, alternate leaves, without pellucid dots: *flowers* regular, polypetalous: *calyx* persistent: *petals* 3 to 5 on a disk, arising from the calyx: *stamens* 2 to 4 times as many as petals, perigynous: *ovarium* sessile, superior, 2-celled: *fruit* drupaceous, with exalbuminous seeds: *cotyledons* wrinkled: *radicle* straight.

Geo. position: Within the tropics.

Yielding Gum-resin:

Boswellia *serrata.*
Icica *heptophylla.*
Balsamidendron *Gileadensis.*
——————— *Myrrha.*

ANACARDIACEÆ.—Trees or shrubs with alternate, exstipulate leaves, without pellucid dots: *flowers* polypetalous, unisexual: *calyx* small, persistent: *petals* perigynous, imbricated in æsti-

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* Raphe—the surface by which the two parts of a double fruit touch each other.

† Chalaza—coloured part in the interior membrane of the seed, where the umbilical cord passes into the seed.

vation: *stamens* alternate, with petals, part sterile: *ovarium* superior, simple: *fruit* indihescent, commonly drupaceous: *seeds* solitary, exalbuminous.

Geo. position: Within the tropics and Temperate zones.

Yielding volatile oil:

Rhus *Toxicodendron.*
Pistacia *Lentiscus.*
——— *Terebinthus.*

DIOSMEÆ.—Trees and shrubs with exstipulate, dotted leaves: *flowers* axillary or terminal, polypetalous, symmetrical, hermaphrodite: *stamens* definite, hypogynous, with an imbricate *calyx*, definite in number: *ovarium* sessile, entire, containing several cells: *ovules* twin: *style* single: *fruit* consisting of several concrete capsules: the *endocarp** separating from the *sarcocarp*†, which is two-valved: *seeds* twin or solitary, with a testaceous integument.

Geo. position: Cape of Good Hope; equinoctial regions of America.

Yielding an aromatic principle:

Diosma *crenata.*
Cusparia *febrifuga.*
Erodia *febrifuga.*
Ticerea *febrifuga.*

RUTACEÆ.—Herbaceous plants with alternate, simple, deeply-lobed, exstipulate, dotted leaves: *flowers* symmetrical, in a centrifugal inflorescence: *calyx* 4-5 cleft, imbricate; *petals* alternate with the divisions of the calyx: definite hypogynous *stamens*: *ovarium* entire, celled: *carpella* concrete: *fruit* capsular, the *endocarp* not separable from the *sarcocarp.*

Geo. position: Temperate zones.

Yielding volatile oil:

Ruta *graveolens.*

ZYGOPHYLLEÆ.—Trees, shrubs, and herbaceous plants with opposite, stipulate leaves without dots: *flowers* polypetalous, symmetrical: *calyx* imbricated: *stamens* definite, arising from hypogynous scales, dilated at the base: *ovarium* entire, with several cells: *stigma* simple: *fruit* capsular, *carpella* concrete: *ovules* pendulous.

Geo. position: America.

Yielding Guiaicum:

Guiaicum *officinale.*

SIMARUBACEÆ.—Trees or shrubs with alternate exstipulate leaves without dots: *flowers* polypetalous, symmetrical, with a 4-5 divided *calyx*, and *petals* equal in number to these divisions: *stamens* double the number of the petals, hypogynous: *ovarium*

* Endocarp—the internal skin of the fruit.
† Sarcocarp—fleshy matter under the skin of the fruit.

entire, cellular; *ovules* solitary, pendulous: *fruit* indehiscent drupes, arranged round a common receptacle: *seeds* pendulous, with an exalbuminous embryo.

Geo. position: Tropical America, Africa, India.

Yielding a bitter-tonic principle:

Quassia *excelsa*.

——— *simaruba*.

OXALIDEÆ.—Herbs with compound alternate leaves: *flowers* polypetalous, symmetrical, with an imbricated *calyx*: *stamens* definite, distinct, hypogynous: *ovarium* of several cells, with placentæ in the axis: *seeds* indefinite, exalbuminous, with a straight *embryo*.

Geo. position: Tropics and temperate zones.

Yielding an acid:

Oxalis *acetosella*.

POLYGALEÆ.—Shrubs or herbaceous plants with exstipulate leaves: *flowers* polypetalous, unsymmetrical: *calyx* regular, imbricated: *petals* three, one being anterior and larger than the rest: *keel* sometimes entire and crested, sometimes lobed and not crested: *stamens* definite, hypogynous in one parcel: *ovarium* superior, two-celled, with a placental *axis*: *fruit* dehiscent, with pendulous *seeds*.

Geo. position: Asia and America.

Yielding a bitter acrid principle:

Polygala *Senega*.

an astringent matter:

Krameria *triandra*.

VIOLACEÆ.—Herbs with simple stipulate *leaves*: *flowers* polypetalous: *calyx* five distinct sepals: *petals* same number, hypogynous: *stamens* alternate with the *petals*, hypogynous, definite, with cohering, bilocular *anthers* bursting inwards: *ovarium* one-celled, many-seeded, with narrow, parietal placentæ: *seeds* with a straight *embryo*, erect in the *axis* of fleshy albumen.

Geo. position: Europe, America, Siberia.

Yielding a stimulant-emetic principle:

Viola *odorata*.

LINEÆ.—Herbaceous plants with entire, exstipulate, usually alternate leavas: *flowers* symmetrical, polypetalous, consisting of a regular imbricate *calyx* and unguiculate *petals*: definite, hypogynous *stamens*: an entire *ovarium* of several cells, with placentæ in the *axis*, pendulous *ovules*, a distinct *style*, and capitate *stigmas*: *seeds* compressed and inverted: exalbuminous, flat *cotyledons*.

Geo. position: Europe and North America.

Yielding Mucilage and fixed oil:

Linum *usitatissimum*.

a cathartic principle:

Linum *catharticum*.

CARYOPHYLLEÆ.—Herbaceous plants with opposite, entire leaves: *flowers* polypetalous, symmetrical: *calyx* imbricate: *corolla* hypogynous: *stamens* definite: *ovarium* celled, with a placental *axis*: *embryo* coiled round a mealy albumen.

Geo. position: Temperate zone.

Yielding a volatile oil:

Dianthus *Caryophyllus*.

POLYGONEÆ.—Herbaceous plants, with alternate, stipulate, or orchreated leaves: *flowers*, in many instances, in racemes, apetalous: *stamens* definite, inserted at the bottom of the *calyx*, which is inferior and divided: *ovarium* superior, with a single, erect *ovule*: *seeds* with farinaceous albumen, and a *radicle* remote from the hilum.

Geo. position: General over the globe.

Yielding a purgative principle:

Rheum *palmatum*.

——— *undulatum*.

——— *Australe*.

Rumex *Aquaticus*.

——— *obtusifolius*.

Acid:

Rumex *acetosa*.

an astringent principle:

Polygonum *bistorta*.

PIPERACEÆ.—Shrubs or herbaceous plants with opposite, verticellate, exstipulate leaves: *flowers* achlamydeous, with *stamens* adhering to the base of the *ovarium*, which is superior, one-celled, crowned with a sessile *stigma*: *fruit* superior, fleshy, indehiscent, one-celled: *seed* erect: *embryo* enclosed in a sac.

Geo. position: Indian Archipelago.

Yielding a stimulant-tonic principle:

Piper *nigrum*.

—— *longum*.

—— *Cubeba*.

STRYACEÆ.—Trees or shrubs, with alternate, exstipulate, toothed leaves: *flowers* monopetalous, axillary, solitary or clustered: *stamens* indefinite or definite, of unequal length, arising from the tube of the *corolla*, cohering slightly: *ovarium* superior, adhering to the *calyx*, containing several *cells*, definite *ovula*: *style* simple: *stigma* capitate: *ovarium* superior, with several cells: *fruit* drupaceous.

Geo. position: Asia, North and South America.

Yielding Resin:

Styrax *officinale*.

an acid and volatile oil:

Styrax Benzoin.

ERICEÆ.—Shrubs with evergreen, rigid, entire, whorled, exstipulate leaves: *flowers* monopetalous, regular: *calyx* persistent, inferior, 4-5 cleft: *corolla* hypogynous: *stamens* definite, inserted into the base of the *corolla:* two-celled, dry *anthers*, with appendages: *ovarium* superior, many-seeded: *seeds* apterous, with the *embryo* in the *axis* of the albumen.

Geo. position: Europe, America, Cape of Good Hope.

Yielding an astringent principle:

Arbutus *uva-ursi.*

a stimulant principle:

Rhododendron *Chrysanthum.*

PYROLACEÆ.—Herbaceous plants with simple, entire, toothed leaves: *flowers* in terminal racemes, monopetalous, regular, deciduous: *stamens* hypogynous, double the number of the *petals*, bearing two-celled dry *anthers*, with appendages: *ovarium* superior, many-seeded, with a single declinate *style*: *seeds* winged: *embryo* minute, invested in fleshy albumen.

Geo. position: Europe, North America, Northern Asia.

Yielding a diuretic stimulant principle:

Chimaphila *Umbellata.*

LOBELIACEÆ.—Herbs or shrubs with alternate, exstipulate leaves: *flowers* monopetalous, with an irregular corolla: *stamens* syngenesious*: *ovarium* inferior, 1 to 3 celled: *ovula* indefinite, numerous: *fruit* capsular, dehiscing at the apex: *seeds* with straight embryo, in the axis of fleshy albumen: *radicle* pointing to the hilum.

Geo. position: Temperate zones.

Yielding an emetic principle:

Lobelia *inflata.*

CUCURBITACEÆ.—Climbing herbs with palmated, succulent, scabrous leaves: *flowers* unisexual, monopetalous, with a five-toothed *calyx;* and five-parted, regular, cellular *corolla*: *stamens* cohering in three parcels: *anthers* long, sinuous: *ovarium* inferior, with three parietal placentæ: *fruit* fleshy: *seeds* flat: *testa* coriaceous: *embryo* exalbuminous.

Geo. position: Tropical climates: a few in the North of Europe, North America, and the Cape of Good Hope.

Yielding a purgative gum-resin:

Cucumis *Colocynthis.*

Elatin:

Momordica *Elaterium.*

VALERIANEÆ.—Herbs with opposite, exstipulate leaves: *flowers* corymbose†, panicled, or in heads, monopetalous: *corolla*

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* Syngenesious—filaments *of the stamens* free, bearing anthers united in a tube.

† Corymbose—when the flower-stalks rising from one common stalk are of such lengths that all the flowers appear on the same horizontal plane.

tubular, some calcarate* at the base: *stamens* distinct: *ovarium* inferior, two-celled: *ovules* solitary, pendulous: *fruit* dry, indehiscent: *seeds* exalbuminous.

Geo. position: Temperate zones, but uncommon in Africa and North America.

Yielding a fœtid volatile oil:

Valeriana *officinalis*.

COMPOSITÆ.—Herbaceous plants or shrubs with alternate or opposite, exstipulate leaves: *flowers* consisting of a dense head of florets on a common receptacle, enclosed by an involucrum: *florets* monopetalous: *calyx* adhering to the ovary: *corolla* either funnel-shaped or ligulate: *stamens* syngenesious: *anthers* cohering and opening inwards: *ovarium* one-celled, with one erect *ovule*: *fruit* a dry indehiscent pericarp, crowned with the limb of the *calyx*.

Geo. position: General over the globe.

Yielding a demulsive fecula or mucilage:

Arctium *lappa*.

Tussilago *farfara*.

a bitter principle:

Corymbiferæ:

Anthemis *nobilis*.

Artemisia *Absinthium*.

——— *Chinensis*.

——— *Indica*.

——— *Santonica*.

Inula *Helenium*.

Chichoraceæ:

Leontodon *Taraxacum*.

Cynarocephalæ:

Cnicus *benedictus*.

a narcotic principle:

Lactuca *virosa*.

——— *sativa*.

an acrid principle:

Anthemis *pyrethrum*.

STELLATÆ.—Herbaceous plants with whorled, exstipulate, scabrous leaves, and quadrilateral stems: *flowers* small, monopetalous: *corolla* rotate or tubular, inserted into the *calyx*, which is lobed: *stamens* definite, alternating with the segments of the *corolla*: *ovarium* two-celled: *ovules* solitary: *fruit* inferior, didymous: *seeds* erect.

Geo. position: Northern parts of the northern hemisphere.

Yielding a colouring stimulant principle:

Rubia *tinctorum*.

CINCHONACEÆ.—Trees or shrubs with opposite, simple

* Calcarate—having a spur.

leaves, and interpetiolar *stipules*: *flowers* monopetalous in panicles: *calyx* superior, simple, with connate bractes at its base: *corolla* tubular, regular, with definite divisions of the limb: *stamens* adhering to the corolla on the same line: *ovarium* inferior, crowned with a disk: *ovules* numerous: *style* single, with a sometimes divided *stigma*: *fruit* inferior, either splitting into two cocci* or indehiscent: *seeds* attached to central *axis*, when indefinite; when definite, erect: *embryo* small, albuminous.

Geo. position: Within the tropics, especially in South America.

Yielding a tonic principle; Quinia, Cinchonia:

Cinchona *cordifolia.*
——— *lancifolia.*
——— *Condaminea.*
——— *lanceolata.*
——— *nitida.*
——— *ovata.*
——— *oblongifolia.*
Portlandia *hexandra.*

Yielding an emetic principle; Emetina:

Cephaelis *Ipecacuanha.*

astringent matter; Tannin:

Nauclea *Gambeer.*

CAPRIFOLIACEÆ.—Shrubs or herbaceous plants with opposite, exstipulate leaves: *flowers* corymbose, monopetalous, with a superior bracteated *calyx*, and a rotate or a tubular *corolla*: *stamens* alternating with the lobes of the corolla: *ovarium* inferior, many celled: *ovules* pendulous: *fruit* indehiscent: *seeds* solitary and pendulous, or numerous and attached to the *axis*.

Geo. position: Northern Europe, Asia, and America.

Yielding a laxative principle:

Sambucus *nigra.*

a tonic principle:

Cornus *florida.*

ASCLEPIADEÆ.—Shrubs with entire, opposite, sometimes alternate leaves: *flowers* regular, in umbels, racemes, or fascicles: *calyx* persistent: *corolla* monopetalous, hypogynous, regular, deciduous: *stamens* five, alternate with segments of the limb: *anthers* two-celled: *pollen* cohering in masses: *ovaria* two: *styles* two: *follicles* two.

Geo. position: Africa, India, New Holland, eastern side of North America.

Yielding an acrid principle:

Asclepias *gigantia.*

APOCYNEÆ.—Milky trees or shrubs, with opposite, somewhat whorled, exstipulate leaves, with glands on the petioles:

* Coccum—a peculiar kind of seed vessels which opens with an elastic spring.

inflorescence corymbose : *flowers* regular, with a contorted corolla : *stamens* arising from the corolla, alternate with its segments : *pollen* powdery : *ovarium* superior, double, the apex connected by a common, simple stigma : *seeds* with a fleshy albumen, foliacious embryo, and radicle turned towards the hilum.

Geo. position : Africa, India, New Holland, North America.

Yielding Strychnia :

Strychnos *Nux vomica.*

——— *St. Ignatius.*

GENTIANEÆ.—Herbaceous plants with opposite, entire, sessile, exstipulate leaves : *flowers* terminal, axillary : *calyx* monophyllous, persistent : *corolla* hypogynous, imbricate, withering, monopetalous : *stamens* inserted into the corolla, some abortive : *ovarium* single, superior, celled : *style* continuous : *stigma* simple or bifid : *fruit* a many-seeded berry.

Geo. position : General over the globe.

Yielding bitter tonic principles :

Chironia *Centaurium.*

Gentiana *Lutea.*

Menyanthis *trifoliata.*

SPIGELACEÆ.—Herbs or under-shrubs, with opposite, entire, somewhat stipulate leaves : *flowers* regular, monopetalous, valvate : *stamens* five, inserted into the corolla in one line : *pollen* three-cornered, with globular angles : *ovarium* superior, two-celled : *fruit* capsular, two-celled, two-valved : *seeds* several, small, with a single testa : *embryo* minute, lying in a thick fleshy albumen : radicle pointing to the hilum.

Geo. position : North America, within the southern tropic.

Yielding an acrid principle :

Spigelia *Marilandica.*

CONVOLVULACEÆ.—Herbaceous plants with alternate, undivided, exstipulate leaves : *flowers* axillary, or terminal, monopetalous, regular : *calyx* persistent : *corolla* hypogynous, deciduous, plaited : *stamens* inserted into the base of the corolla : *ovarium* simple, superior, 2-4-celled : *ovules* definite and erect : *style* divided : *stigmas* obtuse or acute : *seeds* albuminous.

Geo. position : Tropical climates, rare in cold climates.

Yielding a resinous purgative principle :

Convolvulus *Scammonia.*

——— *Jalapa.*

OLEACEÆ.—Trees or shrubs with opposite, simple, or pinnated leaves : *flowers* regular, monopetalous, hermaphrodite, or diœcious : *calyx* monophyllous, inferior, persistent : *corolla* hypogynous, 4-cleft, valvate, sometimes apetalous : *stamens* two : *ovarium* simple, superior, two-celled : *seeds* pendulous.

Geo. position : Temperate zones.

Yielding a fixed oil :

Olea *Europea.*

mannite:

Fraxinus *ornus*.

SCROPHULARINEÆ. — Herbaceous plants with opposite leaves: *flowers* monopetalous, irregular, unsymmetrical: *calyx* divided, persistent: *corolla* hypogynous: *stamens* didymous: *ovarium* superior, two-celled: *fruit* capsular, superior, two-celled: *seed* albuminous: *embryo* in a fleshy albumen: radicle orthotropous*.

Geo. position: General over the globe.

Yielding a Cathartic principle:

Gratiola *officinalis*.

Scrophularia *nodosa*.

a narcotic, diuretic principle:

Digitalis *purpurea*.

SOLANEÆ.—Herbaceous plants or shrubs, with alternate leaves: *flowers* monopetalous, regular: *calyx* inferior, five-parted, persistent: *corolla* monopetalous, plaited, hypogynous, deciduous: *stamens* inserted into the corolla: *anthers* bursting longitudinally, and by pores at the apex: *ovarium* two-celled, with two polyspermous placentæ: *ovules* indefinite: *stigma* simple: *fruit* succulent: *seeds* numerous, sessile: *embryo* curved, lying in fleshy albumen.

Geo. position: General, but especially within the tropics.

Yielding narcotic principles:

Atropa *Belladonna*.

Datura *Strammonium*.

——— *ferox*.

Hyosciamus *niger*.

Nicotiana *Tabacum*.

Solanum *Dulcamara*.

an acrid principle:

Capsicum *annuum*.

Demulcent mucilage:

Verbascum *thapsus*.

LABIATÆ.—Herbaceous plants with quadrilateral stems and opposite, exstipulate leaves: *flowers* irregular, unsymmetrical, in opposite, nearly sessile, axillary cymes: *calyx* inferior, persistent: *corolla* monopetalous, hypogynous, bilabiate: *stamens* four, didymous, inserted in the corolla: *anthers* celled: *ovarium* deeply four-lobed: *style* proceeding from the base of the lobes of the ovarium: *fruit* 1-4 small nuts in the persistent calyx: *seeds* erect.

Geo. position: Temperate zones, between parallels of 40° and 50° north latitude.

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* Orthotropous—when a straight embryo lies in a direction the opposite to that of the grain.

Yielding volatile oil:

Hyssopus *officinalis.*
Lavandula *spica.*
Marrubium *vulgare.*
Melissa *officinalis.*
Mentha *piperita.*
——— *viridis.*
——— *pulegium.*
Origanum *vulgare.*
——— *majorana.*
Rosmarinus *officinalis.*
Salvia *officinalis.*

BORAGINEÆ.—Herbaceous plants or shrubs, with alternate leaves covered with asperities: *calyx* persistent, with 4-5 divisions: *corolla* monopetalous, hypogynous, regular: *stamens* inserted within the petal: *ovarium* superior, deeply lobed: *style* simple: *seeds* destitute of albumen.

Geo. position: Temperate zone of the northern hemisphere.

Yielding a mucilaginous colouring matter:

Anchusa *tinctoria.*

TRIBE II. GYMNOSPERMÆ.

CONIFERÆ.—Trees or shrubs with a stem abounding with resin: linear, acerose, or lanceolate leaves, entire at the margin, or dilated and lobed, sometimes fascicled: *flowers* monœcious or diœcious: *anthers* two-lobed: *pollen* large, usually compound: *ovarium*, in the cones spread open, resembling a scale destitute of style or stigma, and arising from a membranous bracte; in the solitary flower defective: *fruit* consisting of either a solitary naked seed or of a cone: *seeds* with a hard crustaceous tegument: *embryo* in an oily albumen, with two or many opposite cotyledons.

Geo. position: Temperate climates, the arctic circle, and the hottest regions of the Indian Archipelago.

Yielding a resinous volatile oil:

Pinus *abies.*
—— *sylvestris.*
—— *Larix.*
—— *Balsamea.*
Juniperus *communis.*
——— *Sabina.*
——— *Lycia.*

MONOCOTYLEDONS, OR ENDOGENOUS PLANTS.

TRIBE I. PETALOIDEÆ.

IRIDEÆ.—Smooth, herbaceous plants with equitant leaves: *inflorescence* terminal, in spikes, corymbs, panicles, or crowded:

flowers hexapetalous, triandrous: *stamens* three, arising from the base of the sepals: *filaments* distinct or connate: *anthers* fixed by their base, two-celled, bursting externally lengthways: *ovarium* three-celled, many seeded: one *style:* five *stigmas*, often petaloid, sometimes two-lipped: *capsule* three-celled, three-valved: *seeds* attached, either to a central column or parietal placentæ: *embryos* enclosed in albumen.

Geo. position: Cape of Good Hope, middle parts of North America, Europe; few within the tropics.

Yielding a volatile oil:

Crocus *sativus.*
Iris *Florentina.*

SCITAMINEÆ.—Herbaceous plants with a creeping, often jointed *rhizoma**, and a stem formed of bases of the leaves, never branching: *leaves* simple, sheathing, having a single midrib, whence numerous veins diverge at an acute angle: *flowers* tripetaloideous: *calyx* superior, tubular, three-lobed: *corolla* tubular, irregular: *stamens* three, distinct, two abortive, the intermediate one fertile: *filament* not petaloid: *anther* two-celled, its lobes often embracing the upper part of the style: *pollen* globose, smooth: *ovarium* three-celled: *ovules* attached to a placental axis: *style* filiform: *stigma* dilated, hollow: *fruit* capsular, three-celled, many seeded: *seeds* roundish or angular, with or without an arillus, and the embryo enclosed within a peculiar membrane.

Geo. position: Tropical climates.

Yielding an aromatic volatile oil:

Zingiber *officinale.*
Elettaria *Cardamomum.*
Amomum *aromaticum.*
——— *maximum.*
Curcuma *longa.*

MELANTHACEÆ.—Herbs with fibrous or fascicled roots: *rhizoma* sometimes fleshy: *leaves* sheathing at the base, with parallel veins: *flowers* hexapetaloideous, tubular: *stamens* six, with *anthers* turned outwards: *ovarium* three-celled: *style* trifid: *stigmas* undivided: *seeds* albuminous, with a membranous *testa.*

Geo. position: Europe, Cape of Good Hope, Asia, America, New Holland.

Yielding veratria:

Colchicum *autumnale.*
Veratrum *album.*

ASPHODELEÆ.—Herbaceous plants, occasionally trees, with bulbs or fascicled roots: *leaves* with parallel veins: *peduncles* articulated in the middle: *flowers* hexapetaloideous, the *pe-*

* Rhizoma—a part of the stem which is sometimes underneath the soil, and always emits radicles.

rianth regular, coloured: *stamens* six, hypogynous, the three opposite to the sepals irregular, sometimes absent: *anthers* turned inwards: *ovarium* superior, three-celled: *style* one, undivided: *stigma* entire: *fruit* a three-celled capsule: *seeds* numerous, with a hard, black, brittle testa: *albumen* fleshy: *embryo* included.

Geo. position: Temperate climates, widely scattered.

Yielding scillitina:

Scilla *maritima*.

an acrid, oily principle:

Allium *sativum*.

——— *Cepa*.

——— *Porrum*.

a bitter purgative principle:

Aloës *Spiccata*.

—— *vulgaris*.

—— *perfoliata*.

SMILACEÆ.—Herbaceous, climbing plants: *leaves* with reticulated veins: *flowers* hexapetaloideous, hermaphrodite, sometimes diœcious: *perianth* inferior, coloured: *stamens* six, inserted into the perianth: *anthers* turned inwards: *ovarium* three-celled, superior: *style* usually trifid: *stigmas* three: *fruit* a berry, containing seeds with a membranous testa: *albumen* nearly cartilaginous.

Geo. position: Asia, North America.

Yielding a mucilaginous unknown principle:

Smilax *Sarsaparilla*.

——— *Aspera*.

——— *China*.

PALMÆ.—Plants with an arborescent trunk, covered with the sheathing bases of leaves: the *leaves* rigid, terminal, clustered, pinnate, or flabelliform: *inflorescence* a terminal spadix*, enclosed in a many-valved spatha†: *flowers* small, bracteolated, each a hexapetaloideous, persistent *perianth*: *stamens* inserted into the base of the perianth, definite in number: *ovarium* superior, three-celled: *ovules* erect: *fruit* baccate, or drupaceous, with fibrous flesh.

Geo. position: Tropical regions, except in South America and the west coast of New Holland.

Abounding in oil and amylaceous matter:

Cocos *butyracea*.

Sagus *farinifera*.

Phœnix *farinifera*.

Yielding wax:

Ceroxylon *andicola*.

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* Spadix—a spike with a succulent axis, bearing either small blossoms or naked sexual organs.

† Spatha—a foliaceous floral covering, formed of one or more floral leaves.

AROIDEÆ.—Herbaceous plants with leaves sheathing at the base: *flowers* unisexual, spadiceous, enclosed in a spathe, frequently naked: *stamens* definite or indefinite, hypogynous, very short: *anthers* celled, ovate, turned outwards: *ovarium* superior, celled: *ovules* erect or pendulous: *stigma* sessile: *fruit* succulent, indehiscent: *seeds* solitary or several: *embryo* in the axis of fleshy albumen.

Geo. position: Tropical countries, where they are often arborescent: a few extend to the North of Europe, but they are herbaceous plants.

Yielding an aromatic oil:

Acorus *Calamus.*

TRIBE II. GLUMACEÆ.

GRAMINEÆ.—Herbaceous plants consisting of cylindrical, fistular, siliceous, and pointed culms, with a fibrous or bulbous rhizoma, and alternate leaves with a split sheath: *flowers* in locustæ*, hermaphrodite, sometimes monœcious, glumaceous: *glumes*† alternate, unequal: *paleæ*‡ alternate, the exterior simple: *scales* 2-3, sometimes absent: *stamens* hypogynous: *anthers* versatile: *ovarium* simple: *styles* 2: *stigmas* feathery or hairy: *pericarp* membranous: *albumen* farinaceous.

Geo. position: General over the globe, a few confined to the tropics.

Yielding a saccharine matter:

Saccharum *officinarum.*

farinaceous matter:

Avena *sativa.*
Hordeum *distichon.*
Triticum *hybernum.*
Secale *cereale.*

CELLULARES.

The second of the great divisions of the Natural System contains very few medicinal plants; but the parasites, which cover many of the medicinal barks, and are characteristic of their qualities, belong to it. There are neither flowers nor sexual organs present in the plants of this division: the reproduction takes place by means of *sporæ* or germs, which are either enclosed in particular cases termed *thecæ*, or embedded

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* Locusta—a short axis bearing alternate imbricate flowers.

† Glume—the exterior floral covering in grasses.

‡ Paleæ—small scales intermixed with the florets in the grasses.

in the substance of the plant. The plants of this division have been judiciously divided into three tribes:—*Fern-like*, *moss-like*, and *leafless*, flowerless plants.

I. FERN-LIKE PLANTS.—FILICOIDEÆ.

FILICES.—Leafy plants, producing a *rhizoma*, either subterrane or rising into the air like the trunk of a tree: it is coated by a hard, cellular, fibrous rind, composed of the united bases of leaves: the *leaves* are either simple or variously divided, traversed by dichotomous* cellular veins, with occasional ducts: *stomata* are sometimes observed on the cuticle. The *reproductive organs* consist of *thecæ*, either pedicillate or sessile, appearing on the back or the margin of the leaves, springing either from beneath the cuticle or from the actual surface of the leaves: the *vernation* is circinate.

Geo. position: Nearly general over the globe.

Yielding an acrid purgative principle:

Aspidium *filix mas.*

Appearing as parasites in the Cinchona barks.

Hymenophyllum *Tunbridgense.*
Grammitis *serrulata.*
Asplenium *pumilum.*

II. MOSS-LIKE PLANTS—MUSCOIDEÆ.

MUSCI.—Cellular plants having a distinct axis of growth, with minute, imbricated, entire, or serrated leaves: *Reproductive organs* either axillary, pedicillated, hollow bodies, containing spherical or oval particles, which are emitted on the application of moisture, or urn-like *thecæ*, covered by a membranous *calyptra*†, closed by an *operculum*‡, and filled with sporules attached to an axis.

Geo. position: Wherever the atmosphere is humid, thence abounding in tropical forests.

Appearing as parasites in the Cinchona barks:

Leucodon *tomentosus.*
Leskea *densa.*
Hypnum *Loxense.*
——— *Langsdorffii*§

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* This term implies that the divisions are always in pairs.

† Calyptra—the interior covering of the ovarium in mosses.

‡ Operculum—a lid which covers the urn in mosses, and which loosens itself when the sporules are ripe.

§ This species of Hypnum is found only on semiputrid, bad, pale bark; but in general the mosses do not indicate a bad quality of the bark.

HEPATICÆ.—Cellular, terrestrial plants, consisting of an axis or stem, either leafy or bordered by a membranous expansion: the *reproductive organs* are either valved *thecæ*, supported on membranous peduncles, and containing *elateres*§, within which the sporules are intermixed, or a peltate receptacle, with *thecæ* on its under surface, or sessile naked *thecæ*.

Geo. position: Damp, shaded places in all climates.

Appearing as parasites on bad Cinchona barks.

Jungermannia *filicina*.
——— *Tamarisci*.
——— *atrata*.

Appearing as parasites on bad Cusparia bark.

Jungermannia *horizontalis*.

III.—LEAFLESS PLANTS.—APHYLLÆ.

LICHENES.—Aerial, leafless, perennial plants, spreading over almost all dry surfaces, whether of trees or stones, which are freely exposed to the light: the body of the plant consists of a cellular and fibrous, lobed and foliaceous, either hard and crustaceous or warty substance, termed a *thallus*‖: the reproductive organs are either *sporules*, in membranous thecæ, forming little disks or shields on the surface of the thallus, or separated cellules of the medullary layer of the thallus: both are termed generally *apothecia*¶.

Geo. position: General over the globe.

Yielding fecula and a bitter principle:

Cetraria *Islandica*.

colouring matter:

Rocella *tinctoria*.

Appearing as parasites on the officinal barks of Cinchona:

Opegrapha *globosa**. O. *ovata**. O. *Bomplandi*.‡ O. *nana**.
O. *subimmersa**. O. *farinacea*‡. O. *Peruviana*†.
O. *rabdotis**. O. *Condaminea**. O. *rugulosa**.
O. *scaphella**. O. *rhizocola**.

Graphis *fulgurata**. G. *exilis**. G. *cinerea**. G. *pavoniana**.
G. *intricata**. G. *cinnabarina**. G. *hæmatites**.

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§ Elateres — elastic, membranous filets fixed to placentæ in the urn of some mosses.

‖ Thallus. — These consist of two parts: one cortical, wholly cellular; the other medullary, cellular, and filamentous.

¶ Apothecia are of various forms, and have different names; for instance, *pelta*, *scutella*, *patellula*, *cephalodium*, *tuberculum*, *trica*, *lirella*, *globulus*, &c.

* Characterising good pale bark. † Characterising good yellow bark.

‡ Characterising good red bark.

G. *oryzæformis*. G. *frumentaria*‡. G. *chlorocarpa**. G. *rubiginosa**. G. *nivea*‡.

Arthonia *gregaria**. A. *sinensigrapha**. A. *sulfurea**. A. *marginata**. A. *obtrita**. A. *leucocheila**.

Sarcographa *Cinchonarum**.

Fissurina *Dumastii*.

Chiodecton *sphærale**. C. *effusum*†. C. *Meratii**. C. *depressum**.

Trypethelium *variolosum*†. T. *variolosum**. T. *verrucosum**. T. *chiodectonoides*†. T. *clandestinum*†. T. *Sclerotium*†. T. *tetrathalamium**.

Pyrenula *discolor**. P. *umbrata*†. P. *clandestina*†. P. *trypanea*†. P. *annularis*†. P. *pinguis**. P. *verrucarioides**. P. *porinoides*†. P. *mollis*. P. *epapillata*†.

Porina *compuncta*‡. P. *granulata*†. P. *Americana*†§.

Verrucaria *Acharii*†. V. *sinapisperma*‡. V. *Cinchonæ**†‡. V. *catervaria*†.

Thelotrema *urceolare*‡. T. *lepadinum**. T. *terebratum*†. T. *verrucosum*†. T. *myriocarpum*‡.

Ascidium *Cinchonarum**†‡.

Lepra *flava**.

Gassicurtia *coccinea*†.

Variolaria *amara*†. V. *communis*†.

Urceolaria *cinchonarum**†‡.

Lecidea *aurigera*†. L. *tuberculosa*†. L. *conspersa*‡. L. *duplicata**. L.? *cuticula**. L. *tremelloïdea**.

Lecanora *soredifera*†. L. *flavo-virens**. L. *subfusca**†. L. *farinacea**. L. *pallidiflava**. L. *Persoonii**. L. *undulata*†.[1]

Parmelia *crenulata**. P. *pulvinata**†‡. P. *alba**†‡. P. *glandulifera**. P. *compacta*†.

Carcinaria *Erythroxyli**.

Sticta *Kunthii*†. S. *Cinchonæ**†‡.

Collema *azureum*. C. *diaphanum*.

Peltigera *vitellina*†.

Borrera *leucomela**. B. *furfuracea**†‡.

Ramalina *Cumanensis**.

Usnea *florida**†‡. U. *barbata**†‡.

Cornicularia *Loxensis**.

Cœnogonium *Linckii**†‡.

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§ On Cascarilla bark.

[1] All the Lecanoræ indicate good bark: the following species are general—*S. atra, endochroma, byssiseda, versicolor, sulfureo fusca, russula, punicea.*

* Characterising good pale bark. † Characterising good yellow bark.

‡ Characterising good red bark.

Appearing as parasites on cascarilla bark.

Opegrapha *abbreviata.* O. *comma.* O. *calcea.* O. *heterocarpa.* O. *myriocarpa.*
Graphis *tortuosa.* G. *pachnodes.* G. *Cascarillæ.* G. *lineola.* G. *serpentina.* G. *Caribea.* G. *Afzelii.* G.? *endocarpa.*
Arthonia *divergens.* A. *polymorpha.* A. *dilatata.*
Sarcographa *tigrina.* S. *Cascarillæ.*
Fissurina *lactea.*
Glyphis *favulosa.*
Trypethelium *Sprengelii.* T. *crassum.* T. *lageniferum.* T. *scoria.* T. *porosum.*
Parmentaria *astroidea.*
Pyrenula *leucostoma. endoleuca.* P. *nitida.* P. *pinguis.*
Porina *Americana.*
Veruccaria *epidermidis.* V. *caduca.* V. *Gaudichaldii.* V. *planorbis.* V. *serialis.*
Lecideæ? *Arthonioides.* L. *vernalis.*
Conoicarpa *Cascarillæ.* C. *myriadeum.*
Thelotrema *lepadinum.*
Parmelia *perlata.*

Appearing as parasites on Cusparia febrifuga:

Opegrapha *Bomplandi.*[2] O. *inæqualis.* O. *epipasta.*[2] O. *Pelletieri.*[1]
Graphis *leptocarpa.*[2] G. *glaucescens.*[2] G. *marcescens.*[2] G. *furcata.*[2] G. *rubella.*[2]
Arthonia *complanata.*[2] A.? *torulosa.*[2] A. *fuscescens.*[2] A. *granulosa.*[2] A. *glomerulosa.*[2]
Fissurina *Dumastii.* (var. *α. Bomplandiæ.*)[2]
Glyphis *favulosa.*[1, 2]
Chiodecton *seriale.*[2]
Perynula *umbrata.*[2] P. *Bomplandiæ.*[2] P. *nitida.*[2] P. *fimbriata.*[2] P. *irregularis.*[2]
Porina *marginata.*[2]
Verrucaria *stigmatella.*[2] V. *glauca.*[2] V. *Gaudichaldii.*[2] V. *thelena.*[2] V. *decolorata.*[2]
Theolotrema *Bomplandiæ.*[2]
Variolaria *microcephala.*[2]
Myriotrema *olivaceum.*[2] M. *album.*[2]
Urceolaria *viridescens.*[2]
Lecidea *complanata.*[2]

Appearing as parasites on Quassia excelsa.

Opegrapha *Bomplandi.* (var. *α. Quassiœcola.*)
Enterographa *quassiœcola.*
Pyrenula *nitida.*
Porina *Quassiæ.*

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[1] On false Cusparia. [2] On true Cusparia.

Verrucaria *epidermidis.* (var. γ *Quassiæcola.*)
Lecidea *carneola.*
Parmelia *minor.*
Thecari *quassiæcola.*
Carcinaria *Berteriana.*
Lecidea *carneola.*

Appearing as parasites on Winter's Bark.

Graphis *Caribœa.*
Pyrenula *nitida.*

FUNGI.—Cellular plants, aerial, leafless, flowerless, with no thallus, nor external sporuliferous disks; the sporules lying loose among the tissue, or enclosed in a membranous case called sporidia.

Possessing astringent properties:

Boletus *ignarius.*

Appearing as parasites on bad Cinchona barks.*

Himantia *Cinchonarum.*
Hypochnus *rubrocinctus.*
———— *nigrocinctus.*

ALGÆ.—Leafless, flowerless plants, without any distinct axis of vegetation, growing in water: without the *reproductive* organs, or with them contained in the joints of the filaments, in *thecæ: sporules* without any proper tegument, germinating by elongating on opposite *directions.*

Yielding a stimulant principle:

Fucus *vesiculosus.*

The localities of the foregoing list of Cryptogamic plants are those fixed by M. Fee†, who first pointed out to the practitioner, as well as to the student of Materia Medica, the importance of the study of these parasites in ascertaining the relative value of the different kinds of barks employed as medicinal agents. According to M. Fee, all the specimens of Cinchona bark on which *Hypochnus* is found, are doubtful, and those which afford a locality for the *Himantia*, the *Lycoperdons*, *Collemata*, and *Jungermannia*, are utterly useless; on the contrary, those may be regarded as good which display on the cuticle any of the *Graphidæ* or the *Lecanoræ.* The Lichens on the pale Cinchona bark have, for the most part, a thin white, or whitish, rarely yellow, and still more rarely a red or reddish *thallus*: they are chiefly groups of *Graphidæ*, *Verrucariæ*, and *Parmelaceæ*: those on the yellow Cinchona bark have a *thallus* of a whitish or whitish-yellow hue: they consist chiefly of specimens of *Graphis*, *Lecanora*, *Lecidea*, *Trypethelium*, *Chiodecton*, *Pyrenula*, *Verrucaria*, and *Hypochnus*: and on the red Cinchona bark these parasites are chiefly *Thelotrema*,

* Fungi indicate that the bark is of a bad quality.

† Essai sur les Cryptogammes des Ecorces exotiques officinales, 4to. *Paris,* 1824.

Opegraphæ, and some unknown lichens which have a peculiar thin white *thallus*, with and without a border. The Cascarilla bark is covered with *Graphidæ*, of elegant and singular formation, the white colour of the *thallus* of which is the chief source of the snowy hue of the exterior coat of the bark: now and then some yellow spots are perceived intermixed with the white, arising from the *thallus* of *Trypethelii;* but these are few compared with the *Graphidæ*. The true *Cusparia* is covered with Graphidæ, a few *Orpegraphe*, two *Verrucariæ* and two *Thelotremæ*, a *Glyphis*, a *Chiodecton*, an *Urceolaria*, two *Myriotrema*, and some remains of *Sticta Parmella* and *Jungermanniæ*: on the false Cusparia, on the contrary, there are rarely any parasitic plants, except Opegrapha *Pelletieri;* the tubercular, or, as it has been termed, leprous, character of the epidermis not depending on the presence of *Cryptogamia*: thence the presence or the absence of these parasites affords certain characteristics, in addition to the change of epidermis, for distinguishing the true from the false Cusparia bark.

SECTION III.

CHEMICAL ELEMENTS OF MEDICINAL AGENTS.

ALL medicinal agents, whether natural or artificial, consist of simple and compound substances. The simple are few, and chiefly inorganic matters; the compound belong to both the organic and inorganic kingdoms of nature. The compound bodies are either combinations of two simple substances, or they are compounds united with simple bodies or with each other; thus forming series the most extensive, which possess properties perfectly distinct from those of their components. But, although these combinations are varied, yet the elements from which they proceed are few; and the diversity of the substances, whether they be regarded in a chemical point of view, or as therapeutical agents exerting certain influences on the animal œconomy, is more the result of differences in the proportions than in the multiplicity or the number of the elements. From a few elementary matters, indeed, are produced not only the natural substances employed as medicines, but all those also which the pharmaceutical art supplies. These elementary bodies are such as, in the present state of our knowledge, we are unable further to decompose: on which account they are regarded as simple: and, as in noticing the analyses of the various substances of the Materia Medica, frequent reference must be made to them, it is necessary that we should have some general knowledge of their properties.

OXYGEN*.

The most important of the elementary bodies of which I have just spoken is oxygen—a principle with which we are unacquainted, except in a state of combination. It is the most widely distributed of all the elementary substances, forming a large proportion of the atmosphere, 88.9 hundredth parts of the whole of the water of the globe, and existing as a component of almost every product of the animal, the vegetable, and the mineral kingdoms. Oxygen is generally described as it exists in oxygen gas†—an invisible, inodorous, insipid, aeriform or gaseous substance, in which the oxygen is supposed to be combined with light and caloric; and electricity—an opinion originating from the fact, that both heat and light are evolved when the oxygen combines with other substances; such, for example, as the metals, or any other combustible, for which it has a great affinity.

In the purest state in which oxygen is known to us, that of oxygen gas, besides the heat and light emitted during combustion, both are extricated when this gas is forcibly compressed. Oxygen gas is colourless, tasteless, inodorous; it is heavier than atmospherical air: when the barometer stands at 30 inches and the thermometer at 60° Fahr. its specific gravity is 1.1111; and 100 cubic inches weigh 34.454 grains. Its chemical equivalent is 8. It combines with all other elementary bodies. When these are not metallic substances, the binary medicinal compounds which it forms, with a few exceptions, are *acids;* when they are metals, *metallic oxides* are the result, including the *mineral alkalies*, and the medicinal *earths*. The ternary and quaternary compounds, into which it enters in many instances, display also acid and alkaline properties; as, for example, the *vegetable acids* and *alkaloids*. In the *fixed* and *volatile oils*, in *alcohol*, *ether*, *saccharine matter*, *gum*, *resins*, *balsams*, *albumen*, *gluten*, *fats*, and almost all organic bodies constituting articles of the Materia Medica, oxygen exists as a component.

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* The term Oxygen is derived from the Greek words ὀξὺς, acid, and γεννάω, I generate. The experience of chemists, since the period of Lavoisier, who imposed this term, has demonstrated its incorrectness; oxygen not being the sole cause of acidity.

† Oxygen gas is usually procured from one or other of the following substances: peroxide of manganese, peroxide of mercury, deutoxide of lead, nitrate of potassa, and chlorate of potassa. The first affords it at the cheapest rate; the last yields the purest gas. If the peroxide of manganese be used, it must be exposed to a red heat in an iron bottle, placed in an open fire, and having a tube communicating with a pneumatic trough containing inverted bottles filled with water for receiving the gas. If chlorate of potassa be used, a green glass retort is sufficient; but it should never be more than half filled with the salt.

Oxygen is essential for the vital existence of all animals and vegetables. To the former it is requisite for carrying on the function of respiration, whether performed by lungs, or through the medium of the skin: to the latter, for aiding the faculty of reproduction, and effecting the process of germination; and, in some degree, for the performance of a function, closely resembling that of insect respiration, which the leaves of plants perform in the absence of light. But oxygen, as it exists in pure oxygen gas, rapidly exhausts the excitability of animals, and death supervenes: it is, therefore, seldom employed in this state as a medicinal agent.

HYDROGEN*.

Hydrogen is another element which is very extensively diffused; as it forms one-ninth part of all the water of the globe, and the aqueous vapour in its atmosphere; and is a component of almost every organic product. It is copiously disengaged in several pharmaceutical operations: for instance, during the action of metallic zinc in largely diluted sulphuric acid; in which case water is decomposed; the oxygen, one of the components of that liquid, unites with the zinc, whilst the hydrogen, the other constituent, is set free, and is readily collected in a gaseous state. By employing distilled zinc, the hydrogen gas is obtained pure.

Pure hydrogen gas is invisible, inodorous, and insipid, and the lightest body in nature. Its specific gravity is only 0.0694; and the weight of 100 cubic inches, referring to the composition of water†, is assumed to be 2.153 grains, at a barometrical pressure of 30 inches, and when the thermometer is 60° Fahr. or sixteen times lighter than oxygen gas. 100 cubic inches of water dissolve only $1\frac{1}{3}$ cubic inch, or one 75th of its volume of this gas. It is probable that, like oxygen gas, it is a compound; but this cannot be ascertained. It does not support combustion; but it is highly inflammable whenever it comes in contact with oxygen: if mixed even with common air, and fired, a violent explosion takes place; if not mixed, the combustion is slow, and only at the point of contact of the gas and the air: in both cases water is formed. The chemical equivalent of hydrogen is 1.

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* This name is derived from the Greek words ὕδωρ, water, and γεννάω, I generate.

† According to Berzelius and Dulong, 100 parts of pure water are composed of 88.9 of oxygen and 11.1 of hydrogen, or as near as possible in the proportion of 8 to 1; but eight parts of oxygen by weight occupy only one half the space of one part of hydrogen; thence it is evident that oxygen is sixteen times heavier than hydrogen.

Hydrogen exists as an element of many medicinal agents: namely, *water*, which has been already noticed, *ammonia*, *muriatic*, *hydrocyanic*, and *hydriodic acids*, which are binary compounds: the ternary are *alcohol*, *sulphuric ether*, *cyanurets of mercury*, all the *vegetable acids* employed as medicines, *piperina*, *salicina*, *elatin*, *wax*, *tannin*, the *fixed oils*, *camphor*, *fecula*, *gum*, *sugar*, *resins*, *balsams*, and *vegetable gluten*:—the quaternary are *nitric*, *ether*, *the volatile oils*, *hydriodates of oxides of Iron*, *Arsenic*, *Bismuth*, the medicinal *hydrosulphurets*, *oil of wine*, *emetina*, the *vegetable alkaloids*, *bitumens*, *animal gelatine* and *fats*. In some of the chemical changes, also, which occur through the agency of water in pharmaceutical operations, and which depend as much on the nature of its elements as of its affinity, hydrogen plays a conspicuous part. One of these only need be mentioned at present, to illustrate this remark: thus, if bichloride of mercury be put into water, the result is a solution, not of the bichloride, but of a muriate of the metal; a portion of the water is decomposed, the hydrogen unites with the chlorine of the bichloride, forming muriatic acid, whilst the metal, attaching to itself the oxygen, is converted into an oxide, and, combining with the acid, remains in solution as a muriate.

Hydrogen gas cannot support the respiration of animals, who, therefore, die when they are immersed in it: but it is doubtful whether this arise solely from the absence of oxygen gas, or whether the hydrogen exerts a sedative influence on the nervous system; for, although an atmosphere composed of hydrogen and oxygen gases, in due proportion, supports respiration; yet, we are still unacquainted with the effects which this gas produces on the animal œconomy.

NITROGEN*

Is another elementary substance which is known only in a state of combination. It forms upwards of 79 in every 100 parts of atmospherical air, and is readily procured by whatever abstracts oxygen from common air. The simplest mode of effecting this is to burn phosphorus in a jar filled with air and inverted over water. The phosphorus, by combining with the oxygen, is converted into an acid, the phosphoric, which is absorbed by the water; the residual gas consists of nitrogen, a minute portion of carbonic acid, and a little vapour of phospho-

* This name has originated from the fact that Nitrogen is the essential base of nitric acid: its propriety, however, is questionable; the oxygen in this case being the generator of the acid. It was called *Azote*, from the Greek primitive *a* and ζωή, life.

rus in solution; but, after being agitated with a solution of potassa, or of lime water, nothing but pure nitrogen gas remains.

Nitrogen, as obtained in the gaseous form, is invisible, insipid, and inodorous; it is distinguished from oxygen by not supporting combustion, and from hydrogen by not being inflammable. It is lighter than atmospherical air, its specific gravity being 09722: 100 cubic inches, at the barometrical pressure of 30 inches, and a temperature of 60° Fahrenheit, weigh 30.15 grains. Sir H. Davey and Berzelius have maintained that nitrogen is a compound; but their opinions are purely hypothetical. 100 cubic inches of water absorb only 1½ cubic inch of nitrogen gas. The chemical equivalent of Nitrogen is 14.

The medicinal compounds in which nitrogen is a component are not numerous: the binary are *nitrous* and *nitric acids* and *ammonia;* the ternary are the *cyanurets of mercury;* the quaternary, *hydrocyanic acid*, some *volatile oils*, the *vegetable alkaloids*, all the *animal products*, and the medicinal *nitrates*.

Nitrogen gas is fatal to animal life; but only from the absence of oxygen, as it exerts no injurious influence on the living system; a fact which instantly presents itself to the mind, when we reflect that it is the diluting medium of oxygen in atmospherical air.

CARBON.

The Diamond is supposed to be Carbon in a state of absolute purity; the term Carbon, however, is usually employed to signify the inflammable base of Charcoal, which is the residue of all animal and vegetable, and many mineral, substances, when they are heated to redness in close vessels.

Pure Carbon, the Diamond, is prepared by the hand of Nature, crystallized in ochtohedrons: it is intensely hard, and refracts light powerfully; a circumstance which suggested to Newton its combustible nature. When submitted to a high temperature in oxygen gas, or with substances which freely yield oxygen, it is entirely consumed and carbonic acid is generated. The specific gravity of the Diamond, thence of pure carbon, is 3,520. The chemical equivalent of carbon is 6.

Carbon is an element of many medicinal agents. The binary compounds are few:—only *charcoal*, *carbonic acid*, and pure *oil of turpentine**: the ternary are *hydrocyanic acid*, the *cyanurets of mercury*, all the *vegetable acids* employed in medicine, *alcohol*, *ether*, *gum*, *fecula*, *sugar*, *manna*, *tannin*, *resins*, *wax*, *elatin*, *piperina*, *salicina*, *fixed oils*, *camphor:* the

* Gay Lussac and Houton Labillardiere.—Journ. de Pharm. vol. iv.

quaternary are salts composed of the oxides of a metal and carbonic acid, the *alkaline carbonates*, those of *baryta*, *lime*, *magnesia*, *iron*, and *lead:* the *vegetable alkaloids*, *oil of bitter almonds*, the medicinal *volatile oils*, and some animal products.

For many pharmaceutical purposes, pure Charcoal, both of a vegetable and an animal origin, is required.

Vegetable Charcoal.—The easiest method of procuring it for ordinary use is to select firm pieces of common Charcoal, and, having put them into a crucible, and covered them with clean sand, to expose them for some time to a red heat. Thus prepared, Charcoal should be kept in close vessels, as it rapidly absorbs both air and fluids. For particular purposes, it may be procured tolerably pure by subjecting starch to a red heat in close vessels. Common Charcoal contains a small proportion of alkaline and earthy salts; but it is free from these when obtained from the vapour of alcohol passed through a red-hot tube.

Animal Charcoal.—Ivory-black is a mixture of Charcoal and Phosphate of Lime: by digesting it in diluted muriatic acid, and then washing and drying it, the earthy salt is removed, and pure animal Charcoal remains.

Pure Charcoal is insoluble in water, and is little affected by any of the acids except the nitric, or by any of the alkalies. Besides gases and liquids, it absorbs both odorous and colouring principles from animal and vegetable matters: thence the general employment of it, particularly animal Charcoal, for decolouring vegetable solutions.

SULPHUR.

Sulphur is found ready formed as a mineral production in the neighbourhood of volcanos, generally more or less chrystallized in the form of an oblique octohedron. It is also abundantly procured by exposing iron pyrites* to a red heat in close vessels.†

Pure Sulphur is nearly insipid, odorous only when it is rubbed, and of a greenish-yellow colour: it is a non-conductor of electricity. Its specific gravity is 1.99: when it is melted, and the temperature raised to 450° Farenheit, on throwing it into the water the gravity is augmented to 2.325. Sulphur melts at 216° Fahrenheit; it begins to thicken at 320°, and

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* The yellow iron pyrites, bisulphuret of iron, yields the greatest quantity of sulphur.

† Sulphur is found in a pure state in the Cruciferous plants, particularly in the seeds of Mustard and those of Celery, the flowers of the Orange, the farina of Rice, the proper juice of Ferula *Assafœtida*, and some other Umbelliferous plants, in the Rhizomes of Alpinia *galanga*, and in the roots of Rumex *patientia*.

becomes extremely viscid before it attains its boiling point, which is 482° ; from 216° to 600° it is volatilized, and condenses unchanged ; but at 300° in the open air, it takes fire. It is insoluble in water ; but its vapour is soluble in vapour of alcohol : Sulphur itself dissolves in ether, and in boiling oil of turpentine. The chemical equivalent of Sulphur is 16.

Sulphur is a component of a small number only of medicinal substances ; the binary compounds are *sulphuric acid*, and the *sulphurets of potassium*, *calcium*, *antimony*, and *mercury*, and *iodide of sulphur*. Except *hydrate of sulphur*, there are none of its ternary compounds used as medicines : the quaternary are the *sulphates* of the *mineral alkalies*, of *magnesia*, *alumina*, *potassa*, *iron*, *copper*, *zinc*, *subsulphate of mercury :* the quinary are the *volatile oil of mustard* and *sulphuretted oil.*

The effect of Sulphur on the animal œconomy shall be noticed in their proper place.

PHOSPHORUS*.

This element is procured by the decomposition of the phosphate of lime in bones, in which it is combined with oxygen, forming phosphoric acid. Phosphorus, when pure, is nearly transparent and almost colourless, of the consistence of wax, and easily cut with a knife. Its specific gravity, at the usual barometrical pressure and temperature, is 1.7. At the temperature of 60°, in common air, phosphorus undergoes a slow combustion, although in oxygen gas the temperature for this purpose must be 80° ; at 108°, in the air, it inflames ; in oxygen gas the combustion is rapid and brilliant, and phosphoric acid is formed ; in close vessels it fuses at 100°, and boils at 550°, rising in vapour.

Phosphorus is insoluble in water† ; but it readily dissolves in hot alcohol, ether, and fixed and volatile oils. The chemical equivalent of Phosphorus is 15.7‡.

The only medicinal substances which contain it are the quaternary compounds, *phosphate of soda* and *phosphate of lime.*

Phosphorus exerts a powerfully stimulant influence on the animal œconomy : its effects will be noticed in their proper place.

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* Phosphorus was discovered in 1669, by Brandt, an alchemist of Hamburgh, who procured it from urine.

† On this account, and to prevent the slow combustion which it undergoes in the air, it should be kept under water, and in an opaque or blackened bottle.

‡ Berzelius.

BORON*.

Boron is a dark olive-coloured substance, procured by abstracting the oxygen from boracic acid by means of potassium, at a high temperature. It is insipid and inodorous, a non-conductor of electricity, and unalterable in the air at ordinary temperatures; but when heated to 600° Fahrenheit, it burns brilliantly, combining with the oxygen of the air, and forming boracic acid, which is also generated when Boron is heated with sulphuric or nitric acid, or with nitrate or chlorate of potassa. It bears an intense heat in close vessels, without being changed, except in density. It is insoluble in water and in alcohol. The chemical equivalent of this element is 8.

The only medicinal substances in which Boron exists as a component, are the binary compound, *boracic acid;* and the quaternary, *Biborate of soda.*

CHLORINE.

Chlorine is obtained by decomposing muriatic acid, which is a compound of this elementary substance and hydrogen, by means of peroxide of manganese†. It is known only in its compound state, or as a gas, which, besides the Chlorine, contains caloric and light; both of these substances being emitted when this gas is strongly and suddenly compressed.

Chlorine gas has a greenish-yellow colour‡, an astringent taste, and a peculiar pungent odour; its specific gravity is 2.47: 100 cubic inches, at the ordinary barometrical pressure and at a temperature of 60°, weigh 76.25 grains. Under a pressure of four atmospheres and in a very low temperature, it assumes the form of a transparent yellow liquid. Water at 60° absorbs nearly twice its bulk of Chlorine gas, and the liquid acquires the colour, taste, and odour of the gas; it is again disengaged when this solution is heated; and when it is kept exposed to light, a portion of the water is decomposed, and, the hydrogen uniting with the Chlorine, muriatic acid is formed.

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* Boron was discovered by Sir H. Davy in 1807.

† The best proportions of the above material for preparing Chlorine gas are one part of peroxide of manganese in fine powder, and two parts of strong muriatic acid. These ingredients may be put into a tubulated retort, large enough to hold double the quantity, and having passed the beak into a pneumatic trough, containing warm water, and applied a moderate heat to the retort, the gas may be received in wide-mouthed glass bottles containing warm water. As soon as each bottle is filled, it should be immediately closed, under water, with a ground stopper, first drawing the finger round the edge with a small quantity of a lute composed of one part of wax and three of lard.

‡ The appellation Chlorine is derived from the Greek word χλωρος, green.

Chlorine destroys the colour of all vegetable and animal matters in a moist state or in solution; but perfectly dry Chlorine gas does not affect dry vegetable or animal colours. It is a supporter of combustion, for a lighted taper burns in it; and phosphorus, tin, copper, arsenic, antimony and zinc, when pulverized or in thin foil, spontaneously takes fire, when introduced into Chlorine gas, and combine with it: its range of affinity, indeed, is most extensive. The chemical equivalent of Chlorine is 5.45.

The medicinal agents of which chlorine forms a component are numerous. The binary compounds are *muriatic acid*, the *chlorides of sodium*, *barium*, *antimony*, and *mercury;* there is only one ternary medicinal compound, *the chloride of lime;* the quaternary are compounds of chloric and muriatic acids with oxides; *chlorate of potassa*, and *muriate of magnesia*, *muriate of iron*, *muriate of antimony*, *muriate of ammonia*. The *muriates of lime* and of *baryta*, as they are aqueous solutions, are senary compounds; and this is also the case with the *muriates of morphia*, *strychnia*, *cinchonia*, and *quinia*, which are crystallizable salts.

Chlorine has a powerful influence on the animal œconomy, as shall be noticed in its proper place.

IODINE*.

This elementary substance was not known until 1812, when it was discovered by M. Courtois in preparing carbonate of soda from *kelp*, the ashes of Fuci, and other marine plants. He observed that the residual or mother liquor corroded metallic vessels; and, in experimenting to ascertain the cause of that corrosion, he found that sulphuric acid precipitated from the residual liquor a dark-coloured, metallic-like matter, which the application of heat converted into a beautiful violet vapour†. Iodine is usually prepared by adding diluted sulphuric acid in excess to the above-mentioned residual liquor, then boiling, and afterwards leaving the whole at rest for some time, and filtering. Peroxide of manganese, in the proportion of 1000 grains for every twelve fluid ounces of the liquor, is added to the filtered fluid, which is now a solution of hydriodic and sulphuric acids. The mutual reaction of the peroxide and the acid decomposes the whole of the hydriodic acid, the hydrogen of which combines with the oxygen of the peroxide and forms

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* The term Iodine is derived from the Greek word ἰωδης, violet-coloured.

† For Courtois' Experiments, see Ann. de Chimie, tome 89, 90, 91; and for those of Sir. H. Davy, Phil. Trans. 1814-15.

water; whilst the Iodine, thus set free, is sublimed, by the application of a moderate heat, into a cool receiver, and sulphate of manganese remains. The Iodine is afterwards purified by mixing it in water, containing five parts of potassa, and resubliming.

Iodine is an opaque, bluish-black, scaly, crystalline substance, with a metallic lustre, an acrid taste, and the odour of chlorine, but less pungent; staining the fingers brownish-yellow, and having a specific gravity of 4.948. It is a non-conductor of electricity, and a negative electric. At a heat much under 212°, it sublimes; at 224½° it fuses, and boils at 347°: it is distinguished from all other substances by the rich violet colour of its vapour, and by its property of uniting with starch and forming a compound of a deep blue colour. This test detects the presence of Iodine in a liquid containing 1.450.000 of its weight. It requires for solution 7000 parts of water, to which it communicates a brownish tint: alcohol and ether dissolve it readily, forming deep reddish-brown solutions.

The chemical equivalent of Iodine is 126: its range of affinities is very extensive.

The medicinal agents in which Iodine exists as a component are very few: the binary compounds are *Iodides of Arsenic*, *Iron*, *Lead*, *Mercury*, and *Sulphur;* there are no medicinal ternary compounds; the quaternary are the *tincture of Iodine* and the *hydriodates of potassa*, *arsenic*, and *iron*.

Iodine acts as a powerful stimulant on the animal œconomy: its physiological action and therapeutical influence shall be noticed in their proper place.

METALLIC ELEMENTS.

The description of elementary bodies which come under the denomination of metals, differ in certain properties from all other substances. They possess *lustre*, pervading every part; *opacity*, even when they are reduced to extreme thinness; *weight; tenacity*, or the power of resisting the influences which tend, mechanically, to separate their particles from one another; and *fusibility*. Some of them possess, also, *malleability*, or the property of being expanded under the hammer; and *ductility*, or the capacity of being drawn out into wire. They differ from one another in the degree in which they possess these properties. Some of them are always found in a state of combination; others frequently in a pure state.

a. Metallic Elements which are found only in a state of Combination.

POTASSIUM.

Although the oxide of Potassium, potassa, has been known from a very early period, yet its metallic or elementary base was unknown until 1807, when it was discovered by Sir Humphrey Davy. It is procured by decomposing potassa or its carbonate, by means of charcoal, according to a process suggested by M. Brunner*, and afterwards modified by Wohler.

Potassium is an opaque, crystalline metal, resembling mercury in colour and lustre; its specific gravity is 0.865, at 60° Fahrenheit, and under the ordinary barometrical pressure. It is a good conductor of electricity. At the temperature of 32° Potassium is brittle, at 50° it is soft and malleable, at 60° it becomes soft like wax, at 70° acquires a degree of fluidity, and at 150° is perfectly fluid. Its chief characteristic is its powerful affinity for oxygen; by which means it cannot be preserved except under naptha. From the same cause, it rapidly decomposes water: much heat and light is extricated, hydrogen gas is evolved, and the metal, being oxidized, is converted into potassa. This is rendered evident by burning Potassium on an infusion of red cabbage, which is turned green as the alkali forms.

The binary medicinal compounds in which this element exists are *potassa*, and the *sulphuret* and *bisulphuret of Potassium*: the only medicinal ternary compound is the chloride of Potassa: the quinary are salts composed of *acids* and the oxide or potassa. The chemical equivalent of Potassium is 39.15.

Potassium is not employed in its uncombined state as a remedial agent.

SODIUM.

This elementary substance was also discovered by Sir Humphrey Davy, nearly about the same time that he discovered potassium. It may be prepared by decomposing, with the aid of heat, the chloride of Sodium by means of potassium: the latter is converted into a chloride, and the Sodium procured in its pure state.

Sodium resembles silver in its colour and lustre: its specific gravity is 0.972. At the ordinary temperature of the air it is soft, and may be moulded like wax: it fuses at 200°, and is

* Quarterly Journal of Science, vol. xv. and xxii.

volatilized in a full red heat. It has a powerful affinity for oxygen, which it attracts rapidly from the air; and, like potassium, it is also oxidized when placed upon the surface of water; but the decomposition of the liquid is less rapid, and no light is visible, unless the water be hot, when a few scintillations appear. In both instances soda is generated; but, when Sodium is burnt in pure oxygen gas, a peroxide of an orange colour is formed. The chemical equivalent of Sodium is 23.3.

The medicinal binary compounds of Sodium are *soda* and *chloride of Sodium*: there are no ternary compounds: and the quaternary and quinary, like those of potassium, are salts composed of acids and the *oxide* or *soda*.

Sodium is not employed in medicine in its uncombined state.

BARIUM.

This metallic element was also discovered in 1808 by Sir H. Davy. It is procured by decomposing the carbonate of baryta. He formed the carbonate into a paste with water, placed it on a platinum tray, and laid a globule of mercury in a little hollow on the surface of the paste; the positive pole of a powerful galvanic battery was then brought into contact with the tray, and the negative pole with the mercury. The oxygen of the baryta was thus disengaged from the Barium, which amalgamated with the mercury; and, by afterwards distilling this amalgam, so as to drive off the mercury, the Barium was obtained in its metallic state.

Barium is of a dark grey colour, with little lustre, and considerably heavier than water. It is rapidly oxidized in the air, and also by decomposing water when it is thrown into that liquid: in both cases baryta is produced. The chemical equivalent of Barium is 68.7.

The only binary medicinal compounds of this element are the *chloride of Barium* and the *oxide* or *baryta*; and the only salt, medicinally used, into which it enters, is the *muriate*, a compound of the muriatic acid and baryta.

CALCIUM.

Calcium was first procured by Sir H. Davy, by a process similar to that by which he obtained barium. From the minuteness of the quantity in which it has hitherto been procured, its properties are little known, except that by exposure to the air it is oxidized and converted into lime. The chemical equivalent of Calcium is 20.5.

The binary medicinal compounds of Calcium are the *chlo-*

ride of Calcium and the *oxide* or *lime;* the only ternary compound is the hydrate, or slacked lime; the *carbonate* and the *muriate* are salts of lime with acid bases.

MAGNESIUM.

If chloride of magnesia, mixed with potassium, be subjected to a red heat in a porcelain tube, the chlorine quits the Magnesium and is taken up by the potassium: on washing out the chloride of potassium, the Magnesium, set free, is obtained in the form of minute brown scales, which leave a metallic trace resembling lead when they are rubbed in a porcelain mortar. At a high temperature, Magnesium attracts oxygen and is converted into magnesia. It was first procured, by the galvanic influence, in the same manner as calcium and barium, by Sir H. Davy, who discovered this element.

There is only one binary medicinal compound of Magnesium, the *oxide* or *magnesia;* the saline compounds, the *carbonate* and the *sulphate*, are salts of the oxide. The chemical equivalent of Magnesium is 12.7.

Magnesium is not used in its uncombined state in medicine.

ALUMINIUM.

This elementary, metallic base has been procured, in a pure state, by Wohler, from the decomposition of alumina by potassium, in the form of a grey powder, or rather in small scales of a colour and lustre resembling tin. It is insipid, inodorous, nearly insoluble in water, requires a very high temperature for fusion: in its fused state it is a conductor of electricity. It takes fire at a red heat in the open air, burns with a vivid light, and is converted into alumina: in pure oxygen gas the combustion is brilliant, and the emission of heat intense: it is also very feebly oxidized in water, which it decomposes, but only at the boiling point. Its action on water is greatly aided by dilute sulphuric and muriatic acids, solutions of potassa and ammonia. The chemical equivalent of Aluminium is 13. 7.

There is no medicinal compound in which Aluminium is an immediate component. In alum, the oxide is united with sulphuric acid.

ZINC.

Zinc is procured from its native sulphuret, *zinc blende*, or from its native carbonate, *calamine*, of which there are several

varieties. In reducing the ores, which are put into a covered crucible, with a tube fixed in its bottom, the Zinc, when separated, is volatilized, driven through the tube and condensed in a separate vessel. It is purified by another distillation into a receiver containing water.

Zinc has a bluish-white colour, a strong metallic lustre, and a specific gravity of 7. It is acted on by the file with difficulty: it is malleable and ductile at temperatures between 210° and 300°; but, at a low or a high degree of heat, it is brittle. It fuses at 608° Faht.; and, on slowly cooling, it crystallizes in hexagonal prisms. At the ordinary temperature of the air, it scarcely attracts oxygen; but at a high temperature, it rapidly combines with oxygen; and, at full redness, it burns with a vivid, white flame. The chemical equivalent of Zinc is 32.5.

The protoxide is the only binary compound of Zinc medicinally employed: there are no ternary compounds: in the quaternary, the Zinc is indirectly as an oxide combined with acids. Metallic Zinc exerts no action on the animal system.

b. Metallic Elements which are occasionally found in a Pure State.

IRON.

Iron is the most abundant of metals, being found in one form or another in almost every part of the world. It is procured in the native state; and in combination with sulphur, with oxygen, and sometimes with saline bodies: it also forms a component of many plants; and there is much reason for believing that it exists as an oxide in animal blood. For the purposes of medicine and of commerce, metallic iron is procured chiefly from common clay iron-stone, red hæmatite, brown hæmatite, and black magnetic iron ore. The first yields about thirty-five per cent. of iron; the others about seventy per cent. In all, the iron exists in combination with oxygen as a peroxide.

Iron is extracted from these and other ores by reducing them to powder, mixing this with charcoal and lime, and exposing the whole to an intense heat in a furnace. In this process, the lime and the charcoal take the oxygen from the iron, which is fused and falls to the bottom of the furnace; it is there protected from the action of the air by the fusible *slag* which is formed by the carbonaceous flux combining with the impurities of the ore. The fused iron is let off by a hole in the bottom of the furnace; but it is not pure; to free it from carbon and any unreduced ore, it is again exposed to a strong heat with a current of air playing upon its surface, which reduces the undecomposed ore whilst the

carbonaceous matter is burned. The solid Iron thus obtained is afterwards hammered and rolled, to increase its tenacity and render it malleable iron.

Native Iron is rare. A specimen, about four pounds in weight, was found in the mine of Hackenberg; and another in the mine of Johanner, near Kamsdorf, in Saxony. Those singular metallic masses, called aerolites, that have fallen from the atmosphere in various parts of the world, are nearly pure Iron, with a small admixture of another metal, nickel, which distinguishes aerolites from true native Iron.

Pure Iron is a hard, ductile, malleable, and very tenacious metal, of a peculiar, grey colour, susceptible of a high polish. In its purest state, it is scarcely fusible; but when heated to redness, it softens. The specific gravity, at 60° under an ordinary barometrical pressure, is 7.7. It is attracted by the magnet, and may itself be readily rendered permanently magnetic. It has a strong affinity for oxygen, and attracts it from the air when moisture is present: it also decomposes watery vapours, at all temperatures, forming *rust*, which is a hydrated-peroxide of Iron. When heated to redness in the air, it is rapidly oxidized; and in oxygen gas it burns with vivid scintillations. The chemical equivalent of iron is 28.

Iron is present in several medicinal substances and preparations. The binary compounds containing it as a direct component are the *sulphuret* and *bisulphuret*, the *Ioduret* and the *protoxide:* in the salts, the *carbonate*, *sulphate*, and *tartrate*, and in the preparation termed *ferrum ammoniatum*, it exists only as an indirect component.

Iron, both in its pure and its combined state, is medicinally employed; but it exerts no physiological action on the animal œconomy in its metallic state, unless it meet with acid in the stomach.

ARSENIC.

Arsenic is found native; but commonly in combination or alloyed with iron, copper, cobalt, silver, or gold, or united with sulphur, in the shape of arsenical pyrites, or that of realgar. The former occurs in Sicily, Italy, Hungary, and Germany; the latter chiefly in Hungary and in Turkey in Asia. A native oxide is also found in Germany; but it is rare.

Arsenic, in its metallic state, is found in different parts of Germany, in masses more or less considerable, having, when the masses are fresh broken, a brilliancy and a lustre equal to that of silver; but quickly becoming tarnished when exposed to the air.

Metallic Arsenic may be obtained by calcining any of the

ores, in conjunction with charcoal: it is also produced by decomposing the white oxide or arsenious acid, by means of twice its weight of the black flux*; the metallic Arsenic is sublimed when the crucible containing the mixture acquires a red heat, and is condensed in an empty crucible inverted above the former and kept cool†.

Arsenic is a brittle metal, of a bluish white or steel gray colour, brilliant, inodorous, and insipid; of a specific gravity 5.8843: when suddenly exposed to a white heat, it inflames and burns with a bluish white flame; but when the heat is not more than 356°, it rises in vapour, and emits a strong odour of garlic, which distinguishes it from all other metals. This odour is perceived only at the commencement of the oxidizement of the metal, which cannot be volatilized in the open air without undergoing oxidation. This volatility prevents Arsenic from fusing, except under a very high pressure. It attracts oxygen slowly from the air at 60°, losing its lustre and falling into a black powder; and it is also slowly oxidized and dissolved when it is boiled in water. The chemical equivalent of Arsenic is 37.7.

The only medicinal agents in which Arsenic exists as an element is *arsenious acid*, and *Iodide of Arsenic*, which is a binary compound of Arsenic and oxygen.

Metallic Arsenic exerts no influence on the living animal system.

ANTIMONY.

Antimony is found native at Sala in Sweden, and in the Hartz mountains. It also occurs in combination with oxygen, and mixed with other metals: but the most abundant of its ores is the sulphuret, from which the metallic Antimony of commerce is derived. For procuring metallic Antimony, the native sulphuret is decomposed by heating it in covered crucibles with half its weight of iron filings: the sulphur combines with the iron, whilst the metallic Antimony fuses, collects at the bottom of the crucible, and is drawn off into moulds‡.

Metallic Antimony has a lamellated structure, a dark silvery hue running into bluish gray, and displays considerable lustre. It is brittle and pulverulent, inodorous and insipid; yet, when

* Black flux—a compound of two parts of crude tartar and one part of nitre deflagrated together.

† In a large way, the distillation is performed in earthen retorts coated with a mixture of clay, iron filings, blood, hair, and alum: and a sheet of iron, rolled up as a cylinder, is used as an adapter. When the distillation is finished, and the apparatus is quite cool, and this iron cylinder is unrolled, the arsenic is found sublimed upon it in brilliant crystals.

‡ On a large scale, at Riom and Clermont in Auvergne, the sulphuret is first roasted in a reverberatory furnace, then mixed with argol, and the mixture smelted, in a melting pot, in a wind furnace.

rubbed between the fingers, it communicates to the skin both a peculiar taste and smell. Its specific gravity is 6.702. It tarnishes and is slightly oxidized when exposed to a moist air. It fuses at 810° Fahrenheit, and, in a full white heat, when exposed to the air, inflames and burns with a brilliant white light; and the condensed vapour is a protoxide of the metal.

The only medicinal agents in which Antimony exists, as a direct component, are the *sulphurets* and the *chloride*, which are binary compounds: the *hydro-sulphurets*, and the other preparations in the Pharmacopœias, are quaternary and quinary compounds. The chemical equivalent of Antimony is 64.6.

Metallic Antimony exerts no action in the animal œconomy.

BISMUTH.

This metal is found, both native and in combination with other substances, chiefly at Schneebery in Saxony; but some is furnished by Cornwall. Its ores require little more than the application of heat to run the metal from the matrix in which it is embedded.

Bismuth is a brittle, reddish-white metal, having considerable lustre and a lamellated structure. When slowly cooled, it crystallizes in octohedrons. Its specific gravity, at the ordinary pressure and temperature of the atmosphere, is 9.850. It is malleable when warm, fuses at 476° Fahrenheit, and sublimes in close vessels at 30 Wedgewood. It scarcely acts upon the air at common temperatures, but, when fused, it takes its oxygen rapidly; and, when heated to sublimation, in the air, it burns with a bluish flame, and emits fumes of the oxide. It readily decomposes nitric acid, and the oxide thus formed dissolves in the acid. The chemical equivalent of the metal is 71.

The only medicinal compound of this metal is the *subnitrate*, which is a quaternary compound.

Metallic Bismuth exerts no action on the living animal system.

COPPER.

Copper is found native in Cornwall*, and in many other parts of the world; and sometimes, particularly in Siberia, it appears crystallized: it also exists in the form of an oxide, most abundantly in combination with sulphur, and in a saline state. The most common of the ores is the sulphuret named copper

* It is a curious fact, that, notwithstanding the great abundance of copper and tin in Cornwall, it is stated by Cæsar, that all the brass used by the Britons, at the time of the Roman conquest, was imported.—See Commentaries "de Bello Gallico."

pyrites, from which the metal is separated by long-continued roasting in reverberating furnaces, during which the sulphur is driven off, partly as sulphur, partly as sulphurous acid. The residue is then oxidized in calcining furnaces, and afterwards smelted with charcoal, which reduces it: but as it still retains both sulphur and iron, it is strongly heated with a current of air playing on its surface, which oxidizes the sulphur and iron, whilst the Copper is left in a state of tolerable purity.

Pure Copper is a hard, elastic, sonorous metal, of a reddish orange colour, insipid, and inodorous except when much rubbed: it is susceptible of a high polish. It is both ductile and malleable, and nearly as tenacious as iron. Its specific gravity is 8.667. It fuses at a bright red heat. It suffers little change in a dry atmosphere, but is oxidized and converted into a carbonate in moist air. It is an important practical fact, that it is scarcely attacked by sulphuric or muriatic acids, and not at all by vegetable acids if the air be excluded: but when the air is not excluded, the Copper is rapidly oxidized and salts are formed. It rapidly decomposes nitric acid under all circumstances. The chemical equivalent of Copper is 31.6.

The binary compounds of copper are not used as medicines: the *sulphate* is a quaternary compound of the peroxide; and also the *carbonate* contained in ammoniated copper: the *acetate* is a quinary compound.

Metallic Copper does not act on the animal œconomy; instances having occurred in which coins had been swallowed and remained for months in the intestines without producing any injury or inconvenience to the person*.

LEAD.

Lead is very rarely found in a pure state. Its most abundant ores are sulphurets; but it is found also combined with oxygen, and in a saline form. All the lead of commerce is procured from *galena*, a sulphuret found very generally throughout the world, and abundantly in this country, in Northumberland, Cumberland, Durham, and Yorkshire. In Northumberland this ore is roasted in a reverberating furnace; it is then smelted on a low blast furnace along with lime, which decomposes a quantity of sulphate of lead formed during the roasting.

Metallic Lead is a soft and flexible, inelastic metal, both malleable and ductile; of a bluish-grey colour. Its specific gravity is 11.381. The surface, from exposure to the air, is generally covered with a white efflorescence, which is carbonate

* Thomson's Conspectus of the Pharmacopœias; Art. Copper. Paris' Pharmacologia, p. 250. *Orfila*, Toxocol. Générale, i, p. 500.

of lead: but, before this occurs, and on a fresh-cut surface, the lustre is considerable. Lead is inferior in tenacity to other ductile metals. It fuses at 612°; may be heated to whiteness in close vessels without subliming; and, when slowly cooled, it crystallizes in octohedrons. It is quickly oxidized at high temperatures. When submersed in distilled water, it undergoes no change; but when placed partly in air, partly in water, in open vessels, it is quickly oxidized at the point of contact of the air and the water, and carbonate of lead is formed. It rapidly decomposes nitric acid; and the metal is oxidized at the expense of the acid. The chemical equivalent of lead is 103.5.

The binary medicinal compounds of Lead are the *iodides*, and the *protoxide* or *litharge;* the saline preparations, the *acetate*, *subacetate*, and *carbonate*, are quaternary and quinary, or combinations of the oxide with the acetic and carbonic acids.

Pure metallic Lead is not poisonous when taken into the stomach; but, as it is scarcely ever free from the carbonate, it may prove deleterious; indeed the carbonate is the only direct poison of lead—a fact which I have clearly ascertained, and shall demonstrate in its proper place.

MERCURY.

Mercury is found in various parts of Europe, particularly in Spain, Germany, and Hungary; in South America; in the Philippine Isles, and also in China. The most productive mines are those of Idria, of the Palatinate, and of Guanca Velica, in Peru. Mercury is found native in most of the mines; and, in some, it is in the state of an amalgam with silver; but the most common form in which it is found, is that of native cinnabar, a sulphuret of the metal. The metal is extracted by subjecting the ore, mixed with lime or iron filings, to the action of heat: the lime, or the iron, combining with the sulphur, sets the mercury free, to be volatilized in the metallic state.

The distinguishing characteristic of Mercury is the fluidity which it maintains at common atmospheric temperatures. It has a white colour and a strong lustre, and its purity is ascertained by the complete mobility of all its particles. It becomes solid or congeals at forty degrees below Zero, and contracts greatly at the instant of congelation: in this state it is malleable and may be cut with a knife. The specific gravity of fluid Mercury is 13.5, that of solid Mercury 15.612. At 68° Fahrenheit, this metal boils, and is volatilized.

Pure Mercury is not oxidized by exposure to air and moisture at an ordinary temperature; but in a temperature sufficient to volatilize the metal, it is converted into a peroxide. Mer-

cury decomposes the sulphuric and nitric acids; but it does not affect any other acid. The chemical equivalent of Mercury is 200.

The medicinal agents in which Mercury exists as a compound are numerous: the binary compounds are the *chloride* and *bichloride*, the *iodides*, *sulphurets*, *cyanides*, *protoxide*, and *peroxide;* the salts, which are also numerous, are quaternary compounds of acids and the oxide.

Although the preparations of Mercury are most active medicines, yet, the metal itself exerts no influence whatsoever on the living system.

SILVER.

This metal is most abundantly procured in tropical regions: it occurs native, both massive, dendritic, and crystallized; and in combination with other metals, as gold, antimony, arsenic, bismuth, lead, iron, and copper. Sulphur is also a component of some ores of Silver. The greater part of the Silver of commerce is obtained from native Silver and its sulphurets. The ore is reduced to fine powder, mixed with sea-salt, and exposed to heat in a reverberating furnace: a sulphate of soda and a chloride of silver are thus formed; the whole is then ground together, and the powder, being mixed with mercury, water, and fragments of iron, is put into barrels which revolve by means of machinery. The chlorine of the chloride of Silver is taken by the iron, which is thus converted into a soluble salt, and the Silver amalgamates with the mercury, which is afterwards separated by distillation, leaving the Silver in a pure state.

Pure Silver is a soft, malleable, ductile, very tenacious metal, of a clear white colour, and susceptible of a high polish. Its specific gravity, at the temperature of 60° and the ordinary barometrical pressure, is 10.5. It fuses at 20 Wedgewood; and in a very high temperature is volatilized. It does not decompose air or moisture; and, even in the melted state, when it is exposed to a current of oxygen gas, it is not permanently oxidized: it acts upon none of the acids except the sulphuric and the nitric, the latter of which is its proper oxidizing agent and solvent. The chemical equivalent of Silver is 108.

The only preparation of Silver medicinally used is the *nitrate*, which is a quaternary compound of the protoxide and nitric acid.

TABLE *of the Weights, Specific Gravities, Fusibility, and Volatility, of the Chemical Elements of Medicinal Agents.*

Elements.	Weight of 100 cubic inches in grs	Specific gravity.	Chemical equivalents.	Point of fusion.	Point of volatilization.
Oxygen	33.888	1.1111	8	——	——
Hydrogen	2.118	0.0694	1	——	——
Nitrogen	29.652	0.9722	14	——	——
Carbon	——	3.520	6	——	——
—*(in vapour)*	12.708	0.416			
Sulphur	——	1.99	16	216°F.	216° to 600°F.
Phosphorus	——	1.7	15.7	108°F.	550°F.
Boron	——	——	8	——	600°F.
Chlorine	76.25	2.5	35.45	——	——
Iodine	——	4.948	126	227°F.	350°F.
—*(in vapour)*	262.612	8.716			
Potassium	——	0.865*	39.15	136°F.	below red heat.
Sodium	——	0.972*	23.3	190°F.	below red heat.
Barium	——	——	68.7	——	——
Calcium	——	——	20.5	——	——
Magnesium	——	——	12.7	——	——
Aluminium	——	——	13.7	——	——
Iron	——	7.788†	28	130.W.	——
Zinc	——	6.861 to 7†	32.5	698°F.	——
Arsenic	——	5.8843‡	37.7	——	388°F.
Antimony	——	6.702†	64.6	below red heat	——
Bismuth	——	9.822†	71	480°F.	——
Copper	——	8.895§	31.6	27.W.	——
Lead	——	11.352†	103.5	500°F.	——
Mercury	——	13.568†	200	39°F.	650°F.
Silver	——	10.474†	108	30.W.	

* Gay Lussac and Thenard. † Brisson. ‡ Turner. § Hatchett.

SECTION IV.

CLASSIFICATIONS OF MEDICINAL AGENTS, FOUNDED ON THEIR OPERATION.

THE advantages of an arrangement of Medicinal Substances, or, in other words, of the Materia Medica, founded on their medicinal operation, is undoubted. Thence it is, that he who would acquire an accurate acquaintance with the nature and properties of medicinal substances must not only draw largely on the stores of Natural History and Chemistry, but, in order to comprehend the laws of the action of medicinal agents on the living system and their therapeutical influence in disease, he must also have recourse to the aid of Anatomy and Physiology.

The arrangement of Medicinal Substances adopted in this volume is founded upon the basis of their operation on the body; and is that which I follow in my lectures. Before explaining the principles which have regulated its formation, I shall present my readers with the two best modern classifications of medicinal substances, and offer a few comments upon each of them, to justify the alterations which I have made in framing my own.

The first of the two classifications to which I have alluded is that of Dr. Young, as exhibited in the following table:

I. CHEMICAL AGENTS.

1. *Caustics.*
2. *Antiseptics.*
3. *Antidotes.*
4. *Demulcents.*
5. *Diluents.*

II. VITAL AGENTS.

A. SUPPORTING STRENGTH.

1. *Nutrients.*

B. Causing Action.

Partial and Transient.

1. *Expergefacients.*
2. *Excitants.*
3. *Calefacients.*
4. *Sudorifics.*
5. *Errhines.*
6. *Sialogogues.*
7. *Expectorants.*
8. *Stomachics.*
9. *Emetics.*
10. *Cathartics.*
11. *Chologogues.*
12. *Hydragogues.*
13. *Simply Propellents.*
14. *Anthelmintics.*
15. *Diuretics.*
16. *Carminatives.*
17. *Emmenagogues.*
18. *Epispastics.*
19. *Suppuratories.*
20. *Sorbefacients.*
21. *Astringents.*

Permanent.

Tonics.

C. Diminishing Action, or Sensation.

Primarily:

1. *Narcotics.*
2. *Sedatives.*
3. *Nauseants.*
4. *Diaphoretics.*

Secondarily: *Exhaurients.*

III. Insensible Agents.

Specifics.

In the foregoing table, Dr. Young has arranged all the objects of Materia Medica under three distinct heads: Chemical Agents, Vital Agents, and Insensible Agents. The propriety of the first and second of these primary divisions cannot be denied; but, as the existence of specifics is questionable, the third is certainly objectionable. The arrangement, however, of the classes is even less commendable than that of the primary divisions. The first division contains five classes, two only of which, Caustics, and Antiseptics if any really exist, can be correctly considered as operating chemically on the body. With respect to the class Antidotes, it is only necessary to remark, that all substances which may be considered as such do not act chemically; and it is still more difficult to comprehend how Demulcents and Diluents can be regarded as chemical agents. The second division, *Vital Agents*, is less objectionable; but it is too much subdivided, and contains too many classes. In the second section of this division, entitled "causing action," we

find Expergifacients, Excitants, and Calefacients, as distinct classes, which is not easily understood, as the terms are nearly synonymous, and the same medicines must be arranged under each to answer the indications implied. The class Chologogues, or purgers of bile, cannot properly be separated from Cathartics, most of which, as they operate more or less on the duodenum and the gall-ducts, may, in fact, be regarded as Chologogues. The same remarks apply to Hydragogues; for as Cathartics, except those of the mildest description, never operate without throwing off a large portion of fluid by the bowels, a distinct class of Hydragogues is superfluous. The class Suppuratives consists of substances which are, in fact, merely varieties of Epispastics. In the second section, therefore, of this division, the *first*, the *third*, the *eleventh*, the *thirteenth*, the *nineteenth*, and the *twentieth* classes might be advantageously omitted; and, with equal benefit, the class Exhaurients, in the third section, might be expunged. No class should be admitted in any arrangement of Materia Medica which is not essentially different from the others; nor any which is founded on the basis of hypothesis. In my opinion, Dr. Young has judiciously separated Narcotics from Sedatives, for reasons which I shall afterwards have occasion to detail in speaking of my own arrangement.

The following table displays the second of the Classifications to which I have alluded, that of Dr. Murray.

A. General Stimulants.		
	a. Diffusible.	Narcotics.
		Antispasmodics.
	b. Permanent.	Tonics.
		Astringents.
B. Local Stimulants.		Emetics.
		Cathartics.
		Emmenagogues.
		Diuretics.
		Diaphoretics.
		Expectorants.
		Sialogogues.
		Errhines.
		Epispastics.
C. Chemical Remedies.		Refrigerants.
		Antacids.
		Lithontriptics.
		Escharotics.
D. Mechanical Remedies.		Diluents.
		Demulcents.
		Emollients.
		Anthelmintics.

This Classification of Dr. Murray is also framed upon the basis of the operation of the substances employed as remedial agents; and, with a few exceptions, is almost as perfect as the present state of the healing art will admit. Objections, nevertheless, have been advanced to some of its classes, and to the positions which others hold. Thus, the position of the class Refrigerants among the chemical remedies has been justly criticised; and the fallacy of the views upon which its place has been allotted to it by Dr. Murray shall be pointed out when the period for treating of Refrigerants arrives. A tenable objection has also been made to the class of Lithontriptics. No medicines introduced into the stomach have yet succeeded in wholly or partially dissolving calculi, existing either in the pelvis of the kidneys or in the bladder of urine; although it is said to be a well-attested fact, that the angles and asperities on the surfaces of calculi have been occasionally smoothed down by the long-continued administration of some of the substances included in this class. Means, also, have been devised for applying substances known to dissolve calculi out of the body directly to calculi contained in the urinary bladder. But, unless the evidence of their solvent powers were conclusive, a class of Lithontriptics is scarcely admissible. Upon the whole, however, Dr. Murray's Classification is superior to any of its predecessors; and it will be seen that I have adopted it as the general basis of my own arrangement.

In framing the table which will be found at the end of this section, although I have taken advantage of the arrangements of Dr. Young and of Dr. Murray, yet it will be obvious to my readers that my view of the subject is different from that of either of these distinguished medical philosophers. I have adopted one of the primary divisions of Dr. Young and two of those of Dr. Murray: arranging the whole of the Materia Medica under *Vital*, *Chemical*, and *Mechanical Agents*. In the first of these divisions, I have discarded many of the classes of Dr. Young, and have altered the position of others. I have also changed the situation which Narcotics, Antispasmodics, and Refrigerants, hold in Dr. Murray's arrangement; and have divided the class Narcotics, into Narcotics properly so called, and Sedatives. With regard to the propriety of this disunion, I trust that I shall be able to convince my readers that there are medicinal substances which diminish or destroy the *irritability* and *sensibility** of the body; and, consequently, lessen the action of the heart and

* As these terms will frequently recur, it is proper that the reader should be fully aware of what is intended to be understood by them in the following pages.

Irritability is that property of some organic structures, connected with or dependent on vitality, which renders them capable of being excited to contraction, either on the application of external stimulants, or by the will. It is displayed particularly in the muscular fibres; and, to use the language of Blumenbach, "is marked by an oscillatory

arteries, both in strength and frequency, or extinguish it altogether, without having caused any perceptible previous excitement: such medicines are, therefore, justly entitled to the appellation Sedatives. With regard to Refrigerants, which I have removed from amongst the chemical remedies in Dr. Murray's table, there can be no doubt that they ought to be placed under the head of vital agents diminishing action, when we consider the effects of cold in lowering the powers of life. Thus, a stream of cold water directed upon the crown of the head, and continued for a considerable time, is a sedative of such power that it immediately subdues the excitement of Phrenitis; instantly reduces the morbid strength of the most athletic; and is, consequently, dangerous when incautiously employed. But it may be said that cold, in a diminished degree, exerts a tonic influence. This is correct: nevertheless, its depressing influence, and that also of those remedies which produce a cooling

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or tremulous movement, differing from the action of simple contractility, both by occurring far more easily on the application of any pretty strong stimulus, and by being attended with a much more considerable constriction." Some physiologists—as Haller and Bichat, for instance—have attributed this solely to the fibres of the muscles; and regarded it as altogether independent of the nervous system. Others—as Dr. Whytt and Dr. Cullen—on the contrary, considered it as dependent on the nerves distributed to these organs.

The theory of Haller rested chiefly upon the fact, which he had observed, that contraction cannot be produced in the heart, and other involuntary muscles, by the application of stimulants to the trunks of their nerves; from which, and from the results of his experiments, he was led to believe that the irritability of the muscular fibre is a vital property, peculiar to muscles, of a nature different from sensibility, and not derived from the nervous system; whilst, at the same time, he admitted that the voluntary muscles, besides this inherent irritability, possess also a *vis nervosa*, or contractile power, excitable by stimulants applied to their nerves. The most untenable part of this theory is undoubtedly that which attributes the *vis nervosa* to the muscular instead of the nervous fibre. It is probable that Haller was led into this inadvertancy from losing sight of the suggestion of Erasistratus and Galen, which has been verified by the distinguished Bellingeri in Italy, and Sir C. Bell in this country, that there are distinct nerves of sensation and of motion. When we reflect that the nervous system was then supposed to be possessed of the same powers, in all its parts, it is easy to conceive that a physiologist, when he saw motion rendered evident without sensation, should conclude, as Haller did, that both irritability and the *vis nervosa* resided in the muscular fibre.

To the same source we may trace the error into which Dr. Whytt has fallen, in combating the theory of Haller, when he asserts that the motions of stimulated muscles proceed from their sensibility; that the irritability of the muscular organs of the body is in proportion to their sensibility; and, consequently, that whatever augments the sensibility of muscles, increases their irritability; whatever diminishes their sensibility, lessens or wholly destroys their irritability. It is certain that many of the experiments of the present period, particularly those of a galvanic nature, tend to confirm the opinion that *irritability* is a property inherent in, and peculiar to, the muscular tissue.

But, perhaps, the most powerful argument that can be advanced in favour of this proposition may be drawn from the fact, that, when paralysis ensues on tying or dividing the nervous trunks of a muscular organ, the irritability continues vigorous for a considerable time afterwards.

It would be out of place here to proceed further with this argument: I have, therefore, merely to state, that by the term *Irritability* I mean that *vital* property of organic structures which renders them capable of being excited.

The term *Sensibility* has been employed by Chaussier, a French physiologist of great eminence, and by some other physiologists, to express that faculty, which every living fibre possesses, of changing, by any impression or contact, its habitual and natural harmony or disposition of parts; thus making it equivalent to contractility and irritability conjoined. This, however, is not the sense in which the word will be employed in this

effect upon the body when taken into the stomach, is so striking, that I consider myself warranted in placing Refrigerants in the same division as Sedatives; that is, under the head of Vital Agents, which operate on the nervous system by directly diminishing action. The substances in the first division of general Vital Agents, therefore, those influencing the body generally by operating directly upon the nervous system, possess two distinct modes of acting: one which may be regarded as *positive*, which is followed by excitement; the other as *negative*, which is followed by immediate collapse: and it is from a conviction of the accuracy of this view of the subject, that I have arranged them as they stand in my table.

The manner, however, in which remedies that augment action exert their influence is not the same in all of them; and, consequently, subdivisions were requisite. I have, therefore, arranged the classes according as the substances which they include operate directly on the *nervous* system; or, through its

volume; but, approximating to the common acceptation of the term, I shall use it to express that property of the animal body, dependent on the nerves of sensation, which is the cause of a perception in the mind when a stimulant is applied to a part furnished with certain nerves. This change in the corporeal organ is always accompanied by a definite idea; and the same idea is the necessary sequence of the same action, whether this be the result of the application of any external stimulant or an internal cause, as long as the organ on which the impression is made remain in a healthy condition. It is unessential, for the truth of this position, to determine in what the change upon the extremity of the sentient nerve consists, and in what manner it is propagated to the brain; whether by a vibratory movement in the nervous cord, or the undulatory action of a fluid contained within it, or the power of electricity conveyed along it. All that is certainly known is, that the change is the result of a specific action on certain nerves only; and this is necessary to be always borne in remembrance. This fact, which the experiments of Bellingeri and Sir Charles Bell have firmly established, first suggested itself to Erasistratus*; but so little was his opinion the result of anatomical inquiry, that he imagined that the nerves of sensation originated in the membranes, those of motion in the substance, of the brain. Galen maintained a similar opinion regarding two sets of nerves, and supposed that the sensory nerves arise from the cerebrum, the motory from the cerebellum†. These opinions were revived by M. Ponteau‡, M. Lecat, M. Morin, and other moderns: however, they can only be regarded as happy conjectures: nor do they, in the smallest degree, detract from the merit of the distinguished physiologists who have confirmed the vague ideas of the antients by following the only path which can lead to truth—that of experiment and observation*§.

All sensation is undoubtedly dependent on the presence of nerves; and every hour's experience confirms the opinion of Galen, that the degree of sensibility which any part of the body possesses is proportional to the number of nerves which it receives.

That sensibility is distinct from *irritability* is evident; for a muscle, in which all *sensation* is destroyed by a division of the sensitive nerve supplying it, is, nevertheless, still irritable, or enjoys the capacity of being stimulated to contraction. Sensibility is, therefore, a matter of consciousness: irritability is not necessarily so; but, in a part which is endowed with both, the former is greatly heightened in an increased state of the latter. Thus, on a highly irritable surface, impressions which, in a more healthful state of the part, would be either indifferent or pleasurable, excite pain and often inordinate action. *Sensibility*, as I employ the term, differs further from irritability and contractility in being peculiar to animals; whereas both irritability and contractility are properties of all organized bodies, whether animals or plants.

* Rufus Epesius, de Partibus Hominis, p. 65, edit. Lond. 1726.

† Galen de Anatomicis adminis. lib. vii, viii, quoted by Dr. J. Thompson in his life of Cullen, vol. i, p. 205, 207.

‡ Œuvres Posthumes, t. ii, p. 480.

§ Exposition of the Natural System of the Nerves, 8vo. London, 1824.

influence, on the *muscular* and the *sanguiferous* systems: or on the *secerning* system.

I am perfectly sensible of the impossibility of strictly arranging the classes according to physiological principles. Thus the Class Sialogogues might have been included in that of Excitants: but, as the most striking effect of the former is produced upon the salivary glands and the secreting organs, I have preferred making the direct Sialogogues a distinct class, and placing it in the third subdivision. In the same manner, several of the other classes may be regarded as entitled to rank in other subdivisions as well as in that in which they appear: but it is impossible, in any arrangement, to take under consideration all the variations which may present themselves. The chief object of any classification is to enable the student to pursue his investigations with method; and I trust that the one which I have adopted will prove adequate for this purpose. It is not offered as a *perfect* classification; on the contrary, I am satisfied that the progress of Materia Medica will unveil its defects.

In the second general division of the table, that intended to comprehend those medicines which influence the state of the body, or its contents, by their *chemical* properties, I have kept in view only those medicines the primary action of which is chemical; the body or its contents being regarded as one of the agents of the action induced. Thus, as far as regards Escharotics, the chemical affinities of the substances employed are sufficient to overcome the preservative influence of the vital principle; and the solid parts of the body enter into combination with these substances, in the same manner as if they did not form a portion of the living system. I have subdivided this division, therefore, according to the nature of the chemical action of the substances contained in it. Thus, Escharotics exert a solvent power, and combine with the animal matter; or rather, by a resulting affinity, separate the elements of the part to which they are applied, and cause them to enter into new combinations.

In the same manner, the action of Antacids and Antalkalies is as truly chemical as if the operations, instead of taking place in the body, were performed in the laboratory. The influence of Antilithics is not so obvious, and their mode of action not so readily explained; but it is undoubtedly, at least in part, chemical.

In making these general remarks on the second class of my arrangement, however, it is necessary to admit that the remedial effects of some of the substances arranged under it are not confined to their chemical action. Thus, the benefit derived from the operation of an Escharotic does not result from the chemical phenomena which accompany it, but from the stimulus which it causes operating as a counterirritant; the chemical action being no further remedial than as it produces the

eschar by the sloughing of which the issue is to be formed: it is the counterirritation which is the remedial power. Neither can the beneficial influence of Antilithics be wholly ascribed to their chemical properties; somewhat is due to the tone which they impart improving the digestive function and preventing that acescent state of stomach which favours the deposition of calculous matter in the urinary organs.

Little remains to be said respecting the third class of this arrangement, which cannot be regarded as of an active nature. The medicines arranged under it operate rather by a kind of *negative* property, not affecting either the nervous system or the simple animal fibre directly, than by any quality inherent in themselves. They prove beneficial by diminishing the action of acrid and stimulating matters upon diseased surfaces; and effect this by interposing themselves, as it were, between the acrid and stimulating matters and the sentient extremities of the nerves of the organs to which they are applied: they may, therefore, be regarded as mere mechanical agents, although it be not easy to explain their influence upon distant parts with a reference solely to their mechanical action, unless we refer to those in the class *Diluents*, which, being taken into the circulating mass, and carried to every part of the habit, act on each organ as if they were immediately applied to it.

I have purposely avoided extending the following table by introducing the subdivisions of the classes; conceiving that the student will derive more advantage from tables of these placed at the head of each class, than if they were crowded into the general table.

It is only necessary to remark farther, in this place, that each Class will be divided into three primary divisions, according as the medicinal agents are *organic products* or *inorganic* substances, or *mental agents*. Some objections may be advanced to the last of these divisions: but, as mental agents have a powerful influence in the removal of diseases, they become instruments in the hands of the physician as applicable, in a therapeutical point of view, as the material articles of the Materia Medica; and, consequently, when they present themselves, they will form a third and distinct division of the the class.

TABLE OF CLASSIFICATION.

I.—Vital Agents.

A.—Influencing the body generally;

a.—by operating directly on the nervous system:

* *increasing action:* Excitants.

* * *diminishing action:*
- *Primarily.*
  - Sedatives.
  - Refrigerants.
- *Secondarily.*
  - Narcotics.
  - Antispasmodics.

b.—on the muscular and sanguiferous systems:

Tonics.
Astringents.

c.—on the secerning system:

Errhines.
Sialogogues.
Expectorants.
Emetics.
Cathartics.
Diuretics.
Emmenagogues.
Diaphoretics.

B.—Influencing the body solely by their action on the part to which they are applied.

Epispastics
- *a. Rubefacients.*
- *b. Vesicants.*
- *c. Erodents.*

II.—Chemical Agents.

A.—Influencing the body, or its contents, by their chemical properties:

* *acting on the surface:* Escharotics.
- *a. Cauterants.*

* * —— *on the contents of cavities:*
- Antacids.
- Antalkalies.
- *a. Antiseptics.*
- Antilithics.

III.—Mechanical Agents.

Demulcents.
Diluents.

PART III.

SECTION I.

FIRST DIVISION—VITAL AGENTS.

THE application of the term *Vital Agents*, in the present instance, is confined to substances which operate upon living animal structures. The animal body is composed of solid and of fluid parts, displaying, in a general point of view, the same physical properties as all other solid and fluid matter. Thus, every solid part of the body is an aggregation of molecules, which do not separate from one another, except by the influence of some agent acting upon them, either within or without the body; and the whole is made up of such aggregations, differing in *consistency*, *elasticity*, and *tenacity*, under the form of bone, muscle, membrane, ligament, and nerve. So far animal structures correspond with inert matter; but they differ from it in one essential; their solidity does not wholly depend on physical causes. In inorganic bodies the force of cohesion is the sole power which maintains them in a state of solidity: but in organized bodies this is altogether secondary to that unknown principle which we denominate *life*, which is obvious to us by its effects, although its nature will probably for ever remain undiscovered by the powers of human reason. If, for example, a muscle be separated from one of its attachments in an animal body, and as great a weight appended to it as it can support, it will be found that the same muscle, after having been wholly separated from the body, for a space sufficient to destroy its vitality, but not to permit of decomposition, will be unable to support the weight which it sustained when alive: clearly demonstrating that the principle of vitality has more power in maintaining the integrity of animal structures than cohesion. It is upon animal structures, imbued with this principle, that the medicines which we are about to examine under the title of *Vital Agents* operate; and, when this principle is withdrawn, these agents cease to influence the animal frame.

A question here presents itself—do vital agents produce their effects by a direct or immediate action? Is the muscular

fibre affected by the direct operation of the stimulant upon it, independent of the nerves, which, there is every reason for believing, accompany it in every structure in the organism of the body? There is much difficulty in replying to this question; and it would be digressing too widely from our proper subject to venture upon an examination of the facts which lead to the conclusion, that the cellular and the muscular fibre are affected by medicinal agents chiefly through the medium of the *nerves*. It is only necessary to remark, that no efforts have yet succeeded in separating the nervous from the muscular and cellular fibrils; and that muscular action is greatly modified by causes operating primarily on the brain, or on the nerves leading to the muscles, whether the action be voluntary or sympathetic; and this fact of itself is sufficient to justify the inference, that those medicinal agents, termed *vital*, influence the body chiefly by their action on the nervous system. This opinion, indeed, is founded upon the same basis as the Pathology which now almost universally regulates the opinions of the profession; and which arose with the ideas first taught by Hoffman regarding the nervous origin of diseases.

Admitting that the action of medicines almost wholly depends upon motions excited in, and propagated by, the nerves, the medicines capable of inducing such motions operate either generally, or upon particular parts. Those which, however, it must be remarked, influence the body generally, exert also a primary action on particular parts; and this may either be directly on the nervous system, on the muscular and sanguiferous systems, or on the secerning system. In whatever manner the impression is made, the energy of the whole nervous system is excited; and it is by this means that the various effects which result from the administration of medicinal agents are produced in the different parts of the system.

It was at one time supposed that the energy of the whole nervous system depends on the brain; and even Dr. Cullen remarks, in speaking of the operation of medicines, that "all powers, noxious and salutary, operate not only upon the parts to which they are applied, but also upon distant parts of the system, and that by the intervention of the brain; and these causes are therefore to be considered as exciting the action of that organ." It has also been supposed that sympathies can only be explained by admitting that the primary impressions of external agents act on the brain; and that it is from the reaction of this organ that subsequent motions are produced in other parts of the system. But there are exceptions to this explanation of the communication of impression made by vital agents on particular parts: for, without referring to the lower animals, those placed in the class *Vermes* of Linnæus, and the *Radiata* of Cuvier, in which there is no brain, we find,

in man himself, that the powers of the brain are shared by the spinal marrow; and it is not impossible that, although the nerves are, properly speaking, *transmissive* organs, yet, that *they* themselves are possessed of a certain degree of power, independent of that either of the brain or of the spinal marrow. This is rendered evident by the observations made on acephalous infants, in some of which, although the brain was altogether wanting, yet, not only the instinctive functions were performed, but food was taken; which undoubtedly implies some degree of consciousness. "By shewing us," as Mr. Lawrence has justly remarked, "what happens when an important organ is wanting or malformed, it contributes to fix our opinions respecting its uses*." The independence of the nerves on the brain is also partly confirmed by the experiments of Fleurens, Rolando, and other continental Physiologists, in removing portions of the brain. The experiments of Mr. Brodie and those of M. Gallois have farther proved that, in particular, the action of the heart is carried on completely independent of the brain; and, in fact, that the source of the motion of the heart is an influence exerted upon it by the medulla spinalis.

But this is not the place to notice these investigations: it is enough for us to know that those substances which are comprehended under the term *Vital Agents* produce their effects by influencing the nervous energy—that power inherent in the brain, the medulla spinalis, and the nervous system generally, by which not only all the vital actions are maintained, but through which, also, we are willing, moving, and conscious beings.

SECTION II.

EXCITANTS—MEDICAMENTA EXCITANTIA†.

Syn. Stimulants.

EXCITANTS may be defined "Substances that augment, powerfully, the motions 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, communicated by the nerves to the whole system."

Excitants, whether of an animal or vegetable nature, or in-

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* Medico-Chirurgical Transactions, vol. v, p. 176.

† From the Latin word *excitare*, to excite, awaken.

organic substances, have some sensible properties in common. They impart a warm or an acrid impression on the organs of taste; and, when they are of a vegetable nature, they are generally odorous. These qualities have been regarded by several writers on the Materia Medica as constituting the essential properties of every Excitant. There are, nevertheless, inorganic Excitants which, correctly speaking, have neither taste nor odour; as, for example, *Caloric* and *Electricity;* but the impulse which they give to the nervous system differs rather in degree than in kind from that which is communicated by an aromatic substance. In the vegetable kingdom, the exciting agent, whenever it can be isolated from the other principles of the plants that contain it, produces all the effects of the entire plants in an increased degree.

The inorganic substances belonging to this class of medicines appear to have no principle in common to which their action can be referred.

The general effects of Excitants are very obvious. They consist in—1. a greater susceptibility of impression in the nerves; 2. an increase of action in the moving fibres; 3. an acceleration of the frequency, and an augmentation of the force of the pulse; 4. a higher degree of the temperature of the body. The organs upon which they chiefly display their influence are those of digestion, circulation, respiration, and secretion. Their effects are also displayed powerfully on the cerebro-spinal system. In small doses, the action of Excitants is scarcely perceptible, and is confined to the surface on which they are received: in large doses, it becomes obvious, not only to the individual excited by them, but to others, and the effects of their action is extended over the system. In still larger doses, their effects assume the character of disease. Thus, the first effect experienced after taking a strong Excitant is a sensation of heat and acrimony in the gullet, extending to the stomach and causing thirst: the digestive function is evidently suspended; and nausea, sometimes vomiting, supervenes; the substance, if not ejected, is next rapidly carried into the duodenum, and increases the peristaltic movement of the intestinal canal. These effects, however, do not always depend on the extent of the dose; but, in many instances, on the condition of the body.

1. Excitants, when taken into the *stomach*, exert their primary action on that organ; a sensation of heat is experienced, which the person affected instantly refers to the stomach; and it is probable that the mucous membrane, if the viscus could be seen, would be found redder than natural and more sensitive, and the muscular coat contracted. If the stomach be empty, a sensation of hunger is felt; and if food be immediately taken, or if the exciting substance be swallowed directly after taking food, the digestive faculty is rendered more active. From the stomach,

the impulse is communicated to other parts of the system; but the general result is not, in every case, commensurate to the impression made upon the stomach; and many Excitants act powerfully on the general habit, which display little influence on the organ receiving their primary impulse. If Excitants pass the pylorus without acting on the stomach, their influence on the general system is less than when their primary impression is made on that organ. The cause of this is connected with the functions of the part and the nature of the stimulants that thus operate. As far as regards the functions of the part, the natural effect of a stimulant on the intestinal canal is to increase its peristaltic motion; the stimulating substance is, consequently, carried forwards; and although it continues its impulse as it proceeds, yet, this is too transitory to be very influential. As far as regards the nature of the stimulants that thus act, if they are vegetable substances, the aromatic principle is so involved in other matters that the digestive process must be exerted to a certain extent before it is evolved; and this does not happen until it has passed out of the stomach.

Some stimulants, chiefly those of an inorganic nature, exert little influence until they are taken into the circulation; thence they may be said to communicate their impulse directly to the heart and arteries. In whatever manner, and on whatever part the impulse is first impressed, it is rapidly communicated to the rest of the system.

2. *Excitants affect the Circulating Organs.*—The influence of certain impressions on the stomach is to augment the force of the heart and arteries in affecting the circulation of the blood: thence, when an Excitant is swallowed, it renders the pulse both quicker and stronger than before; and the impulse thus given is extended even to the capillaries. Red blood is impelled into channels in which, under ordinary circumstances, it is absent; the skin is therefore reddened, its temperature elevated; and, if the dose of the stimulant be considerable, restlessness, watchfulness, and headache supervene. These effects are necessarily proportionate to the dose of the Excitant; but other circumstances also, in some degree, modify these effects. Thus, Excitants act with much energy in persons of sanguine temperament, as far as concerns the circulating system; whereas, in those of an opposite frame of body, their power upon the heart and arteries is often scarcely perceived. The influence of mental Excitants, in this respect, is remarkably exhibited in blushing, palpitation of the heart, and that sensation of a glow of heat overspreading the chest which often attends highly agreeable or pleasurable feelings.

The natural consequence of an accelerated condition of the pulse is an increase in the movement of the thorax: a greater number of inspirations and expirations than usual occur in a given

time; thence a more complete change takes place in the blood circulated through the pulmonary vessels. It is from observing these phenomena, when Excitants are administered, that they are asserted to influence the respiratory organ.

3. *On the Secerning System.*—I have already stated that Excitants taken into the stomach increase the action of the capillaries; thence they awaken, as it were, the activity of the secretory and exhalant systems. They act powerfully on the kidneys; and, therefore, all Diuretics are Excitants: on which account, some volatile oils, when taken in a large dose, cause distressing effects upon the urinary organs.

4. *It is on the Nervous System*, however, that Excitants display the most obvious effects of their power.—Almost immediately after any exciting substance, in a sufficient dose, is taken into the stomach, the impulses communicated to the nerves of that organ are transmitted to the rest of the body, developing vital energy in the various anatomical centres to which the nerves relate.

We cannot explain this power of transmitting impressions inherent in the nerves. We acquire no information from our knowledge of the structure of the nervous tissue:—from the brain to the minutest nerves, we find that it is constituted of two distinct substances; one, apparently, consisting of a congeries of blood vessels, of a grey or cineritious colour; the other firm, white, and composed of minute and delicate fibres: both, however, are essential to the structure of an organ destined to perform specific functions. With it we find two distinct functions united, both dependent on vitality, the nervous and the sensorial power: it is to the first of these that we are accustomed to refer the faculty of transmitting impressions received in one part of the system to other parts; and it is through it, consequently, that the animal is connected with the external world; of which, indeed, we can be conscious only by the diffusion of the impulses received from external objects on particular parts of the frame, to other parts, or to all its parts. Whether this communication is made through the medium of a nervous fluid, or whether it is a mere oscillation, or a property analogous to the galvanic or electrical influence, or whether it is made by any other material agent, we know not: our information extends no farther than the fact, that an impulse communicated to one set of nerves, those of the stomach, for instance, is transmitted to the rest of the body, through the medium of the nerves. There is one curious fact, which would lead us almost to conclude that the transmission of volition, and that of mere impulses neither affording sensation nor connected with volition, depend on distinct circumstances: it is this, that, after the death of an animal, the muscles, which during life are subservient to the will, contract when their nerves are subjected to galvanic power; but the involuntary muscles

cannot be thus excited, although, for many hours after death, the heart, which is an involuntary muscle, can be excited on the contact of a mechanical or chemical agent. In the brain itself the influence of Excitants is manifested by the perceptions becoming more vivid, the imagination more pregnant with ideas, and those of a more brilliant and exalted character: thence the medicines belonging to this class were denominated exhilarants by the ancients. Indeed, it is impossible to deny that the employment of stimulating substances, within a certain limit, often produces inspirations and mental sensations. Their influence on the brain becomes most manifest when they are administered in large doses: these being followed by vertigo, temporary delirium, and a change in the perceptions; or, in other words, inebriety. Whether the cerebellum is affected in a manner similar to that of the brain, is uncertain; but there is no doubt that some Excitants affect in a special manner the medulla spinalis, and through it the sensitive nerves of the skin, as is evident when Strychnia is administered. This power, however, of augmenting the general sensibility, is common to all Excitants, although it is possessed in a higher degree by some than by others.

Upon the whole, the influence of Excitants is always more or less perceptible in their effects on the organic functions: on the *digestive function* they are displayed by the food being more quickly and completely digested; on the *circulating*, by the blood being formed in more abundance, more florid, richer in colouring matter, and moved with more rapidity; on the *respiratory*, by the greater freedom of movement of the thorax, and the glow which pervades its cavity; and on the *secerning*, by the increase both of the secretions and the excretions. The excitement of the brain and the spinal marrow is evidenced by the greater susceptibility to impressions in the nerves of 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 separating and arranging ideas.

Excitants, besides differing in their effects according to the part of the system on which their specific impression is made, differ, also, as far as concerns their degree of force or power. The same Excitant, also, acts differently according as it is combined with different substances. Different Excitants, in different quantities, produce different effects. They vary, also, in the rapidity with which their effects are produced; some being almost instantaneous, others requiring some time; and this altogether independent of the nature of the part to which they are applied. The force or violence of their effects is generally in the ratio of the degree of the rapidity of their action; and the continuance of the impression is, also, in some degree, connected with the same circumstance; since we invariably observe, that the most powerful stimulants, those the action of which is the

most rapid, are followed most quickly by a state the opposite of action—that of collapse. This result of Excitants distinguishes them from some other medicines which also increase action, especially tonics; but it increases the difficulty of separating them from another class, that of Narcotics, which first quicken action, and soon afterwards exhaust greatly both sensibility and irritability. On this account, we should have a clear conception of what is understood by the term *collapse*.

It is evident that the expressions *excitement* and *collapse* are merely terms relative to some given standard, or to some point which, in the healthy system, can be considered neither. With respect to Excitement, "if," to borrow the language of 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 that may take place while life still subsists, every lower may be called a degree of collapse." As the terms are meant to be understood in these pages, *Excitement* implies every state 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 adequate to the ordinary functions of the system; *Collapse*, that state in which the cerebral energy is so much diminished as to suspend the exercise of the functions of sense and volition—a state of defective activity of the brain, similar to that which causes sleep, only in an augmented degree. There can be no doubt that a certain supply of blood to the brain is essential for the support and continuance of its function: too great an increase of the momentum produces *excitement;* a diminished afflux, on the contrary, within certain limits, or an exhaustion of the moving powers from previous over-exertion, is productive of *collapse*.

From what has been stated, this fact may be collected—that there is a distinction between what are termed general excitants and those which belong exclusively to this order of our arrangement.

There is also, as I have already stated, a distinction between Excitants and Tonics; although this difference is chiefly in degree; but to this distinction I must add, that they differ, also, in the nature of their effects. Excitants increase the mobility of the system; Tonics augment the strength of the muscles: Excitants exhaust the excitability; Tonics, within a certain limit, maintain it: the action of Excitants is immediate, powerful, and transitory; that of Tonics is slow, almost imperceptible, and progressive, but permanent.

With regard to the state of the habit in which Excitants are useful as remedial agents, we may advance this as a general principle—that it is that state in which powerful and sudden impressions on the system are required; in which, from some cause, the functions of the brain and nervous energy are di-

minished; and in which the impulse of the blood on the brain, necessary for its healthful action, is greatly defective. This state is, in truth, one of direct debility of the brain: and that it depends on a deficient impetus of the blood to that organ may be inferred from the fact, that a state closely resembling it is induced by pressure on the carotids; and, when this impetus is excessive, so as to produce convulsions, these are stopped by whatever diminishes the action of the heart, as, for instance, bloodletting; and they have, also, been stopped by compression on one or both carotids. The renewal of this impulse is to be obtained by increasing the general momentum of the blood; and this is most quickly induced by the application of Excitants to the nerves of the stomach, and to those of the Schneiderian membrane and of other parts on which their influence is direct, and can be immediately impressed. Some objections might be raised against this explanation of the mode in which the increased momentum is said to be produced by those who contend, and justly so, that the brain exerts very little influence over the action of the heart and arteries; but, when we consider the momentary influence which the passions exert over the heart during perfect health—when we reflect on the magnitude of the cardiac nerves and the sympathy that exists between the heart and other organs in relation to its momentum—we shall have little hesitation in admitting that Excitants, operating on the blood-vessels, produce their effects chiefly through the influence of some portion of the nervous system. The sensible demonstration of the effect of Excitants on the heart and arteries is the increased power and fulness of the pulse.

Such is the general view necessary to be taken of Excitants in reference to their action on the body in health and in disease; but, besides these properties, it is necessary that we should have a correct knowledge of the substances that operate as Excitants, in order to understand their utility as Therapeutical agents.

TABLE OF EXCITANTS.

* ORGANIC PRODUCTS.

a.—VOLATILE OIL—

* *Uncombined, obtained from—*

Carum *Carvi.*	5. 2.†Umbelliferæ‡.
Pimpinella *Anisum.*	—. —. ———

† Class and Order in the Linnean System. ‡ Natural order.

	Anethum *graveolens.*	5.	2.	Umbelliferæ.
	——— *Fœniculum.*	—.	—.	———
	Melaleuca *Cajuputi.*	18.	3.	Myrtaceæ.
	Citrus *Aurantium.*	18.	2.	Aurantiaceæ.
	—— *Medica.*	—.	—.	———
	Ruta *graveolens.*	10.	1.	Rutaceæ.
	Lavandula *spica.*	14.	1.	Labiatæ.
	Mentha *piperita.*	—.	—.	———
	——— *sativa.*	—.	—.	———
	——— *pulegium.*	—.	—.	———
	Origanum *vulgare.*	—.	—.	———
	Rosmarinus *officinalis.*	2.	.1	———
	* * *Combined:* in			
Roots* ——	Aristolochia *Serpentaria.*	20.	6.	Aristolochiæ.
	Acorus *Calamus.*	6.	1.	Aroideæ.
	Zingiber *officinale.*	1.	1.	Scitamineæ.
	Curcuma *longa.*	—.	—.	———
Wood ——	Laurus *sassafras.*	9.	1.	Laurineæ.
Barks ——	——— *Cinnamomum.*	—.	—.	———
	Drymis *Winteri.*	11.	1.	Wintereæ.
	Canella *alba.*	—.	—.	Meliaceæ.
Flowers —	Caryophyllus *aromaticus.*	12.	1.	Myrtaceæ.
	Crocus *sativus.*	3.	1.	Irideæ.
Fruit ——	Eugenia *Pimenta.*	12.	1.	Myrtaceæ.
	Piper *Cubeba.*	2.	3.	Piperaceæ.
	Laurus *nobilis.*	9.	1.	Laurineæ.
Seeds ——	Elettaria *Cardamomum.*	1.	1.	Scitamineæ.
	Myristica *Moschata.*	22.	8.	Myristaceæ.
b.—CAMPHOR—obtained from				
	Laurus *Camphora.*	9.	1.	Laurineæ.
	Dryobalanops *Camphora.*	13.	1.	Dipterocarpeæ.
c.—ACRID OIL.—contained in				
	Piper *nigrum.*	2.	3.	Piperaceæ.
	—— *longum.*	—.	—.	———
	Cochlearia *Amoracea.*	15.	2.	Cruciferæ.
	Sinapis *nigra.*	—.	—.	———
	——— *alba.*	—.	—.	———
	Anthemis *Pyrethrum.*	19.	2.	Compositæ.
d.—BITTER EXTRACTIVE—contained in				
	Dorstenia *Contrayerva.*	4.	1.	Artocarpeæ.
e.—STRYCHNIA—obtained from				
	Strychnos *nux vomica.*	5.	1.	Apocyneæ.
	——— St. Ignatias.	—.	—.	———

f.—ALCOHOL.

* *Uncombined.*

Pure Alcohol.

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* Under roots, are comprehended rhizomes and tubers.

* * *Combined.*

Ardent spirits.
Medicinal tinctures.
Wines.
Cider.
Beer.
Mead.

g.—SULPHURIC ETHER.

1. Æther rectificatus.
2. ——— ——— cum Alcohole.

* * INORGANIC SUBSTANCES.

a.—ELECTRICITY.

(Galvanism.)

b.—CALORIC—in Hot air baths;
—— water baths;
—— vapour baths;
—— medicated baths.

c.—IODINE.

* *Uncombined.*

1. in substance.

* * *Combined.*

2. chemically.
   a. with Sulphur.
   b. —— Lead.
   c. —— Mercury.
   d. —— Arsenic.
   e. —— Potassium.
3. in solution.
   a. with Alcohol.

d.—MERCURY.

I. ——— *combined with Oxygen.*

† *protoxide* prepared by

1. trituration.
   a. with saccharine matter.
   b. —— unctuous substances.
   c. —— Ammoniacum.
   d. —— Carbonate of Lime.
   e. —— Carbonate of Magnesia.
2. decomposition.

†† *peroxide* prepared by

1. the action of Heat and Air.
2. ——— Nitric acid.

II. ——— *oxidized and combined with acids.*

† *protoxide.*

1. with Nitric acid.
2. Acetic acid.

†† *peroxide.*
1. with Sulphuric acid.
2. —— Muriatic acid and Ammonia.

III. ————*combined with Chlorine.*
† *protochloride* prepared by
1. sublimation;
2. precipitation.
†† *perchloride* prepared by
1. sublimation.

IV. ————*with Sulphur:* by
1. trituration;
2. sublimation.

V. ————*with Cyanogen:* by
1. decomposition.

VI. ————*with Iodine: by*
1. trituration.
2. decomposition.

e.—AMMONIA.

Carbonate of Ammonia.
Muriate of Ammonia.

* * * MENTAL EXCITANTS.

Joy.
Impetuosity.

ORGANIC VEGETABLE SUBSTANCES WHICH OPERATE AS EXCITANTS.

VOLATILE OIL. *Oleum volatile.* (Syn. *Essential oil*).—Volatile oil is secreted by vegetables, and, in many instances, deposited pure in leaves, flowers, and fruits, either in peculiar vesicles on the surface, or in cells in the substance of the vegetable body; it is also diffused through the plant in combination with other principles: thence, volatile oils are to be considered either as *uncombined*, or deposited in distinct cells; or *combined*, or intimately united with other principles.

The odour of plants is chiefly owing to the exhalation of these oils. Some plants are odorous from the spontaneous exhalation of the oil; in others, the cells require to be ruptured before this odour can be perceived. The influence of light and heat favours the formation of volatile oils; thence the plants of tropical climates yield them in the greatest abundance. The ultimate components of all are Carbon and Hydrogen: some contain also Oxygen, and others Nitrogen: it is

probable that they derive their origin from already elaborated juices.

Every Volatile Oil, whatever may be its consistence, contains two distinct parts: one, a volatile, odorous liquid, the *Elaiodon* of Herberger and *Igreusine* of Bizio and Bouillay; the other a concrete, often crystalline, inodorous substance, the *stearopton* of Herberger and *Sereusine* of Bizio*. The first may be regarded as the Volatile Oil in its extreme purity; the second a substance dissolved in the former, separating by time and rest. I am disposed to regard the solid matters deposited from volatile oils to be either *Camphor* or *Benzoic* acid.

The *uncombined* Volatile Oils can readily be procured from the plants in which they are secreted, either by simple expression, or by distillation with water or with watery vapour. The oil and the water pass over together; but after a short time they separate, the oil, according to its density, collecting either on the surface or settling at the bottom of the water. More oil is procured when the distillation of the fresh plant is commenced with cold water than when boiling water is employed. This is supposed, by M. Dumarest, to depend on the cold water yielding Oxygen to the oil, which is thus rendered insoluble in water. Dried plants yield the greatest quantity of oil. When procured in a separate state, volatile oils are of various consistence; some are as liquid as water, and preserve their fluidity at low temperatures; whilst others become concrete; others, again, crystallize by slow evaporation; some always have the vicidity of oil, some the consistence of butter.

The purest Volatile Oils are limpid; indeed, when first drawn, many of them are nearly colourless; and it is probable that the green, blue, and yellow colours, which some of them display, are due to colouring matters not present with them in the plants, but merely elevated with them in the process of distillation. Their taste is acrid and penetrating; their odour fragrant, but of the most varied description. Some, as those of Cloves, Cinnamon, Pimento, and Sassafras, are heavier than water; those of Lemon, Orange, Lavender, Rosemary, Peppermint, Caraway, and others, are lighter than that fluid. Those which are the products of plants of temperate climates are the lightest†. They are all insoluble in water; although, when agitated or distilled with it, they are suspended in it in minute globules, rendering the water, for some time, milky, and communicating to it their *taste* and *odour*. When triturated with sugar, the purest part of the oil is rendered soluble in water; forming what is termed an *Oleo-saccharum*. They are

* Journal de Pharm. 1829, p. 167.

† M. Brandes ascertained the specific gravity of thirty-one of the light kinds, and found the range to be between 0.8520 and 0.9725.—Archiv. 21, 1827.

soluble in alcohol, but not all in the same degree: thus, oil of Turpentine, when mixed with alcohol, separates by rest. They are, also, soluble in ether, in every proportion; and in fixed oils.

Volatile Oils unite very imperfectly with alkalies and other oxides, forming a species of soapy compound, which the French chemists term Savonules. They are acted upon by the mineral acids, which probably yield Oxygen to them, as they are changed into substances resembling resins. Nitric acid reddens some of the medicinal Volatile Oils; namely, oil of Cloves and of Sassafras; on all of them the strong acids act powerfully, sometimes producing combustion: both oil and acid are decomposed, and carbonic acid, azote, the oxide of azote, sulphurous acid, and aqueous vapour, are evolved, according to circumstances. With chlorine there is less action; a heavy, white, concrete, oily substance is formed, and muriatic acid evolved. This fact has not yet attracted the attention of chemists. I imagine that the oil loses an equivalent of hydrogen, which changes it to the state of a concrete essential oil, whilst the hydrogen, combining with the chlorine, forms muriatic acid. Iodine, when mingled with some of them, causes heat sufficient to evaporate the Iodine: most of them dissolve Iodine: and some of them Sulphur, forming a deep, brown-coloured liquid, termed *Balsam of Sulphur*.

When exposed to the atmosphere, at the temperature of from 32° to 212° Fahr. the Volatile Oils yield part of their carbon and hydrogen to the oxygen of the air, perhaps also absorb oxygen, thicken, and acquire the properties of varnishes. They burn with a bright flame and black smoke, forming much carbonaceous matter, carbonic acid and water.

Volatile Oils are frequently adulterated with cheaper volatile oils, alcohol, and fixed oils. The first is detected by the colour, when the suspected oil is dropped on paper and heated: Alcohol, by dropping the suspected oil with water; it forms a milky, instead of a transparent film, if impure: and fixed oil by dropping a little of the oil on clean paper, and warming the paper: a greasy spot is left on the paper, if fixed oil be present; if not, the whole of the oil evaporates, leaving the paper clean.

Such are the general physical and chemical properties of the Volatile Oils. The following particulars of the uncombined Volatile Oils, employed as Excitants, are necessary to be known.

The volatile oils of *Caraway*, *Anise*, and *Dill* seeds, which are lighter than water, are obtained from the testæ of the seeds of Carum *Carvi*, Pimpinella *Anisum*, and Anethum *graveolens*, plants belonging to the natural Order Umbelliferæ. In these seeds the oil, secreted in the upper part of the testa, termed *vittæ*, descends through canals, marked by longitudinal furrows

on the seed, and is deposited at the lower part, which sometimes enlarges to a cell. The oil of Anise crystallizes at 50° Fahr. in flat plates*; its ultimate components are 76.487 parts of Carbon, 9.352 of Hydrogen, 13.821 of Oxygen, and 0.340 of Nitrogen†. The seeds yielding these oils are frequently employed in powder, as cardiacs, to expel flatulence; but the oils themselves, in the form of oleo-saccharum, are preferable to the seeds. They are useful adjuncts to correct the griping properties of some drastic cathartic pills.

The seeds of Fennel, Anethum *Fœniculum;* and of Dill, Anethum *graveolens;* Umbelliferous plants, and the distilled oil obtained from them, are used as Excitants. The Fennel is a biennial plant, which grows chiefly in stony places in most parts of Europe and in Hindostan. The seeds are smooth, ovoid, striated longitudinally; they have an acrid, somewhat sweetish taste, and unpleasant odour—qualities depending on the volatile oil they contain. The oil is nearly colourless, has a hot, sweetish taste, and congeals in a temperature 50° below zero. Its specific gravity 997‡. Dill is an annual, a native of Spain and Portugal. The seeds are oval, concave on one side, convex and striated on the other. The oil procured from them closely resembles that of Fennel. Neither of these oils is much used, except in the form of distilled water. The seeds enter into several officinal preparations.

Cajuputi oil is obtained from the leaves of the Melaleuca *cajuputi*, an elegant tree, belonging to the natural order Myrtaceæ, a native of the Molucca Islands. This oil is deposited in minute cells in the leaves§. On being bruised, the leaves smell strongly of the oil, which is prepared from them by distillation, after they are dried.

Cajuputi oil is limpid, and of a beautiful bluish-green colour: its odour is powerful, resembling a mixture of turpentine, camphor, benzoic acid, and cloves: its taste pungent and aromatic. When pure, it rapidly diffuses itself over water, and completely evaporates. It dissolves readily in alcohol; burns rapidly when ignited, and leaves no residue. It dissolves Iodine; is acted upon by sulphuric acid at 60° Faht. and by nitric acid with the aid of heat. The colour is no test of its purity, as the pure rectified oil in India is colourless.

This oil is a powerful Excitant: when taken into the stomach, it causes a glow, fills the pulse, and powerfully excites the nervous system; and, from determining to the surface, and equal-

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* In the chemical action of these oils on the mineral acids, the oil of Caraway differs from the other two in acting most violently on sulphurous acid; both the oil and the acid are decomposed, and much sulphurous acid evolved.

† M. Th. de Saussure. ‡ Lewis.

§ See Woodville's Med. Bot. 3d edit. vol. v, p. 57, pl. 15. Rumphius' Herb. Amboin. vol. ii, t. 17. London Dispensatory, art. Melaleuca.

lizing the circulation, it has been lately much prescribed in malignant cholera. The dose for internal use is from m. iii to m. vi, in the form of an oleo-saccharum. As an external Excitant, diluted with four parts of olive oil, I have found it useful as an embrocation in Phlegmasia dolens: after the active inflammation is subdued.

In the natural order Aurantiaceæ, we find two medicinal uncombined volatile oils, that of the Orange, Citrus *aurantium**, and that of the Lemon, Citrus *medica*†. These oils have a pale straw-colour, an agreeable odour, and a pungent acrid taste. They dissolve Iodine readily, forming a deep reddish-brown compound. The oil of Orange-peel scarcely acts upon nitric acid, the oil of Lemon-peel not at all. With muriatic acid, both form a kind of paste, made up of white lamellar scales, and a yellow fluid oil: freed from the latter, the crystals sink in water, dissolve in alcohol, and sublime when heated in close tubes; thus resembling, in many respects, the artificial camphor produced by the action of dry muriatic acid on oil of turpentine. The ultimate components of oil of Lemons are 86.899 of Carbon, 12.326 of Hydrogen, and 0.775 of Nitrogen‡.

Neither of these oils is much employed as Excitants.

The Order Rutaceæ presents us with only one volatile uncombined oil, that of *Rue*, a secretion of the whole plant of Ruta *graveolens*§. Although this oil is deposited in a pure state in distinct cells in the leaves and the flowers of the plant, yet, in other parts of the plant, it is in combination with resin. The Oil of Rue has a strong, unpleasant odour, and a hot, biting taste. The colour of the fresh-drawn oil is pale greenish yellow; but this deepens by age; and a deposit resembling resin gradually takes place, without injuring the properties of the oil. This oil dissolves Iodine readily; is rapidly decomposed by sulphuric acid; and acts on nitric acid, but very feebly. It congeals at 40° Fahrenheit.

The whole of the plant of Rue is employed on the Continent as an Excitant, in the forms of powder, decoction, and extract: but the oil is generally used in this country; and, when triturated with mucilage, or with sugar as an oleo-saccharum, it is preferable to the plant. In the latter form, it may be administered in doses of from m. ii to m. v, at moderate intervals. The Edinburgh and Dublin Pharmacopœias contain an aqueous extract; but, as the oil is dissipated during its preparation, it possesses no

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* Woodville's Med. Bot. 3d. edit. p. 523, pl. 188. London Dispensatory, art. Citrus.

† Woodville, p. 528, pl. 187.

‡ M. de Saussure.

§ Woodville, p. 487, pl. 184. London Dispensatory, art. Ruta.

excitant properties: decoction also is an injudicious form for a medicine the properties of which depend on volatile oil.

Oil of Rue excites powerfully the whole of the nervous system. The plant itself is extremely acrid in the fresh state; it was prescribed by Hippocrates, after being dried, in chlorosis and other diseases of females connected with a low state of the nervous energy; and it was equally prized by Boerhaave in the Neuroses: but it requires to be cautiously administered to pregnant women. It has been externally applied as a Rubefacient in palsy.

The Order Labiatæ contains more plants secreting uncombined oil than any other order. All the parts of these plants are studded with vesicular glands filled with volatile oil. The quantity formed by the plants depends much on the state of the atmosphere: when the air is dry and the temperature considerable, the secretion proceeds with greater activity; when it is moist and the season wet, the quantity of oil is much diminished. Thence, within the tropics, the Labiatæ yield not only Volatile Oil of a better description, but also in greater quantity than those in the temperate zones. These oils deposite more Camphor than any of the other volatile oils.

When the Labiated plants are carefully dried, and the vesicles not ruptured, the plants retain all their properties in perfection; in fact, they become more active from losing their moisture.

The *Oil of Lavender* is the produce of the Lavandula *spica**. The odour of this oil is most agreeable; the taste, like that of all volatile oils, is hot and biting. When newly distilled, it is nearly colourless, but it gradually acquires a lemon-yellow hue: it dissolves Iodine rapidly; producing a perceptible increase of temperature, and slight explosions. Sulphuric acid decomposes it instantly; but the nitric does not act upon it for some time, unless mixed with the sulphuric; in which case the action is violent. From these facts, the impropriety of ordering Tincture of Lavender in combination with diluted sulphuric acid, in the form of drops, is obvious. This oil dissolves in concentrated acetic acid; but it separates again when the solution is diluted with water. Its ultimate components are 75.50 of carbon, 11.07 of hydrogen, 13.07 of oxygen, and 0.36 of nitrogen†.

This oil is a powerful and frequently-employed Excitant. It is administered in the form of an oleo-saccharum, and in combinations with spirit, in the simple and compound spirits of Lavender of the British Pharmacopœias: formerly the powdered flowers

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* Woodville's Med. Botany, third ed. p. 221, plate 114. London Dispensatory, art. Lavandula.

† M. Th. De Saussure.

were used as an Errhine in cephalalgia. They still form an ingredient of the compound powder of Asarabacca of the Edinburgh and Dublin Colleges.

Three species of the Genus Mentha yield volatile oils employed as Excitants: the *Piperita*, *Viridis*, and *Pulegium**. All the plants of this Genus so closely resemble one another, that it is difficult to distinguish them, unless we have recourse to the characteristics pointed out by the late Sir E. Smith: the hairs on the pedicils, and those of the bractes and the sepales. Thus, Spear Mint, Mentha *viridis*, besides being distinguished by the uninterrupted floral spikes, has the bractes and calcycinal teeth furnished with stiff hairs, or setæ: the Pepper-mint, Mentha *piperita*, has obtuse spikes, interrupted in the lower part; but the chief characteristic is the smooth, naked calyx, the teeth only being furnished with dark purple hairs; in the Penny Royal, Mentha *Pulegium*, the pedicils and the sepales are every where covered with down. All these species yield, by distillation with water, a considerable quantity of volatile oil†. They differ very little from one another, either in their physical or chemical properties, or in their effects on the animal œconomy: consequently, they may be indiscriminately used. The oils are of a pale yellow colour, lighter than water, have a penetrating odour, and leave on the palate an agreeable sensation of coolness, which is peculiarly striking in the oil of Peppermint. They are all ready solvents of Iodine, and are decomposed by, and decompose, both sulphuric and nitric acids. M. Dublanc, by exposing oil of Peppermint to a temperature of 8° to 12° below 0, centigrade, obtained crystals of a tetrahedral form, which separated and left a thin fluid oil. These crystals are soluble in alcohol and ether, and taste acrid and rancid. Aqueous infusions of the plants, and water distilled from them, are employed in anorexia and weakened states of the digestive organs; and occasionally the plants themselves are used in the form of powder. These oils, rubbed up with sugar, or with mucilage, may be advantageously administered in doses from m. i to m. iv, in cases of cramp of the stomach, flatulent colic, and other conditions of the digestive organ depending on a weakened state of its nerves. The pharmaceutical preparations of the plants are infusions, distilled waters, and spirits; the medicinal properties of all of which depend on the presence of the volatile oil of the plant in them.

In the same Order, the Origanum *vulgare* and *marjorana*‡ yield volatile oils of a reddish-yellow colour, and an acrid, bitter

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* Woodville, pp. 336, 338, 342. Dispensatory, art. Mentha.

† The English oil of Peppermint is preferred even on the Continent.

‡ Woodville's Med. Bot. third ed. p. 344, pl. 123, 124. London Dispensatory, art. Origanum.

taste. Both of them dissolve Iodine rapidly, and are instantaneously decomposed by, and decompose, sulphuric acid, much sulphurous acid being evolved. Both act also upon nitric acid with violence, after they have remained for half a minute in mixture and assumed a dark colour. When long kept, they deposite white diaphanous crystals. The oils of Origanum are chiefly used as local stimulants in toothache, rheumatism, and other diseases attended with pain: they are too hot and acrid for internal administration.

Oil of Rosemary is a very powerful uncombined volatile oil, contained in the petals of Rosmarinus *officinalis**. This oil has a penetrating, unpleasant odour, and differs in its chemical properties from other volatile oils, by the slight influence which it exerts upon the sulphuric and nitric acids. When kept for some time, it deposites much Camphor. The ultimate components of this oil are 82.81 of Carbon, 9.42 of Hydrogen, 7·73 of Oxygen, and 0.64 of Nitrogen†. It is often adulterated with oil of Turpentine. The powdered plant is employed in the composition of cephalic snuffs. On the continent, an infusion of it is administered to awaken appetite and augment the digestive powers of the stomach. The dose of the volatile oil, if internally employed, should not exceed six minims. The best form of administration is that of an oleo-saccharum.

All these Volatile Oils operate as direct Excitants, in as much as their primary influence is exerted on the stomach; but, in almost every instance, the effect produced is extended by the nerves to the whole system. Volatile oils, however, are also taken into the circulation, and, pervading the system, shew themselves in some one or more of the excretions. The medicinal use of Volatile Oils is of a very ancient date; for, although they were not obtained by distillation in the time of the Coan sage, yet, they were procured by the trituration of the plants and flowers yielding them with fixed oil. From their antiseptic qualities and agreeable odour, in many instances, they were early employed in embalming the dead, and for the preservation of animal matter from putrefaction.

Applied to the living system, Volatile Oil is powerfully stimulant: even on the surface, its application produces local inflammation. When taken into the stomach, the primary effect is that of a powerful Excitant acting directly on the nerves of the viscus, and causing an excitement which is propagated over the whole system. When the dose is large, the inflammation of the stomach is intense; and it may be followed by gangrene and death; but, when it is small, and its acrimony sheathed by other

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* Woodville's Med. Bot. 3d ed. p. 39, pl. 117. London Dispensatory, art. Rosmarinus.

† M. Th. de Saussure.

substances, as with fecula, as in the seeds of the umbelliferæ, the stimulus is beneficial; promoting digestion and giving vigour to the habit, partly through the medium of the stomach, partly by being absorbed into the blood, exciting the action of the heart and arteries, and thence promoting the excretions of the skin and kidneys. Although they are all more or less general Excitants, yet their action, in some instances, is chiefly exerted upon particular organs. Thus, the oil of Juniper will be found among the Diuretics; that of Savine among the Emmenagogues.

Volatile oil is often the active principle of vegetable medicines; but, it is so variously combined, that it is frequently difficult to determine its share in the excitant property of the remedy. In its separate state, it is so powerfully stimulant, that it is never administered alone, or undiluted with mucilage or some bland emulsion which can sheath its acrimony. Besides being employed as Excitants, Volatile Oils are used to correct the griping property of resinous cathartics; they afford a fresh stimulus which exhausts the excitability of the nerves on which the griping property of the resins acts; and, on the same principle, a drop introduced into a hollow tooth, relieves toothache. In languid and sinking states of the system, the Volatile Oil may be advantageously administered in the form of an oleo-saccharum. The more acrid of them are employed externally as embrocations in paralytic affections and deep-seated pains.

Having examined the uncombined medicinal Volatile Oils, we have next to inquire into the nature of those which exist in plants in combination with other principles; namely, gum, fecula, extractive, resin, fixed oils, and a few other principles peculiar to certain plants. In these combinations, volatile oils are found forming the active medicinal agent of roots, wood, bark, leaves, flowers, and fruit.

* *Roots and their Appendages.*

SERPENTARIA ROOT. *Serpentariæ Radix.* L. E. D.—Serpentaria is the root of Aristolochia *Serpentaria**, a low, slender, perennial plant, a native of North America, particularly Virginia, whence the name *Virginian Snake Root.* Each root consists of a small gibbous body, from which numerous fibrous radicles proceed, of a brownish colour in their dried state. The root owes its excitant properties to volatile oil in combination with gum-resin, a bitter principle, and a large proportion of fecula, which, indeed, forms the greatest part of the caudex; consequently this part is much less active than the ra-

* The genus Aristolochia contains species with flowers of the greatest diversity in point of size. One species, growing on the borders of Madalena, is so large that they serve as bonnets for children.

dicles, and ought to be rejected. The plant seldom rises more than eight or ten inches in height: the stem is slender and flexuous, furnished with alternate heart-shaped acuminate, entire leaves, slightly ciliated. The flowers are small, of a purple colour, and situated on long pedicils at the lower part of the stem, distant from the leaves*.

This little plant is generally found growing in thick woods and on the shady sides of mountains from New England to Carolina. The dried roots are imported to Europe in bales. As imported, they are sometimes mingled with roots of the Asarum *virginicum*, readily distinguished by their black colour and defect of aromatic odour†. The odour of Snake-root is aromatic, resembling that of camphor: it has a warm, bitter, terebinthinate taste, not easily concealed by any admixture. It owes its odour to an essential oil, which rises in the distillation of the root with water, and renders turbid the tincture on the addition of water; its bitterness is due to a principle closely resembling Quassine, at least as far as can be determined by tests: subacetate of lead and nitrate of silver being the only substances which precipitate the infusion.

Serpentaria has been examined by Chevalier and by Bucholz. According to the latter, it consists, of volatile oil 0.05, greenish-yellow resin 2.85, bitter extractive 1.07, gummy extract 18.01, ligneous fibre 64.04, water 14,45. It also contains a free acid, the nature of which I have not determined. The volatile oil is closely combined with the resin. It is a powerful Excitant, acting on the vascular and the cuticular systems; thence it is indicated when the powers of life are languishing, and the skin is hot and dry. If the surface be kept warm, it rarely fails to excite the action of the capillaries of the skin; determining to the surface, at the same time that it supports the powers of life. When the surface is kept cool, it operates on the kidneys.

From its stimulant nature, it is contraindicated in states of the habit requiring the use of the lancet; and also if any acute or subacute inflammations exist in the digestive organs. In large doses—℈ii to ℈iv—it causes nausea, vomiting, colic, and tenesmus, and its influence extends to the brain, causing a sensation of pain there. The form of preparation commonly employed is infusion, made of various strength ac-

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* Barton's Veg. Mat. Med. of the United States, plate 28, page 41. Woodville's Med. Bot. third edition, p. 153, fig. bad. London Dispensatory, art. Aristolochia.

† The root of the officinal species was brought into notice in Europe in 1635, by a pamphlet, published in Paris by Dr. J. Cornutus, recommending it as an effectual remedy for the bites of snakes; thence its specific name, Serpentaria. The generic name is derived from two Greek words, αριστος and λοχια, from some supposed use of several of the species in cleansing the lochia after parturition; and thence, also, the English name *Birthwort*.

cording to circumstances: perhaps the best proportions are ℥i of the bruised root to f℥xii of water. Of this infusion f℥iss may be given for a dose. In large doses, its effects last twenty-four hours; in small, twelve hours.

Another species of Aristolochia, the A. *rotunda*, was an ingredient in the celebrated Portland powders, an obsolete remedy for the gout, which Parliament bought from the proprietor. Cullen affirms that this species of Aristolochia has the power of preventing attacks of gout when it is taken daily for some time: but that it causes dyspepsia and hypochondriasis!

As a local Excitant, Serpentaria has, also, been found useful in gangrenous sores; and, in the form of a gargle, in ulcerated throats, in which case I have generally combined it with tincture of capsicum.

ROOT OF SWEET-FLAG. *Radix Calami.* L. *Acori Calami radix.* E.—Syn. *Calamus Aromaticus.*—This substance is improperly termed a root in the Pharmacopœias; it is a *rhizome*, or descending part of the stem, emitting roots or radicles. This rhizome is the active part: in it, volatile oil is combined with fecula, inulin*, and gum. The plant to which this rhizome belongs, the Acorus *Calamus*, is an indigenous aquatic, belonging to the natural order Aroideæ†. It is found in many parts of Europe, in India, and Japan; and grows abundantly in shallow pools and on the banks of rivers in England. The rhizome is about half an inch to an inch in thickness, flat, jointed, and of various lengths. The joints are nearly an inch in length, and send off from their lower surface whitish-yellow rootlets, and also from the upper part bunches of brown, hair-like fibres, when the plant has grown in its natural marshy situation. The leaves of the plant, which are ensiform and waved on one margin, are, when bruised, as aromatic as the rhizomes.

The dried rhizome is covered with a corrugated cuticle, of a brownish-yellow colour, marked with many white elevated spots whence the radicle fibres issue. It breaks with a hackly fracture, displaying a pale bluish-white interior, tinged on the outer part with shades of rose-red and bistre; it exhales an agreeable aromatic odour, and has a warm pungent taste, not unlike that of camphor, becoming bitter and nauseous when much chewed. The smell and taste are improved by drying. The aromatic principle is an essential oil, which can be separated by distillation; it differs from most of the other volatile oils in some particulars: it does not dissolve iodine; it instantly de-

* This principle has much resemblance to starch; from which, however, it is distinguished by being deposited as its solution in hot water cools, and in striking with Iodine a greenish-yellow instead of a blue colour. It is distinguished from gum by its insolubility in cold water, and by not yielding saccholactic acid when digested in nitric acid.

† Barton, Veg. Mat. Med. vol. ii, plate 30, p. 66. Woodville's Med. Bot. vol. iv, pl. 248, p. 725, 3d edit. London Dispensatory, art. Acorus.

composes sulphuric, but it is slowly acted upon by the nitric, acid. It is lighter than water, of a pale yellow colour, and possesses the odour and pungency of the plant in an eminent degree: it is combined with inulin, and vegetable mucilage detected by subacetate of lead. When alochol is digested on the pulverized rhizome, a resinous extract is procured on evaporating the tincture.

The Rhizome of Acorus *Calamus* is an excellent Excitant in colic, in the flatulence of dyspepsia, and in the low sinking stage of malignant fevers; and, from my own experience, I know that it is one of the best additions to bark and sulphate of quinia in intermittents. It has been used alone, successfully, in Norfolk, in curing ague. The volatile oil is the active principle; but, in its primary or topical action, the resin and bitter extractive aids the effect produced on the stomach itself. The oil enters the circulation and operates chiefly on the kidneys, in the secretion of which it is readily detected by its odour. It is an excellent medicine in those cases of dyspepsia in which vertigo, arising from flatulence, is one of the symptoms: but, like many other valuable native remedies, it is much neglected. Dr. Paris mentions that it is so favourite a remedy with the native practitioners in India in bowel complaints, that a penalty is incurred by any druggist who refuses, in the middle of the night, to open his door and to sell the Acorus-root, if demanded. This is true; but the Indian Acorus is not our plant: it is a variety which Wildenow has described under the name Acorus *verus*; which is also a native of Flanders, Poland, and Tartary.

Calamus aromaticus is advantageously administered in the form of powder; decoction destroys its efficacious properties by dissipating the volatile oil. The dose of the powder is from ℈i to ʒi. It is usefully combined with magnesia and chalk, in the flatulent colic of infants. The volatile oil may be given as an oleo-saccharum in combination with sulphate of quinia, the anti-periodic effect of which it greatly improves. The dose of the oil is from ♏ii to ♏vi.

GINGER. *Radix Zingiberis.* L. E. D—This substance is a rhizome, which contains volatile oil combined with fecula. It is a tuber or reservoir of nutriment for the future plants of the Zingiber *officinale*, belonging to the natural order Scitamineæ. It is a native of the mountains of Gingi, in Hindoston, whence its name is derived. It was carried from India to Cayenne and to the West Indies, where the greater part of the Ginger used in Europe is cultivated.

The tubers or rhizomes, the parts medicinally employed, are attached to the base of the plant. They are perennial, palmated or knotted, flat, fleshy, and greenish within, but becoming fibrous and pale yellow with age; they are covered with a wrinkled, purplish epidermis, and marked with scarcely percep-

tible circles*. In the dry state, *White* Ginger is nearly white on the exterior, long, and more or less knotted; it breaks with a fibrous fracture, and has a whitish-yellow tinge within. The *Black*, or common Ginger, is in shorter pieces, and covered with a cuticle of a dirty grey colour.

The Ginger is dug up in January, after the stems, which are annual, have withered: the best pieces are selected, scraped, separately washed, and dried in the sun, for what is termed *white ginger:* but, when they are simply scalded before being dried, they are then called *black ginger*. The difference consists in the higher flavour and greater pungency of the white Ginger. Soundness or freedom from worm-holes, compactness and weight, constitute the goodness of both kinds.

Ginger has an aromatic, pungent odour, and a hot, biting, acrid taste. Alcohol and ether extract its efficient principle, which is an acrid oil lighter than water, that, besides its union with the fecula that constitutes the greater part of the ginger, is combined with resin. This oleo-resin can be obtained by distilling the alcoholic tincture of ginger; the residue is this substance.

The volatile oil, which is of a bluish-green colour, is obtained in small quantity by distilling the bruised tubers with water: it is not pungent. When the oleo-resin is removed, the fecula is nearly insipid†.

According to the analysis of M. Morin, Ginger contains—1. A resinous matter—soluble in Ether; 2. A sub-resin, insoluble in Ether, 3. a bluish-green volatile oil—lighter than water, and extremely acrid; 4, free acetic acid; 5, Acetate of Potassa; 6, Osmazome; 7, Gum; 8, a vegeto-animal matter and mineral salts; 9, a large proportion of fecula, some sulphur, oxides, and lignine‡.

Ginger acts powerfully upon the mucous membrane, in whatever manner it is applied to it. It also acts on the salivary glands, causing an abundant flow of saliva. In a moderate dose, Ginger is an useful general Excitant in flatulent colic, dyspepsia, and gout in the stomach; but it requires to be employed with caution, particularly by those who have any tendency to stricture of the uthera, as it excites the genital organs. It rouses, generally, the nervous energy; but I cannot accord with those who assert that it improves the sight, strengthens the memory, and elevates the moral faculties. It is a useful addition to griping purgatives, rendering them less likely to irritate the

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* For the botanical characters of the plant, see Woodville's Med. Bot. p. 731, pl. 250, 3d edit Jacquin Hort. Vindob. vol. i, p. 76; and for the method of preparing the Ginger, see London Dispensatory, art. Zingiber.

† M. Planché says the starch is as pure and bland as that obtained from wheat.

‡ Journ. de Pharm. Juin 1823.

nerves of the intestinal canal: it also appears to rouse the vitality of the intestinal surface, and to render it more susceptible of the influence of cathartic substances. The dose of ginger, in the form of powder, is from gr. x to ℈i: but, from habit, much greater quantities are daily taken as a condiment. It forms one of the numerous ingredients of the ancient Mithridate; and enters into many modern officinal preparations.

TURMERIC. *Curcumæ longæ Radix.* D.—This plant is a native of India, and extensively cultivated there. The tubers are rhizomes, which owe any medicinal properties they possess to the combination of a volatile oil with fecula. They are tuberose, oblong, whitish, knotted, and about the thickness of the finger, with some fleshy fibres attached to the nodes*.

The tubers are cylindrical, oblong, about the size of a pigeon's egg, rugose, and heavy: they break with a waxy fracture, and display internally a deep yellow colour marked with shining points. According to an analysis of Vogel, Pelletier, and Caventou, they consist of—1, a brown colouring matter, resembling extractive; 2, a small quantity of Gum; 3, an odorous, very acrid volatile oil; 4, a yellow colouring matter; 5, some Hydro-chlorate of Lime; 6, Fecula and Lignine†.

The dried rhizomes are brownish, externally wrinkled, of a golden yellow or saffron colour; in odour not unlike ginger; in taste acrid, aromatic, and slightly bitter: they tinge the saliva yellow. The yellow colouring matter resembles resin; when pulverized, it is heavier than water, in which it is sparingly soluble; it is very soluble in alcohol, in ether, and in both fixed and volatile oils; the alkalies deepen it to a dark red-brown, thence paper, tinted with Turmeric, is used as a test of the presence of alkalies.

Turmeric was at one time employed as a stimulant to the uterus, in defective or obstructive menstruation; but its use has now become almost obsolete. As an Excitant, it sharpens the appetite, and aids the digestive process; quickens the pulse, and elevates the temperature of the body.

** *Woods.*

SASSAFRAS. *Sassafras Lignum et radix.* L. E. *Oleum Volatile.* D.—Sassafras is the wood of the Laurus *Sassafras*,

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* For a botanical description of the plant, see Woodville's Med. Bot. p. 737, to 252, 3rd edition. Jacquin Hort. Vindob. tome iii, p. 5, tab. 4. London Dispensatory, art. Curcuma.

† Journ. de Pharm. 1826, p. 289. John also analysed Curcuma, and obtained—a volatile oil, 1 part; yellow resin, 11 parts; yellow extractive, 12; gum, 14; lignine mixed with a matter soluble in potassa, 57; water, 5; = 100.

one of those plants in which the volatile oil, to which it owes its medicinal properties, is so abundantly secreted as to render the roots, the wood, and the bark officinal. It is a native of North and South America*; a handsome tree, rising about forty feet in height, with large alternate leaves, varying in form, some oval, nearly obtuse, narrowed at the base, entire, with reticulated nerves; others trilobed, almost cordiform, with two or three longitudinal nerves†. The wood is imported in junks of different sizes, in general about the thickness of the arm of a man, covered with a rust-coloured, spongy, highly aromatic bark. The wood of the root is more aromatic than that of the stem. It has a brownish-yellow colour, veined with brown. The odour is powerful, not unlike that of Fennel; the taste, aromatic, sweetish, and slightly acrid. The volatile oil, which can be separated by distillation, and is so abundant that six pounds of the rasped wood yield two ounces of the oil, is colourless when newly drawn, but acquires a deep yellow, almost red colour by age. It is heavier than water, and is violently acted upon by nitric acid. Boiling water extracts partially the properties of the bark and wood of Sassafras; alcohol completely; and by distilling the tincture, an oleo-resinous extract remains, possessing all the active virtues of the Sassafras.

The exciting power of Sassafras seems to be exerted chiefly on the capillaries; causing sweating or a flow of urine, according as the surface is kept warm or cool. When the skin fails to be effected, it excites febrile symptoms. At one time the bark and the wood were highly extolled, and, whether given in the form of an infusion or in any other form, were regarded as specifics in rheumatism and gout. Their fame was also great as antisyphilitics. To those who may still wish to try their effects in syphilis, it should be known that bichloride of mercury is incompatible with the infusion which it precipitates; neither can the infusion be given in combination with salts of iron. But, although Sassafras and its preparations are certainly Excitants of some power, stimulating the capillaries and invigorating the general habit, yet, they have fallen into disrepute, and are now employed almost solely as domestic medicines, in Acné and similar cutaneous eruptions—a relic of the humoral school, the sole remnant of the doctrine of sweetening the blood. It enters as a component into the compound decoction of sarsaparilla, and of guaiacum.

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* It was discovered by the Spaniards after their conquest of Florida, under Ferdinand de Soto, in 1538.—Savary's Dictionary, vol. ii, p. 487. The Spaniards called it Cinnamon tree; the Indians Pavamé. The name Sassafras was imposed by the French.

† For the botanical characters, see Woodville's Medical Botany, p. 674, pl. 234, 3d edit. London Dispensatory, art. Laurus.

* * * *Barks.*

CINNAMON* BARK, OIL OF CINNAMON. *Cinnamomi Cortex;—Oleum.* L. E. D.—Few Excitants of a vegetable origin, which owe their remedial powers to volatile oil, possess the importance of Cinnamon bark, in a national or commercial, and even in a medicinal point of view. The tree, Laurus *Cinnamomum*, which yields it and the bark usually termed Cassia, belongs to the natural order Laurineæ. It is a native of Ceylon, Cochin China, Sumatra, Malabar, the Nicobar, and Philippine Isles, and Tobago. It is now cultivated in the Isles of France and Bourbon, the West Indies, at Cayenne, the Brazils, and some other parts of South America. The Cinnamon grown in these places is not only different in quality, but is the produce of different species of plants; thus, the Cinnamon of the Celebes is the Cinnamomum *Catilawan* of Nees ab Essenbeck; that of Bengal, the C. *Tamala;* and that of Sumatra, the C. *nitidum* of the same botanist. But the best is that which is grown in Ceylon†.

The Laurus *Cinnamomum*‡ is a small tree, seldom exceeding thirty feet in height, with a slender stem, covered with an ash-coloured rough bark; the leaves are in nearly opposite pairs, on short channelled petioles; entire, oblong, smooth pointed, three-nerved: when mature, they have a strong aromatic odour, and a hot, biting taste. The flowers are in panicles, small, whitish, slightly fœtid. The fruit is an oval berry, bluish-brown, maculated. The bark is sometimes freed from the epidermis before it is stripped from the branches, and afterwards from a green, pulpy matter under it; a process performed by laying the inner side of the piece of bark on a convex piece of wood, and then scraping it: after which it contracts, dries, and assumes the quilled form. The smaller pieces are put within the larger, and in this state it is exported. The acrimony of the recent bark is so great that it blisters the mouth. The bark is examined piece by piece, and sorted into three parcels, the first, second, and third sort. That which is evidently taken from *large* branches is rejected, as well as that

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* The name *Cinnamon*—κινναμωμον of the Greeks, *Kinamon* of the Hebrews—is supposed to be derived from *kayu-manis*, the Malay name of the tree.

† Some years ago, Mahommed Ali, Pacha of Egypt, introduced the cultivation of Cinnamon into his country. The original plants were three cuttings from the garden of M. Boursault, at Paris: they have been so well managed, that some Egyptian Cinnamon has already found its way into the European markets.

Dr. Martius, the distinguished Bavarian naturalist, sent me a specimen of Brazilian Cinnamon: it is, in every respect, inferior to the worst of the Oriental Cinnamon.

‡ For an accurate botanical description of the tree, see Woodville's Med. Bot. p. 670, pl. 233, third edition; and for an account of its varieties, cultivation, and mode of barking, see the London Dispensatory, art. Laurus.

from *very young* twigs; the first because the aroma is sharp and not very agreeable; the second because the oil contained in very young branches is rapidly dissipated in the drying of the bark. These inferior specimens of Cinnamon are put into the still for the purpose of obtaining the oil; for, besides the preparation of the bark, the volatile oil is distilled in Ceylon.

There are four varieties of Cinnamon, known in commerce —*Ceylon*, *Chinese*, *Cayenne*, and *flat*.—*Ceylon* Cinnamon is the best. It is in long pieces, very thin, scarcely thicker than paper, and one piece is slipped within another. It has a citron-fawn colour, an aromatic odour, and an agreeable, hot, slightly biting, sweetish taste, without leaving any nauseous or bitter impression on the palate. It does not break short, but bends before breaking, and has a splintery fracture. It yields, in distillation, a small quantity of a highly acrid volatile oil, which has the odour and taste of the Cinnamon in a concentrated state. This oil is stated to be deposited in particular cells in the interior of the bark, or that part which is next to the wood in the living plant. It is of greater specific gravity than water. When the Cinnamon is devoid of sweetness, and leaves a mawkish taste in the mouth, is very dark, or too light coloured, is deficient in aromatic flavour, or is bitter or astringent, it is of an inferior quality. 2. What is termed *Chinese* Cinnamon is thicker than that of Ceylon; of a higher colour, a stronger odour, and a more pungent taste; it affords a larger quantity of volatile oil. The Chinese is, however, sometimes as thin and as good as the Ceylon*. 3. The *Cayenne* Cinnamon has the same characters as the Ceylon, but is thicker. A variety grown in the Brazils is much inferior. 4. *Flat* Cinnamon is taken from the larger branches of the tree; it is thicker than any of the other kinds, less quilled, slightly rugose, of a deeper yellow on the surface than the quilled, and of a paler yellow within and glazed: its fracture is fibrous, and its odour and taste are very feeble.

Both alcohol and water extract the active principles of Cinnamon. Ether, when it is digested for some time on the powder of Cinnamon and evaporated, leaves an oleo-resinous matter which tastes and smells like Cinnamon. The aqueous infusion is precipitated by persulphate of iron of an olive-green hue, and also by gelatine, demonstrating the presence of tannin: the acetate of lead discovers mucilage: iodine does not detect the presence of fecula. The infusion is also precipitated by lime-water and the carbonates of alkalies; the precipitates being compounds of oxides or alkaline bases and tannin. According to the analysis of Vauquelin, Cinnamon bark con-

* Cinnamon is now also an article of trade from Borneo; and some of a very fine quality is grown in the central mountains of Cochin China.

tains *volatile oil*, *tannin*, *mucilage*, *a colouring substance of a vegeto-animal nature*, an *acid*, and *woody fibre**. It is to the volatile oil, and some *bitter resin* which Vauquelin has overlooked, that the active properties of the Cinnamon are to be ascribed. M. Planché asserts that it also contains *fecula* and *caryophylline*. The volatile oil can be obtained by simple distillation; but, in Ceylon, the bark is macerated in sea water for two days before it is put into the still. It is more easily procured by distilling the alcoholic tincture nearly to dryness, then mixing the extract with water, and redistilling, two kinds of oil come over, one lighter, the other heavier than water: the water in which the oil is distilled remains highly charged with it; but the quantity yielded is extremely small, being less than a drachm from ℥xvi of the bark. The Ceylon oil has a whitish-yellow colour, possesses a hot, biting taste, and a pungent odour, and is heavier than water.

As a medicinal agent, Cinnamon is a powerful Excitant, acting primarily on the nerves of the stomach, awakening a sensation of warmth in the epigastrium, exciting the spinal marrow, and thence the whole nervous system, causing all the organs to exercise their functions with augmented energy. When its use is long continued, costiveness follows.

Cinnamon is scarcely ever employed alone as an Excitant; but it is generally added to medicines that possess no aromatic principle, and for covering the taste of nauseous medicines. It cannot be prescribed in conjuuction with the yellow Cinchona bark, on account of the tannin which it contains; but it may be united with Cascarilla, Quassia, Gentian, and Calumba. The oil is a more energetic Excitant than the bark, and may be administered in the form of an oleo-saccharum: in which state it may be given with advantage, either united with any tonic bitter, or alone, in cramp of the stomach, flatulent colics, malignant cholera, and gout suddenly attacking the stomach by metastasis. It is well adapted for checking those vomitings attendant on some dyspeptic affections, apparently depending on a morbid condition of the spinal and ganglionic nerves, which this excitant seems to change by the impression which it makes on the sentient extremities of the gastric nerves. The tannin it contains in combination with the volatile oil admirably fits this bark for those cases of diarrhœa which, from the absence of all inflammation, seem to depend on direct debility of the intestinal canal. The powder may be given in doses of ℈ss to ℈i; or the oil to the extent of from m. iii to m. v, either united with water, as an oleo-saccharum, or by means of mucilage or yolk of egg.

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* Journal de Pharmacie, Octobre 1827. M. Planché first obtained this crystalline matter from Cloves, and thence named it *Caryophylline*.

Cinnamon bark enters into several pharmaceutical preparations: *a distilled water*, which is an agreeable vehicle for many other medicines, but which, when long kept, becomes nearly inert, owing to the subsidence of the oil; a *spirit*, which is a mere solution of the oil in diluted alcohol; and two *tinctures;* one simple, containing the oil, tannin, and colouring matter of the bark; and the other a compound of various aromatics in conjunction with the oil and tannin of the Cinnamon in proof spirit. There is also a *compound powder of Cinnamon* (P. Cinnam. Comp. L. Pulvis Aromaticus, E. D.), consisting of nearly the same ingredients as the compound tincture, independent of the alcohol. They are all good Excitants. The oil is sometimes used locally in toothache, being dropped upon cotton and inserted into the hollow of the decayed tooth. It operates by rapidly exhausting the nervous excitability. Cinnamon, nevertheless, is usually regarded rather as a useful adjunct to tonics and other medicines than as a direct Excitant.

CASSIA was generally supposed to be the production of Laurus *Cassia*, a distinct species of Laurus; and as such it is set down in all the British Pharmacopœias. But Mr. Marshall, who, from his appointment as a staff surgeon to the forces in Ceylon, had excellent opportunities of determining the fact, asserts that it is the bark of the same tree as that which yields the best Cinnamon. It is true that the Laurus *Cassia* grows in Ceylon; and there is a marked specific distinction in the ribbing of the foliage of the trees. In the Laurus *Cinnamomum* the leaves are strongly marked with three longitudinal nerves, which extend from the base to the apex of the leaves: in the L. *Cassia* these longitudinal nerves, or bundles of vessels, are also present; but they do not extend the whole length of the leaf; on the contrary, they are given off from the midrib. The leaf of the Cassia is, also, waved on the margin; and it is less odorous than that of the true Cinnamon.

Mr. Marshall informs us that the Cassia is never barked, on account of the bitterness of its bark, which has, in some degree, the odour and taste of myrrh. The term Cassia, which was formerly used in Ceylon to specify the Cinnamon, is now employed only to designate *Coarse Cinnamon*. The worst kind of Cinnamon, that which is set aside for distillation in Ceylon, and, also, a Cinnamon imported from Cayenne, have been brought into this country and sold as Cassia. It is thicker than good Cinnamon, and affords, when masticated, the idea of a slimy substance. The difference consists chiefly in the cellular tegument, which is removed from the Cinnamon, being left in the Cassia. When this is scraped off, Cassia is in every respect the same as Cinnamon.

On the infusion of Cassia, chemical reagents display a reaction different from that which they exert on the infusion of

Cinnamon: the solution of persulphate of iron throws down a greenish precipitate; lime water a copious light-brown; and oxalate of ammonia a similar precipitate, an effect which must depend on the presence of some salt of lime, not formed in good Cinnamon bark. Tincture of Iodine produces a blue colour in infusion of Cassia; which effect, and the precipitate with oxalate of ammonia, readily distinguish it from Cinnamon. The salts of lead, iron, silver, bichloride of mercury, and lime water, are incompatible with infusions of Cinnamon and of Cassia. It is a curious fact that a very striking difference exists in the action of nitric acid on the oils of Cinnamon and Cassia: the former is scarcely affected; the latter rapidly changes to a deep brown: alcohol added to the former merely dilutes; to the latter, it changes the solution to green.

The medicinal properties of Cassia are in every respect the same as those of Cinnamon. It may be given in the same doses, and in the same combinations. It is, however, less agreeable to the taste, owing to the cellular exterior part of the bark, which is separated in good Cinnamon.

WINTER'S BARK. *Winteræ Aromaticæ Cortex.* E.—*Drymis Aromatica—Cortex.* D.—A valuable combination of volatile oil with resin is found in the bark of the Drymis *Aromatica* or *Winteri*, the true Winter's Bark. The tree which yields this bark belongs to the Natural order Wintereæ: it grows in the straights of Magellan, where it was discovered by Captain Winter in 1579, and thence received his name*.

The true Winter's Bark is usually in slightly quilled pieces, about eight or ten inches in length, and from one to two inches in breadth, and not more than one fourth of an inch in thickness. It is wrinkled on the exterior, is of a reddish-grey colour, and spotted with elliptical red blotches: interiorly, it is a dark-brown Cinnamon-hue. It breaks with a compact fracture, which is grey at the outside and red within; these two colours being separated by a very sensible line of demarkation. Its odour is fragrant, augmented in the powder; its taste acrid and peppery: both depending on a volatile oil and an acrid resin. Besides these two principles, M. Henry has discovered in it a *colouring matter*, *tannin*, the *acetate*, *hydrochlorate*, and *sulphate of potassa*, *malate of lime*, and *oxide of iron*. The oxide of iron and the tannin distinguish it from Canella bark, and are easily detected; the oxide by ferrocyanate of potassa, the tannin by persulphate of iron and gelatine. On

* For the botanical characters of the tree, see Woodville's Med. Bot. p. 647, pl. 266. London Dispensatory, art. Wintera. Medical Obs. and Inquiries, vol. v. Richard. Hist. Nat. Med. tome ii, p. 605.

account of the sulphate of potassa, the infusion is precipitated by the salts of baryta.

Winter's bark imparts its properties to boiling water, and may be administered in the form of infusion. Decoction is a bad form of preparation. It is given also in the simple state in powder, in doses of from gr. vi to ℈i: on the Continent, a wine and tincture of this bark are much employed. It acts as a simple but powerful Excitant, exerting its primary influence on the nerves of the stomach; but, like all the other vegetable Excitants, its active principle is also taken into the circulation and imparts its odour to the urine. Captain Winter, who first brought it into notice, used it as a condiment in seasoning the food of his sailors, who were suffering under the ravages of scurvy; he also applied the leaves of the tree, in the form of fomentations, to their sores. Under this treatment they got well; but, as Murray justly remarks—"Nec ullam prærogativum præ aliis aromaticis huic considere possum sub eo morbi gradu eaque conditione, qua aromata considere possunt*." Winter's bark is, nevertheless, a valuable Excitant; and, in diarrhœas depending on a low condition of the habit, with deficient cutaneous action, the combination of the tannin and volatile oil gives it an advantage over Canella *alba*. In cases of dyspepsia which permit the use of Tonics, it is an admirable addition to simple bitters; with which intention it is often used on the Continent, although seldom in this country. It has been more neglected than many less valuable medicines.

Canella Bark. *Canella Cortex*. L. *Canellæ albæ Cortex*. D.—This bark is the product of the Canella *alba*†, a tree which is a native of Jamaica and some other of the West India islands. It belongs to the natural order Meliaceæ. The Canella found in the shops is the inner bark of the young branches freed from its epidermis. It is in pieces of from five to eight inches in length and from one to two in breadth; some quilled, others nearly flat: but it varies greatly both in size, thickness, and quilling, according as it has been taken from younger or older branches. The interior of this bark is of a pale-orange hue; the exterior whitish: it has the fracture of marble. Canella alba has an aromatic, pungent taste, leaving a bitterness in the mouth: the odour somewhat resembles a mixture of cloves and pepper.

MM. Petroz and Robinet analysed Canella *alba*, and obtained *saccharine matter*, crystallizable and resembling mannite;

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* Apparatus Medicaminum.

† Woodville's Medical Botany, p. 694, pl. 237. Sloane's Jamaica, vol. ii, p. 87. t. 191, f. 2. London Dispensatory, art. Canella alba. Richard, Hist. Nat. Med. tome ii, p. 700.

a peculiar, *bitter resinous principle; resin;* an acrid *volatile oil; gum; albumen;* and *fecula.* Alcohol is its proper menstruum, taking up both the resin and the volatile oil; whilst water takes up the gum, fecula, and albumen, with a portion of its bitter, but very little of the volatile oil. The infusion, therefore, possesses scarcely any of the warmth and pungency of the bark: it is not affected by tincture or infusion of galls, lime-water, tartar emetic, the salts of iron, or those of mercury; all of which, therefore, may be prescribed in conjunction with it; but, in consequence of the albumen, it is precipitated by nitrate of silver; and, owing to the gum, it throws down subacetate of lead. The volatile oil can be obtained by macerating the bark and afterwards distilling it. This oil is thick, heavy, yellow, very pungent, and gratefully aromatic.

Canella alba is a powerful Excitant, an useful addition to tonic medicines in those cases in which a cordial is required, as in some varieties of dyspepsia and in atonic gout. From its not acting on the salts of iron, it is an excellent vehicle for these in the treatment of chlorosis and other diseases of cold, leucophlegmatic habits. It is a good adjunct to jalap, colocynth, and other griping purgatives. It is most useful when administered in the form of powder, in doses from gr. x to ʒss, and may be combined with sulphate of potassa, rhubarb, and bitters. It enters into several officinal preparations.

* * * * *Flowers.*

THE CLOVE. *Caryophyllus.* L. *Caryophyllus aromaticus. Flores nondum expliciti et oleum volatile.* E. D.—The Clove is the unexpanded flower of Eugenia *Caryophyllata*, a tree which is a native of the Moluccas*, and belongs to the natural order Myrtaceæ. It is a tall, handsome, evergreen tree, with a stem covered with a greyish, smooth bark†. The Clove is the calyx of the flower, enclosing the ovary or germen. The unblown petals sometimes remain, and form a small, round head; sometimes they fall off, and leave the four points of the calyx to form the nail-like appearance of the Clove. The Cloves are first procured from the tree when it is six years old. They are col-

* When the Dutch captured these islands from the Portuguese, they destroyed all the trees except those on the islands of Amboyna, Honimoa, Ana, and Nousalant. The French, however, in 1769, broke this monopoly of the Dutch, by introducing the tree into the isles of France and Bourbon, and their other colonies: in 1789, it was carried to the island of Dominica by an Englishman of the name of Buée; and, in 1803, it was introduced into Sumatra by Dr. Roxburgh.

† See Woodville's Med. Bot. third ed. p. 538, pl. 193. London Dispensatory, art. Eugenia. Richard, Hist. Nat. Med. tome ii, p. 403.

lected at Amboyna when they begin to redden, and are quickly dried by an exposure to heat and smoke, at a temperature of 120° Fahrenheit, until they assume their deep brown colour: after which the drying is completed in the sun. Those dried wholly in the sun and those which come from Molucca are the best. They ought to be of a bright brown colour, heavy, greasy, and easily bruised; their odour agreeable and aromatic, and their taste acrid and biting. They yield, by distillation, a large quantity of a heavy, highly pungent volatile oil.

Cloves yield their medicinal properties to water and alcohol. The infusion contains some gallic acid and much tannin, striking a deep black-blue with persulphate of iron, and precipitating copiously with lime-water and acetate of lead. Iodine does not affect it; but the three mineral acids produce a floculent precipitate; and, after a short time, the nitric acid displays effects which would almost permit the supposition that brucia is present in the Clove. Thus, when it is added to the infusion, slightly warmed, a deep bright red hue, resembling that which brucia and morphia assume when treated with this acid, gradually appears. M. Bonastre, who first observed this fact, ascribes it to the oil of the Cloves, acted on by the nitric acid; and he properly cautions against the conclusions that might be formed of poisoning by brucia or morphia when the contents of the stomach, tested with citric acid, display this red appearance. According to the analysis of Trommsdorff, 1000 parts of Cloves contain 180 of waxy *volatile oil*, 40 of *scarcely soluble extractive*, 130 of *gum*, 60 of *resin*, 280 of *lignine*, and 180 of *water*. M. Planché has found sulphur in them; and MM. Lodibert discovered *Caryophylline* and a green, acrid, aromatic, fixed oil in the Cloves of Molucca. Caryophylline is rough to the touch and devoid of odour and taste: it crystallizes in fine needle-formed rays; is scarcely soluble in cold alcohol, but soluble in boiling alcohol; is not reddened by nitric acid; and does not produce any effect on vegetable blues reddened by acids*.

In a medicinal point of view, Cloves are powerful Excitants, requiring much caution in their administration. An overdose, even of the infusion, disturbs greatly the cerebral function, causing vertigo, cephalalgia, and dimness of sight. By regulating the dose, however, the Clove is one of the most certain of this class of remedies. It is also an useful addition to simple bitters, in cases which require a strong and immediate stimulant effect to be produced on the stomach; namely, atonic gout affecting that organ.

The clove is generally administered in the form of powder,

* Journal de Pharm. tome ii, p. 104.

in doses of grs. vii to grs. xii mixed with sugar: and in that of infusion, made with ʒi to a pint of boiling water. It enters into several officinal preparations. The oil is also used as a corrigent to some drastic, cathartic gum-resins, the purgative power of which it considerably augments: it is also employed to destroy the nerves in decayed teeth, in which it acts almost like an escharotic. The dose of the oil is from m. i to vi, triturated with sugar, as an oleo-saccharum, and diffused in water.

SAFFRON. *Croci Stigmati.* L. *Croci Sativæ Stigmata.* E. D. —Saffron is the dried stigmata of the Crocus *Sativus*, a plant which belongs to the Natural order *Irideæ**. The active principle of Saffron is a volatile oil in combination with a peculiar colouring principle named *polychroite*†.

Saffron in its dried state, when good, has a yellow colour, mixed with a deep reddish orange; its taste is pungent and bitter, and it exhales an agreeable odour. When powdered, it is of a beautiful orange colour. According to the analysis of Vogel and Bouillon la Grange, Saffron contains

A colouring extractive matter (Polychroite). .	66.
Volatile oil (the quantity undetermined).	
Wax	0.50
Gum.	6.50
Albumen.	0.50
Salts, with bases of Lime, Potassa, Magnesia .	2.50
Water and lignine.	20.
	100.00

Saffron yields its active principles to water, wine, proof spirit, alcohol, and ether.

Saffron is sometimes adulterated with the petals of the safflower, and the officinal marigold; but these frauds are of little

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* For the botanical characters of the plant, see Woodville's Med. Bot. p. 763, pl. 269, 3rd edit. and for an account of the manner in which the stigmata are prepared for medicinal use, see London Dispensatory, art. Crocus. Richard, Hist. Nat. Med, tome i, p. 410.

† Polychroite is separated from the other principles by infusing the Saffron in cold water, evaporating the infusion to the thickness of a soft extract; acting upon this with alcohol; filtering, and evaporating the alcoholic solution to one third. To separate the oil, a little potassa must be next added; and, having again saturated it with acetic acid, filter and evaporate, and the residue will be Polychroite. Ann. de Chimie, tome lxxx, p. 186.

Polychroite is a red powder, having a weak but agreeable odour, and a slightly bitter taste: it colours the saliva yellow, is soluble in cold water, and in alcohol, ether, the fixed and volatile oils, and the alkalies. It is partially soluble in the vegetable acids: nitric acid changes its colour to green; but this disappears on the addition of water. Sulphuric acid acts upon it in a singular manner: it first becomes blue, then violet, then green, and lastly brown: displaying those Cameleon changes which have given it its name. Chlorine destroys its colour. This principle was discovered by Bouillon la Grange and Vogel. It exerts no influence on the living system. Journ. de Pharm. tome vii, p. 397.

consequence, as far as concerns the medicinal properties of the Saffron. A worse fraud is the mixing good Saffron with that which has been used and afterwards dried.

Saffron was regarded as an Excitant of considerable power by the ancients. It is to the volatile oil that any medicinal virtue which it possesses is to be attributed. Its power may be judged of by the quantity of oil in a given quantity of Saffron: 100 parts generally afford 3 of oil. It excites the nerves of the stomach, and is partially absorbed. It exhilarates the spirits, and, like other Excitants, the excitement it produces is followed by exhaustion: in large doses, it affects the brain, causing headache, convulsive laughter, coma, and delirium*; and it is said that fatal effects have followed the imprudent use of Saffron. Even the aroma, when the stigmata have been recently gathered, is reported to be narcotic. This power of exciting the nerves renders Saffron an useful addition to narcotics in many convulsive and spasmodic affections. Thus the liquid laudanum of Sydenham, which contains one ounce of Saffron in the pint, in combination with cinnamon and cloves, is the best preparation which I know, in cases that require the combined action of a narcotic and an excitant.

Much diversity of opinion exists with respect to the exciting powers of Saffron. The experiments of Dr. Alexander† would induce the belief that it is a very inert substance. My own experience does not accord with that of this distinguished physician; and I am disposed to attribute much of the contradictory evidence advanced on this subject to diversity in the goodness of the drug.

Much evil has been produced by the custom, prevalent among the lower classes, of administering Saffron at the commencement of fevers attended with cutaneous eruptions, with the idea of throwing out the eruption.

Saffron may be administered in the forms of powder, infusion, or tincture. The dose of the powder is from grs. x to ʒi; that of an infusion made with ℥ss of the Saffron to half a pint of water is two table-spoonfuls given once in three or four hours: the dose of the tincture is from f ʒi to f ʒii. It is an in gredient in several officinal preparations.

* * * * * *Fruits.*

Pimenta Berries. *Pimentæ Baccæ.* L. *Myrti Pimentæ Fructus.* E. *Pimenta.* D.—Pimenta, or Jamaica Pepper, is the fruit of the Eugenia *Pimenta* of De Candolle, a tree which grows

* M. Hannin, Cours de Mat. Med. tome ii, p. 329. † Experimental Essays, p. 88.

in great abundance in Jamaica, in the other West India islands, and in South America*.

The fruit of the Pimenta, as it is imported, is about the size of a small pea, of a dark reddish-grey or brown colour, rough, with a slight indentation on its upper surface. It is bilocular, and in each cell is a seed imbedded in a moist green pulp. Pimenta is the unripe berry; for the ripe fruit loses much of its aromatic quality, and becomes terebinthinate to the taste. The best kind of Pimenta is the produce of Jamaica. A kind of Pimenta is imported also from Tobago: it is larger than that of Jamaica, but is not so much valued, being considerably less aromatic. It is supposed to be the produce of a distinct plant, the Myrta *pimentoides* of De Candolle†.

Pimenta has an agreeable odour, not unlike that of a mixture of cinnamon and cloves; thence its name, allspice: it has a pungent, hot taste, resembling that of pepper; properties dependent on the volatile oil which it contains, and which resides in the exterior coat chiefly, the kernel containing only one half the quantity which the outer coat yields. The volatile oil, separated by distillation, is of a deep reddish-brown colour, and very heavy. Sulphuric acid decomposes it rapidly; nitric acid acts on it with great violence, both acid and oil being decomposed.

Water takes up the active principles of Pimenta; and, in distilling the berries to obtain the oil, a considerable portion of the flavour and taste of the Pimenta is communicated to the water, which is used under the name Aqua Pimentæ. The active principles of Pimenta are also taken up by alcohol and ether. The spirit is officinal.

Besides the volatile oil, the tannin which Pimenta contains renders the infusion incompatible with salts of iron. Nitrate of silver, the salts of lead, and infusion of cinchona, throw down precipitates. The mineral acids produce curious effects on the infusion: the sulphuric and the muriatic redden it, and throw down pale, rose-coloured precipitates; the nitric gives it a yellow hue, but no precipitate falls. The infusion also reddens the tincture of Litmus.

These effects of re-agents are explained by a knowledge of the constituents of Pimenta. The acids detected in a free state, are found to be the malic and gallic; the latter, in conjunction with the tannin, precipitates the salts of iron; the tannin and resin are affected by the mineral acids; whilst the nitrate of silver demonstrates that the saline ingredients contain a muriate. According to the analysis of M. Bonastre, 1000 parts of Pimenta yield—

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* Woodville's Med. Botany, p. 541, plate 291, 3d edit. London Dispensatory, art. Myrtus. Richard, Hist. Nat. Med. t. ii, p. 404.

† Prodromus, tom. iii, p. 243.

	Skin.	Kernel.
Volatile oil	100.00	50.00
Green fixed oil	80.00	25.00
Tannin.	114.00	398.00
Gum.	30.00	72.00
Colouring matter and resin.	52.00	—.—
Saccharine matter.	30.00	80.—
Malic and Gallic acids.	6.00	16.—
Stearine	9.00	12.00
Lignine and water	535.00	30.00
Saline matter (muriates?)	28.00	18.—
	984.00	702.00
Loss	16.00	18.00
Red insoluble matter	——	88.00
Pellicle, residue of Cotyledons	——	192.00
	1000.00	1000.00

In this ample display of constituents, the volatile oil is the chief active medicinal agent; thence, the oleo-saccharum of the Oil of Pimenta should be preferred to the berries.

Pimenta operates on the living system as an excitant, entering into the circulation and augmenting the force and frequency of the pulse. It is particularly serviceable in the dyspepsia of broken-up constitutions, when much flatulence is present, and particularly when there is a tendency to atonic gout: but in every instance much caution is requisite not to give it with that red and glazed state of the tongue which indicates subacute inflammation of the mucous membrane of the stomach. In measles, smallpox, and other exanthemata, when the fever assumes the typhoid character, the watery infusion of allspice, sweetened with sugar and mixed with a little milk, is taken without reluctance by children, and proves highly useful. The distilled water is an excellent vehicle for other medicines.

Pimenta may be administered in the form of powder, in doses of from gr. x to ʒs; and, in cases requiring an astringent, it is the preferable form. As the first impression on the stomach is considerable when the powder is taken, the entire berries are sometimes swallowed instead of the powder; but the best mode of administering the Oil is to form it into an oleo-saccharum, or to combine it with some cretaceous powder which, absorbing it, obtunds the acrimony of its first impression.

CUBEBS. *Cubeba.* L. *Cubebæ fructus.* D.—A very natural and frequent combination of volatile oil, that with resin, exists in this species of Pepper, the fruit of Piper *Cubeba*, a member of the natural order Piperaceæ, and a native of the Indian Archipelago, Nepaul, and the Isle of France*. Cubebs resemble

* Richard, Hist. Nat. Med. tome i, p. 312.

black pepper, except that they are less wrinkled, and have pedicils attached to them: thence the name *Piper caudatum.* They have a fragrant, agreeable odour, and a pungent, aromatic, bitter taste, which leaves a sensation of coolness on the palate resembling that of Peppermint. The oil which they contain is so very volatile, that it is soon dissipated if they be bruised; and, therefore, Cubebs should not be kept in a state of powder. Cubebs, in powder, are sometimes adulterated with powdered Pimenta. According to the analysis of Vauquelin*, they contain—a volatile oil nearly concrete; a small quantity of coloured resin, a resino-gummy coloured matter; extractive; and some salts.

The volatile oil, when procured by distillation, is separable into two parts: a white concrete crystalline substance, and a pale, greenish-straw-coloured, fluid oil, possessing the taste and odour of the Cubebs; and on which their efficacy depends.

The powder of Cubebs, when taken into the stomach, acts primarily on the nerves of that organ, augmenting its energy, and through it increasing the action of the heart and arteries: it is, however, quickly taken into the system, the oil is separated and excreted by the kidneys, imparting its peculiar odour to the urine. The powder stimulates the intestinal canal through its whole extent, and imparts the same cool sensation in passing from the rectum as it leaves in the mouth. In doses from ʒiss to ʒii, it acts powerfully on the mucous tissue, causing nausea and diarrhœa, with some febrile excitement: if no purging occur, the heat of the body is greatly augmented; the palms of the hands and the soles of the feet burn; the face flushes, and severe headache supervenes.

In 1818, Mr. Crawford published an account of the advantages derived by the Hindoo practitioners from the administration of powdered Cubebs in Gonorrhœa, and confirmed it by his own experience and that of the English surgeons in Java†. The experience also of European practitioners has since established and confirmed the value of this remedy in Gonorrhœa.

Regarding Cubebs as an Excitant, it may be demanded, in what manner do they cure Gonorrhœa, which is an inflammatory affection? In replying to this question we must bear in recollection that Cubebs are injurious in severe cases of the disease, when the inflammatory state is considerable, extending to the neck of the bladder, and accompanied with much symptomatic fever. In such cases I have seen them bring on bloody urine, strangury, and other violent symptoms. When these circumstances are absent, and the disease is confined to the mucous membrane, the morbid action which exists there is of a specific nature; otherwise a virus, resembling that which produced the disease, would not be generated. Now, when Cubebs are taken

* Journ. de Phar. tom. vi, p. 309.

† Edin. Med. and Surg. Journ. vol. xiv, p. 33.

into the stomach, the volatile oil, separated from the resin and extractive, by the digestive function, is absorbed, passes by the kidneys, and thence acts on the bladder and the urethra, during the excretion of the urine. A new action in these parts is thus induced, sufficient to change the diseased state; and this new action being afterwards gradually let down, the diseased action does not return. It is also probable that the local effects of the Excitant on the intestinal canal may operate, in a certain degree, as a counterirritant. This explanation is greatly confirmed by the fact that Cubebs produce little benefit, unless their effect be soon apparent.

Cubebs are administered most advantageously in the form of powder, to ensure the efficacy of which it should be kept in stopped phials; or pulverized only when about to be used. The volatile oil may be prescribed instead of the powder; it possesses the advantage of not losing its properties by keeping. When the powder is administered, it is digested in the stomach, as I have already stated, and the volatile oil, entering the circulation, is carried to the kidneys, which it stimulates, thereby augmenting the quantity of the urine, and imparting to it its odour. Some of the benefit derived from Cubebs is undoubtedly due to this augmented secretion of urine, which assists in washing out the virus present in the urethra; but the inflammation and the pain is already abated; so that more depends on the specific action of the medicine on the mucous tissue than on its diuretic power. That this is the fact, is demonstrated by the utility of Cubebs in chronic inflammation of the bladder. When they prove useful in Gonorrhœa, the discharge is checked, and the inflammatory symptoms are allayed in less than eight or ten days; and when this does not occur, they seldom prove beneficial. Another very striking symptom, which is indicative of their proving curative, is a peculiar sensation of coldness in the rectum, when the fæces are passed. I have rarely found that they fail, when this symptom presents itself. The dose of the powder of Cubebs, sufficient to produce the usual effect of the medicine, is from ℈i to ʒss: but it is, sometimes, requisite to augment the dose to ʒi, three times a day. The best vehicle for administering the powder is milk.

A tincture of Cubebs is ordered by the Dublin College; but, as far as regards Gonorrhœa, it is a bad form of preparation. It is a mere alcoholic solution of the volatile oil. It may prove useful in chronic rheumatism, in some cases of which Cubebs are stated to have afforded relief*.

In some habits, Cubebs excite great irritation and fever. In a case recorded by Mr. Brodie†, this irritation was so considerable, from the administration of ʒi of the powder of Cubebs,

* See Dr. Crane's observations, Edin. Med. and Surg. Journ. vol. xxi, p. 305.
† Medical Gazette, vol. i.

that it tended to hasten the death of the patient. Mr. Broughton has also described a similar case, in which temporary paralysis followed the use of Cubebs in doses of ʒii three times a day; a state not to be wondered at from so large a dose. In one case, which fell under my own observation, in which the extent of the dose was ʒi, so much febrile irritation was also excited, that the life of the patient was in danger. It is not unlikely that such occurrences were the cause of the remedy formerly falling into disuse; for, although it was much prescribed in some diseases, yet, it had been neglected for many years.

Several cases of Leucorrhœa are recorded in which the administration of Cubebs seems to have been highly beneficial*; but, in prescribing them, the state of the uterus should be ascertained, as Cubebs might augment greatly any organic disease in that organ. An infusion has been recommended as an injection in Leucorrhœa.

Cubebs formerly were not used for the cure of Gonorrhœa, or any inflammatory state of the mucous membrane. They were chiefly employed as a stimulant in dyspepsia, particularly in that variety of it attended with vertigo; and in hysterical affections.

LAUREL BERRIES AND LEAVES. *Lauri Baccæ et Folia.* L. E. D.—These berries are the fruit of the Laurus *nobilis*, or Bay tree, the type of the order Laurineæ†.

It is a beautiful evergreen tree, rising, in favourable situations, upwards of twenty feet in height; it is found in most of the countries of southern Europe, as France, Spain, Italy and Greece‡. The male and female flowers are borne on different plants.

Both the *leaves* and the *berries*, improperly so called, of the Laurel have an aromatic flavour, joined to a bitterness, and leave on the palate an astringent sensation. When bruised, the leaves have an agreeable fragrancy. The fruit, which is a drupe, yields a volatile oil by distillation. M. Bonastre has analysed the fruit, and found in it—1, *volatile oil;* 2, a *peculiar crystalline matter*, which he has named *Laurine;* 3, a *fatty green-coloured oil;* 4, *stearine;* 5, *fecula;* 6, *gummy extract;* and 7, *lignine.*

The excitant power of the fruit depends on the volatile oil: but it is too feeble to merit much attention; and, upon the whole, the Laurel, however dear to the poet, might easily be spared from the list of the Materia Medica.

It may not be out of place to notice here an oil which has

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* Edin. Med. and Surg. Journ. vol. xv, p. 318.

† The classical character of the Laurel, as forming the groves of Parnassus, and as the favourite plant of Apollo, is universally known; but few are perhaps aware that it has also been employed in crowning medical proficients. "Nec non," says Geoffrey, "quibusdam in locis novi Medicinæ Doctores Laura coronantur: inde fortasse Laureandi et Laureati dicuntur."

‡ Woodville's Med. Bot. 3d ed. p. 678, pl. 285. London Dispensatory, art. Laurus. Richard, Hist. Nat. Med. tome i, p. 529.

lately been imported from South America, under the name Laurel oil. It is a pure, colourless, warm, pungent, aromatic oil, of a sp. gr. not exceeding that of alcohol. It has all the usual chemical properties of volatile oils; and is a solvent of camphor, caoutchouc, wax, and resin. The tree which yields it is said to be a Laurel, but this is uncertain: it is a native of South America, between the rivers Parime and Oronooko. The oil is procured by merely striking the tree with an axe, so as to divide the proper vessels, when it gushes out in such abundance that several quarts of it are obtained from a simple incision. This oil has been advantageously employed, as an internal stimulant, and as a rubefacient, applied to the skin in chronic rheumatism.

* * * * * * *Seeds.*

CARDAMOM SEEDS. *Cardamomi Semina.* L. D. *Amomi Repentis Semina.* E.—The Cardamom is the seed of a plant which was formerly regarded as an Amomum, but which the investigations of Mr. Roscoe have proved not to belong to that genus. Dr. Maton endeavoured to fix the true botanical characters of the plant, which he named Elettaria Cardamomum, from the Malabar name, Ela-tari, applied to the ripe capsule of the seed; tari signifying a small seed, and Ela the name of the plant. It has since been named Matonia, in honour of Dr. Maton, and stands under that name in the list of the London Pharmacopœia: it grows native on the range of the Gaughts in Malabar, and also in Cochin China*.

Cardamom seeds are imported in capsules: when separated from them, they are of a deep brown colour, angular, corrugated, pulverulent; have an agreeable aromatic odour, and a warm, spicy taste. Both water and alcohol extract their virtues. The watery infusion has a turbid appearance, is coloured blue by tincture of Iodine, and lets fall slight precipitates on the addition of alcohol and the acids; precipitates are also produced in it by sulphate of iron, bichloride of mercury, and acetate of lead. Cardamoms seem to consist entirely of fecula, mucus, some resin (?), and volatile oil.

The active principle is the volatile oil, which is deposited in the testa or skin of the seeds. Newman obtained 20 parts of volatile oil, 15 of resinous extract, and 45 of aqueous extract, from 100 parts of these seeds: the existence of the resin, however, is doubtful; for ether, digested on the seeds and evaporated on the surface of water, leaves nothing except volatile oil.

In a medicinal point of view, Cardamoms are excitant; but

* Woodville's Med. Bot. third edit. p. 734, pl. 251. London Dispensatory, art. Matonia. Linn. Trans. vol. x, p. 229. Richard, Hist. Nat. Med. tome i, p. 416.

they are chiefly employed, as aromatic additions to tonic medicines, in dyspeptic and gouty affections. They are sometimes ordered in combination with magnesia and rhubarb, in the flatulent colic of infants. The dose of the powder for an adult is from ten grains to a scruple. They are said to be stimulant, but not heating like other aromatics—a distinction which I cannot understand. The London College orders two tinctures of these seeds: one a simple tincture, which may be regarded as a solution of the volatile oil in proof spirit; the other is one of those curious combinations which display neither ingenuity nor judgment in the inventors—a combination of the volatile oils of the Cardamom, caraway, and cinnamon, coloured with cochineal and sweetened with raisins.

THE NUTMEG. *Myristicæ Nucleus.* L. E. *Nux Moschata.* D.—A useful combination of volatile oil and fixed oil is found in the Nutmeg, the fruit of the Myristica *Moschata**, a plant belonging to the natural order Myristicæ. This tree grows in the Molucca Islands; but it is chiefly found in the island of Banda. Before 1770, the whole of Europe was supplied from the Moluccas with this spice; but at that time, the Myristica *Moschata* was carried to the Isle of France and there perfectly naturalized. It is also now cultivated in Cayenne and the West Indies†.

There are two kinds of Nutmegs found in commerce, the *wild* and the *cultivated.* The former is long, pointed, lighter, and less aromatic than the cultivated Nutmeg. The shell, which is covered with a cotton down in the wild, is naked and smooth in the cultivated Nutmeg. The cultivated Nutmeg itself is nearly round; its consistence hard and unctuous; its odour strong, aromatic, and agreeable; its taste oily, hot, and acrid. When it is cut transversely and examined by the microscope, the dark-coloured veins are found to consist of cellular matter filled with fluid volatile oil. The arillus or *mace* is divided into longer lacinæ, is thicker, more unctuous, and of a deeper orange hue than that of the wild Nutmeg. Both the

* Woodville's Medical Botany, third edition, p. 698, pl. 238. London Dispensatory, art. Myristica. Richard, Hist. Nat. Med. tome i, p. 465.

† The tree has also been discovered in New Holland, the Southern Peninsula of India, and Cochin-China; but Mr. Crawford, in his History of the Indian Archipelago, affirms that the Nutmegs in these places have no aromatic properties, and are consequently useless. Many Nutmegs drop from the trees; but those only which are regularly plucked are exported to Europe. A good nutmeg tree yields from ten to fourteen pounds of nutmegs annually; but in this there are eight pounds only of *Nutmegs*, strictly speaking, two pounds being *Mace* and the remainder, or four pounds, *shells.* It is a curious fact in political œconomy, that the consumption of Nutmegs and Mace in Europe has greatly diminished since the middle of the eighteenth century, although the price has also considerably diminished. In 1615, about 100,000 lbs. of Nutmegs and 15,000 lbs. of Mace were consumed in England: at present the consumption is only 56,960 of Nutmegs and 3620 of Mace. In Europe, two centuries ago, the consumption of Nutmegs was 400,000 lbs.; that of Mace 150,000: at present (1832) 214,720 lbs. of Nutmegs and 250,040 of Mace are consumed.

Nutmeg and the Mace are eaten and perforated by the larva of the Dermestes *Surinamensis*. Nutmegs are also occasionally punctured and boiled, to obtain the volatile oil; and the orifices afterwards closed with powdered Sassafras. This fraud is detected by the lightness of the Nutmeg*. According to the analysis of M. Bonastre, 100 parts of Nutmeg contain—24 of an *insoluble white matter* (stearine); 7.6 of a *soluble coloured butter* (elaine); 6.2 of a *volatile oil;* 0.6 of *an acid;* 2.4 of *fecula;* 1.2 of *gum;* and 58.0 of *ligneous matter*†.

The Nutmeg yields its volatile oil by distillation: it is one of the few oils produced in tropical climates lighter than water: it possesses the odour and taste of the Nutmeg. Nutmegs, when heated, yield also to the press a concrete oil, which entangles, like a sponge, some of the volatile oil.

The *Mace*, which is the arillus of the Nutmeg, and surrounds the nut within the drupe, yields also a very acrid volatile oil. The Mace itself is a thick, deeply divided, fleshy, reddish membrane, having an agreeable aromatic odour, and a hot, biting taste. Besides the volatile oil, it contains also a fixed oil. According to M. Henry, *Mace* contains—1, a small quantity of *volatile oil;* 2, a large quantity of a *yellow odorous fixed oil*, soluble in ether, but insoluble even in boiling alcohol; 3, a nearly equal quantity of a *red, odorous, fixed oil*, soluble both in ether and alcohol: 4, a *gummy matter*, forming about a third the weight of the Mace: and 5, a small quantity of *woody fibre*‡.

The use of the Nutmeg as a medicinal agent is as old as Avicenna, who first employed it medicinally. It is used chiefly as a grateful aromatic addition to some tonics that are apt to excite nausea and vomiting. It is also employed to relieve vomiting when it is present. The *Mace* answers for the same purpose as the Nutmeg; but neither is much employed except as agreeable aromatic additions to other medicines. The volatile oil is sometimes ordered, in the form of an oleo-saccharum, in flatulent states of the stomach and intestines, and in atonic gout attacking the stomach. It is also useful, in moderate doses, in dyspeptic states of the digestive organs, and in the diarrhœa of relaxed bowels.

The concrete oils of Nutmegs and of Mace are employed as local Excitants in neuralgic and rheumatic pains; and, with this view, they form a component of an useful stimulant application, the *Emplastrum Picis compositum* of the London Pharmacopœia.

The only officinal preparation of the Nutmeg is a distilled

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* Formerly the Nutmeg was always imported in the shell, as in this state they can be long preserved; but the Dutch, in order to increase the demand for the annual produce of their newly acquired islands, and to secure their monopoly by sending the kernels in a state not fit to germinate, introduced the practice of freeing them from the shells; in which state the nutmeg is the most perishable of seeds.

† Journal de Pharm. Juin 1823. ‡ Journal de Pharm. tome x, p. 281.

spirit, which is a simple solution of the volatile oil in diluted alcohol.

When the Nutmeg was formerly much employed as a condiment, and taken in large quantity, it was found to produce symptoms indicating great determination to the head; on which account it should be cautiously used in apoplectic and paralytic habits. It is probable that the oil separated by the digestive function is taken into the circulation, and, being conveyed to the brain, favours congestion in that organ. Cullen mentions the case of a person who took two drachms of powdered Nutmeg: an hour afterwards he was seized with drowsiness, which increased to stupor and insensibility; and, not long afterwards, he was found fallen from his chair, lying on the floor of his room. This state was succeeded by delirium, from which he did not recover for six hours*.

Such are the properties, physical, chemical, and remedial, of Volatile Oil, both in its *uncombined* and *combined* state. The bounty of Nature, in supplying it in such variety, is more to be admired than the wisdom of the framers of Pharmacopœias in arranging in the Materia Medica so many substances the operation of which may be justly regarded as alike in every particular. If we take a review of the various articles contained in the list which has been just gone through, and select from the uncombined volatile oils those of Cajuputi, Peppermint, Rue, and Lavender, and from among the substances containing combined volatile oils, Caraway seeds, Acorus Calamus, Ginger, Serpentaria root, Cubebs, Winter's bark, Cinnamon, and Pimenta, we shall possess ample means for fulfilling every indication for which Excitants of a vegetable nature can be required in the treatment of diseases.

b. CAMPHOR.—*Camphora.*
L. E. D.

Camphor is a solid, white, transparent, very volatile, combustible substance, unctuous to the touch, and closely allied to the volatile oils. It is friable, and breaks with a crystalline fracture; but, nevertheless, it is ductile, and, therefore, not easily pulverized. It has a penetrating, peculiar, fragrant odour, and a bitterish, pungent, acrid taste, which is followed by a sensation of coldness on the palate. Owing to its volatility, it is gradually dissipated when exposed to the air, and, if kept in a covered glass vessel, crystallizes in hexagonal plates in stars on the side exposed to the light. Its specific gravity is 0.988. At 288° Fahr. it melts, and boils at 400° Fahr: it is readily ignited, and burns with a brilliant flame, forming much smoke.

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* Cullen, Mat. Med. vol. ii, p. 204.

Camphor is scarcely soluble in water; but when triturated with it, enough is dissolved to communicate both odour and taste to that fluid. Ether, alcohol, strong acetic acid, fixed and volatile oils, carbonic acid, and the mineral acids diluted, dissolve Camphor; but it is again precipitated by adding water to the solutions. Strong sulphuric acid converts it into a substance resembling artificial tannin: nitric acid into Camphoric acid.

According to the analysis of Dr. Ure, Camphor appears to consist of 10 equivalents of carbon (6×10) $= 60$, + 1 of oxygen $= 8$, + 9 of hydrogen $= 9$: $= 77$. But chemists have differed in their statements of the elements of Camphor, as the following table demonstrates:

ELEMENTS.	NAMES OF CHEMISTS.					
	Gold.	Fée.	Saussure.	Thomson.	Ure.	Liebeg.
Carbon	74.67	74.38	74.38	73.91	77.38	81.376
Oxygen	14.09	14.61	14.71	11.60	11.48	8.535
Hydrogen	11.24	10.67	10.67	14.49	11.14	9.722
Nitrogen	0.0	0.0	0.34	0.0	0.0	0.0

The sources of Camphor are various; each producing a modification or variety of the substance. That brought to this country and employed in medicine, which may be taken as the standard, is procured by distillation from the roots and smaller branches of the Laurus *Camphora* and *Sumatrensis**. Another variety, also medicinally used, but scarcely known in this country, is found concreted in the interior of the Dryobalanops *Camphora*†. All the essential oils of the Labiatæ deposite it in crystals when they are exposed for a long time to the air‡. M. Proust has ascertained that 10 per cent. of Camphor are obtained from the oils of Rosemary and Majoram, 12½ from the oil of Sage, and 25 from that of Lavender§. The volatile oils of some of the Scitamineæ — for instance, those of Zedoary, Maranta *galanga*, Kœmpferia *rotunda*, and Zingiber *officinale* — also yield Camphor: and it has been procured from the roots of Anemone *pratensis*, Asarum *Europeum*, Andropogon *Schænanthus*, Inula *Helenium*, and some species of the genius Aristolochia: an artificial variety is obtained by passing a stream of dry muriatic acid gas through purified oil of turpentine in a vessel surrounded by a mixture of snow and salt‖.

* Woodville's Medical Botany, third edition, vol. iv, p. 681, pl. 236. London Dispensatory, art. Laurus. Richard, Hist. Med. Nat. t. i, p. 558.

† Woodville's Med. Bot. third ed. vol. v, p. 124. Colebrook, Asiatic Researches, vol. xii, p. 539. London Dispensatory, art. Dryobalanops.

‡ Camphor deposited by these are termed *Camphoroides*, as they are not perfectly identical with true Camphor.

§ Journ. de Phys. Mars. 1790.

‖ Zea describes a species of Camphor, called *caratti* in South America, which exudes in tears from the bark of a tree.

The difference in these varieties is considerable: thus, the Camphor of the Dryobalanops differs from that of the Laurel in being "opaque, of a chalk-white colour, in tabular plates, pulverizable without the aid of alcohol, and remaining in powder without agglutination; its specific gravity is greater also than water, and it does not spontaneously sublime*." The other varieties are still more distinct in their characters. A fluid Camphor, said to be the produce of the Dryobalanops, has also been brought to Europe under the name of oil of Camphor, and possesses excitant powers similar to those of the volatile oils.

The distinct character of Camphor was not known until Neuman published an account of it in 1725, and proved that it is neither a *volatile oil* nor a *resin*: yet it is still frequently prescribed under the name *Resin of Camphor*.

In examining the medicinal influence of Camphor, its local as well as its general effects on animal life should be taken into consideration, to aid us in fixing its claim to the character of an Excitant.

In its volatile form, mixed with the air, it operates as a powerful poison to many insects: thence its use in preserving clothes and vegetable matter from the destructive attacks of moths. It also destroys warm-blooded animals in the same manner, as was proved by the experiments of Carminati on birds†. When given to quadrupeds by this physiologist, and also by Menghini‡, various effects were produced; but in all it appeared to operate as a powerful stimulant: some became furious; others were oppressed with stupor; some were attacked with violent convulsions. Two drachms given to a dog brought on symptoms very closely resembling those of hydrophobia. Post mortem examinations displayed the stomach to have been in a state of active inflammation. In those animals that suffered from stupor, the meninges of the brain, the lungs, heart, and intestines, were inflamed.

Camphor, when taken into the human stomach, excites a glow of warmth at the epigastrium, with an uneasy sensation: it is generally supposed to operate by its action on the nervous energy, which it is said to increase without raising the pulse; and this idea is thought to be supported by the transitory nature of its action. But the opinions on this point have been very opposite. Boerhaave, Stahl, and Neuman, maintain that it acts chiefly on the heart and arteries, increasing their impetus; while Hoffman, Burserius, Cullen, and others, contend that the action and force of the pulse are diminished. Cullen even asserts that he never found the pulse quickened, nor the

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* Supplement to the Edinburgh New Dispensatory by Dr. Duncan, p. 52.
† De Animal. ex mephitibus interitu, p. 186. ‡ Comment. Benon. t. iii, p. 314.

heat of the body increased, by giving it to the extent of half an ounce in the day. Dr. Alexander, who made many experiments on his own person with this medicine, concluded that it diminishes the temperature of the body and the celerity of the pulse: but, beyond a certain point, it produces the opposite effect. Having taken a very large dose of it, he was found foaming at the mouth; and his pulse quick, full, and hard: and, on his recovery, which did not take place until after six hours had elapsed, he complained of violent headache. His recovery was facilitated by drinking tepid water, which brought up part of the undissolved Camphor by vomiting. It is probable that, like opium and some other substances, the first effect of Camphor is excitant. Opinions differ regarding the mode in which its stimulant effects are produced: it is contended by some that it passes into the circulation and is exhaled like sulphur by the skin, stimulating the system in *transitu;* by others, that it acts chiefly on the nerves, exciting the skin by the sympathy which exists between it and the stomach. My observations and experience induce me to adopt the latter opinion.

The first effect of a full dose of Camphor is certainly derived from its local stimulant power. In swallowing the dose, it is felt warm in the throat; and this sensation continues for a considerable time afterwards, sometimes occasioning thirst. Its influence on the gastric nerves is then propagated to the cerebro-spinal centres and entire system. During this time the heat of the surface is diminished, rigors sometimes occur, and vertigo supervenes, with perverted vision. The second general effect is one of increased action: the pulse becomes strong, frequent, and vibrating; the heat of the body is augmented; the surface is redder; the eyes glisten; and cephalalgia occurs. These symptoms are probably the result of its absorption. Experiments made on living animals, by injecting Camphor into the rectum, have demonstrated that it soon pervades all the tissues, and is made sensible in them by its odour: dogs thus treated often die in convulsions.

The medicinal use of Camphor has been little regulated by the opinions formed of its physiological action. Even those who regard it as an Excitant—on observing that, when taken in moderate doses, it softens and fills the pulse, and promotes diaphoresis, mitigates pain, dissolves spasms, and seems to rouse the nervous energy, without quickening greatly the pulse—have considered that it may be given in diseases of excitement, particularly when it is combined with antimonials. It cannot however be administered, except in small doses, in such cases; and much injury may result from its local influence, even in small doses, where there is subacute inflammation of the stomach or intestines. It is said to obviate the irritating and stimulant effects of opium and other narcotics; and it has been

much employed in maniacal affections. Its influence, nevertheless, as an Excitant, is much increased by combining it with small doses of opium: in which combination, also, it determines powerfully to the skin.

Camphor has been found extremely serviceable, as a stimulant, in low fevers, of that description which are termed putrid—an effect which is, undoubtedly, owing to its excitant properties: and it is in the latter and sinking stages of these fevers that its influence is most beneficial. Whether, in such cases, the benefit is to be ascribed to the absorption of the remedy, admits of doubt. The quantity that may be administered in these cases is so regulated by circumstances that it is impossible to lay down any rules respecting it. In some persons, a few grains excite powerfully; whilst others, in these fevers, can take ʒiii or ʒss in the course of the day, not only with impunity, but even with advantage. In these cases it is advantageously combined with Peruvian bark, or the salts of Quinia or Cinchonia, or with Serpentaria, and aromatics. In gangrene, whether of the dry or humid kind, Camphor is found to aid greatly in stopping its progress and enabling the sound parts to throw off the diseased. In these cases its excitant properties are those to be looked to. It is, also, usefully employed, as a local stimulant, sprinkled on gangrenous sores. For the same reason, it is a beneficial addition to aromatics and opium, in cases of smallpox, measles, and other eruptive fevers, when these assume a typhoid character and the eruption suddenly recedes. In erysipelas it has been given, in large and repeated doses, with the best effects. It has been employed with success in many affections proceeding from a morbid state of the encephalon and the medulla spinalis. Thus it quiets cough, arrests palpitation, relaxes spasms, and allays vomitings and intestinal pains which have often been erroneously ascribed to inflammatory states of the affected organs.

When Camphor is applied to the sound skin, it stimulates, causing redness, heat, and increased action in the part; thence it is advantageously employed, as a rubefacient, to relieve internal pains; but, like all other local stimulants of a transitory nature, it is apt to favor metastasis, or a translation of inflammatory action, in these cases, when there is any febrile excitement; and, therefore, it ought never to be employed in acute rheumatism and similar affections; although, in chronic rheumatism, a solution of Camphor in fixed oil, used as an embrocation, is often highly beneficial. A fact, however, should be noticed, which is, at first sight, apparently at variance with the local stimulant effects which have been just mentioned: when a lotion with Camphor is applied to a hot and inflamed surface, instead of stimulating, it acts as a refrigerant, producing an agreeable coolness—a circumstance depending on the great volatility of the Camphor.

Camphor may be administered in various forms. It is readily reduced to powder by the aid of a few drops of alcohol, and in this state may be suspended in aqueous vehicles by means of mucilage; or it may be given in the form of powder, in combination with magnesia, aromatic powders, or bitters. Its insolubility in water renders that vehicle an unfit one for administering it, unless it be suspended by means of mucilage or yolk of egg; or, what is preferable, by first dissolving it in olive oil, and then forming this into an emulsion with mucilage of gum and water, or almond mixture. An emulsion is formed by triturating it with blanched almonds and sugar, according to the directions of the Edinburgh Pharmacopœia: but, in this case, the quantity of oil contained in the almonds is insufficient to keep the Camphor in solution; and, consequently, it soon separates and swims on the surface of the water. As an extemporaneous form of prescription, however, Camphor may be advantageously ordered in this form. Dr. Cassils, of Kendal, recommends milk as a solvent of Camphor: ʒss of Camphor is formed into an excellent emulsion when triturated with fʒiv of milk and fʒviiss of water*.

Opinions have varied, even regarding the doses of Camphor. The usual dose is from two grains to a scruple; but on the Continent it is given to a much greater extent. Gizeke began with ʒss and increased the dose to ʒi. Stoll and other Germans have given it as freely. I have never seen its excitant effects produced by less than grs. viii given for a dose; and I have never had occasion to increase it beyond a scruple; repeated every fourth hour. Professor Hallé has remarked that Camphor, mixed with nitrate of potassa, administered in the interval of intermittent fever, prevents a return of the paroxysm; thus acting as an *anti-periodical*.

As an external Excitant, Camphor is employed in solution in acetic acid, alcohol, and fixed oil: it also enters as an ingredient into stimulating liniments; compound soap liniment, for instance, and the compound soap liniment with opium. In my opinion, the most useful vehicle for its external application is oil, both on account of the minuteness of its division in that vehicle, and also the facility of its application. In all those cases in which its external application is indicated, the object is to produce a counterirritant effect; and, therefore, that vehicle must be the most useful which restrains its volatile properties, as is the case when the fixed oils are employed. I cannot comprehend what advantage is to be expected from its solution in acetic acid; as that agent is a more powerful rubefacient than the Camphor. It may aid the anodyne effects of opium, as an external application, when conjoined with it

* Edin. Med. and Surg. Journ. vol. vii, p. 124.

in a small quantity. Camphor is also used externally as a fumigation: the patient is covered with a blanket, tied or pinned close round the neck; half an ounce, or more, of Camphor is then thrown on an iron plate placed over a small chafing dish, within the blanket. The effect is a more copious perspiration than could be produced by the heated air. According to M. Dupasquier, an absorption of Camphor by the skin takes place.

c. ACRID FIXED OIL.

Acrid fixed oil is regarded as the active principle in several vegetable Excitants; but, in strict language, the fixed oil is merely the vehicle of the acrid principle, whatever that may be. In our endeavour to investigate its nature, let us first ascertain that of the vehicle in which it is presented to us.

Fixed and volatile oil agree in some of their properties. Thus they are both extremely fusible, being either always liquid at the ordinary heat of the atmosphere, or becoming so when exposed to a very slight elevation of temperature: both are very combustible, insoluble in water, altered by exposure to the air, and acted upon with energy by the mineral acids. The sulphuric acid thickens fixed oils, and forms a tenacious soapy compound: strong nitric acid rapidly decomposes them, and itself suffers decomposition, in some instances causing combustion. Chlorine also renders them thick and viscid. On the other hand, fixed oils differ from volatile oils in being, with two or three exceptions, very sparingly soluble in alcohol and ether, in leaving an unctuous stain on paper, and forming true soaps with alkalies.

Fixed oils are compounds of two distinct substances; one of which Chevreul, who discovered both, has named *stearine**, a solid crystalline substance; the other *elaine*†, which is a fluid‡. These substances seem to be mechanically mixed in fixed oils; as they can be obtained in a separate state by submitting the oil, at a very low temperature, to strong pressure between folds of blotting paper: the elaine is absorbed, whilst the stearine remains in the solid state. They are also procured by boiling the fat oils in alcohol: the *Stearine* crystallizes as the alcohol cools, and the *elaine* remains in solution. *Elaine* constitutes the greater part of the fluid fixed oils: it retains its fluidity at 20° Fahr. *Stearine* is the chief constituent of butter.

Fixed oils exist in the vegetable bodies in a state which is not readily understood: but the greater part seem to be uncombined, in distinct cells; as they can be procured by simple pressure and by ebullition. They are in this state in the ker-

* From the Greek word στεαρ, suet. † From ελαιον, oil.

‡ Ann. de Chimie, tome lxxiii, p. 225.

nels of many seeds, in which they abound; but, in roots, bark, and wood, in which they only occasionally exist, they are intimately combined with the other principles of the plants. They are of various consistence; some being always limpid, others always of a consistence similar to that of butter. All the vegetable fixed oils are lighter than water. They do not ignite until they are brought to a state of vapour; and it is on this account that wicks are requisite in the ordinary combustion of fixed oils, by enabling a small quantity to be successively exposed in the state of vapour to a temperature sufficient for its combustion. If the whole oil be consumed during combustion, only water and carbonic acid are formed; but, in general, a portion of the oil is imperfectly decomposed, and forms soot.

Although the fixed oils are insoluble in water, yet, they are readily suspended in it by means of mucilage, forming emulsions. They are partially soluble in alcohol and ether, in very different degrees: thus, scarcely any Olive oil is taken up by alcohol, whilst Castor oil is soluble in it in any quantity. They combine with many of the metallic oxides; their combination with oxide of lead is the basis of the officinal plasters.

When the fixed oils are analysed, they are found to be composed of different proportions of Carbon, Hydrogen, and Oxygen. If we take olive oil as the purest specimen of fixed oil, the proportions, according to Gay Lussac and Thenard, are—

10 prop.	Carbon	$(6+10)=60$	or 77.213
1 ——	Oxygen . . .	$=8$	9.427
11 ——	Hydrogen	$(1\times11)=11$	13.36
	Equivalent	79	100.000

But olive oil consists of 72 parts of Elaine and 28 of Stearine; the ultimate principles of which, according to M. Chevreul, are—

	Carbon.	Oxygen.	Hydrogen.
Elaine .	29.030	9.548	11.422
Stearine .	78.776	9.445	11.770

Such is fixed oil. It is not so easy to determine either the general properties of the acrid principles dissolved in it, or the part in the plants which they occupy; but it is probable that the situation is perfectly distinct from that of the fixed oil in the living plant; and that it combines with the fixed oil only in the press. This opinion is rendered highly probable by the fact, that the seeds of the castor oil plant, Ricinus *communis*, when treated with strong alcohol, yield up the acrid principle to the alcohol, leaving the fixed oil, which can be afterwards pressed out in the usual manner; and when it is thus obtained, it possesses only the bland qualities of ordinary

fixed oil. The Vegetable Excitants, which depend on acrid fixed oil for their active properties, are Black and Long Pepper, Mustard, and Pellitory Root.

PEPPERS.

a. BLACK PEPPERS. *Piperis Nigri Baccæ.* L. E. D.—Pepper is the fruit of a trailing or scandent plant, Piper *Nigrum**, a native of the East Indies. It is most successfully cultivated at Sumatra and Malacca, in Java, Borneo, and of late years in Cayenne. The plant belongs to the natural order Piperaceæ, of which it is the type†. The entire dried fruit, which has a black colour and a shrivelled surface, is known by the name of *Black Pepper:* when the external coat is removed, the seed exhibits a pale yellow colour, and is therefore called *White Pepper*. Both kinds are imported in great abundance into Europe, not only for the purpose of medicine, but as a condiment most extensively and generally employed.

The *Black* Pepper is gathered as soon as the first berries of the spadix ripen; and it is not unusual to gather them green, if they have attained their full size. When gathered, the fruit is spread out upon mats, or smooth spots of clean, hard ground, where it soon dries and loses its green colour, becoming black and somewhat shrivelled, as it is imported into Europe. The ripe Pepper shrivels less than the unripe, which often falls to dust. Its goodness is tried by rubbing it hard between the hands: if the Pepper be sound, this produces little effect on it; but if it be injured in the drying, or unsound, it is readily reduced to powder.

White Pepper, as I have said, is the white and perfect berries stripped of the outer coat. The pepper is steeped in water for a fortnight, or until it swell and burst its tegument; from which it is afterwards separated by drying it in the sun, and rubbing it between the hands. In India, the coat is removed from the undried fruit by means of a preparation of lime called *Chinam*.

The appearance of *Black Pepper* is well known: it is about the size of a small pea, covered with a dark brown, rough coat, which should not be too much shrivelled. It has an extremely pungent, biting taste, and a powerful aromatic odour. This pepper swells greatly when steeped in water. *White Pepper* is milder and less aromatic than the black; and it has this su-

* Woodville's Med. Bot. third edit. p. 271, pl. 216. London Dispensatory, art. Piper. Richard, Hist. Nat. Med. t. i, p. 309.

† Every species of this natural genus is imbued with aromatic principles, and used in some part of the world: Pepper, Cubebs, the Betel of the Malays, and the Kava of the South Sea Islanders, are Pipers.

periority, that it can be made only of the soundest fruit; and, consequently, it brings nearly double the price of the black.

The infusion or decoction of Black Pepper in water, reddens vegetable blues, owing to the presence of free malic and uric acids; the presence of the latter of which causes the decoction of Pepper to decompose the hydrosulphuret of potassa and to throw down its sulphur. In making the decoction of Black Pepper, a quantity of green acrid oil is separated during the boiling, which does not appear in making that of White Pepper. This is a fixed oil; for, in distilling the alcoholic tincture of Black Pepper, it remains in the retort. The decoctions of both Black and of White Pepper yield a floculent precipitate with infusion of galls, which dissolves again at a heat of 120°, and indicates the presence of starch; on which account the tincture of iodine strikes a blue colour with these decoctions. According to the analysis of Pelletier, and M. Poutet, Black Pepper contains—1, *piperina* (to be noticed in the class of Tonics); 2, a concrete, green, fixed, *acrid oil;* 3, a *volatile oil* nearly colourless and lighter than water; 4, a *gummy, coloured substance*; 5, an *extractive principle;* 6, *starch;* 7, *bassorine*, a kind of gum, resembling tragacanth; 8, *malic* and *uric acids;* some alkaline and earthy salts; and 9, *lignine**. I am of opinion, however, that we may regard it as composed chiefly of *piperina*, a *concrete, fixed, acrid oil, starch*, and the *malic* and *uric acids*. The decoction forms precipitates with solutions of most of the metallic salts, sulphate and hydriodate of iron, acetate of lead, bichloride of mercury.

b. Long Pepper. *Piperis Longi fructus.* L. E. D.—This is the fruit of a perennial, scandent shrub, the Piper *Longum*, a native of Hindostan, Nepaul, and Java†. The fruit is a condensed spike, about one inch in length, dry, firm, heavy, and of an obscure grey colour. Each little eminence contains a seed, red or blackish on the outside and white within. Like black pepper, it is gathered before it is fully ripe. The spike is preserved in its entire condition.

Long Pepper is less aromatic than Black Pepper; but equally hot to the taste, and affording nearly the same constituents. The concrete acrid oil is even more pungent than that of the Black Pepper; at least the pungency is more permanent.

Decoction of Long Pepper is affected by the same tests as that of common Pepper. According to the analysis of M. Dulong, this Pepper consists of—1, *Piperina;* 2, a *fat, concrete, very acrid matter;* 3, a small portion of *volatile oil;* 4, *extractive;* 5, *coloured gum;* 6, *starch;* 7, much *bassorine;* 8, a

* Journ. de Pharm. t. vii, p. 373.

† See Woodville's Medical Botany, third edition, vol. iv, p. 724, pl. 247. London Dispensatory, art. Piper. Richard, Hist. Nat. Med. tome ii, p. 314.

malate and *salts**. Ether digested on it takes up one part in four, and, when evaporated on the surface of water, leaves a resin impregnated with the pungent oil on which the smell and taste of the Pepper depend†. I conceive, therefore, that the addition of resin is the chief distinction between the components of Long Pepper and those of Black Pepper. This resin is not mentioned by Dulong.

The effects of both these Peppers, as condiments, are well known. As medicinal agents, they were long supposed to owe all their medicinal qualities to the acrid oil which they contain; but, since the discovery of *piperina*, this opinion has been set aside: it is, nevertheless, still justly admitted, that the exciting properties of Pepper are solely due to the acrid fixed oil. This oil, when separated, is too pungent to be tasted with impunity, unless greatly diluted; and it is undoubtedly the most powerful of the vegetable Excitants. Applied to the skin, it reddens and inflames it; and thence we readily trace the cause of the sensation of almost insupportable, long-continued burning which it excites when taken into the stomach. It enters the circulation, stimulating powerfully the action of the heart, arteries, and capillaries, and the brain and spinal marrow. Like all powerful medicines, Pepper is highly beneficial when administered in proper doses: it affords an agreeable stimulus to the nerves of the stomach, promotes the secretion of the gastric juice, and, consequently, aids digestion in weak stomachs.

Pepper, steeped in rum, is a well-known domestic remedy, among the poor, for the cure of intermittent fevers. It operates by exciting copious perspiration; but, when it does not arrest the rigors, and the hot stage supervenes, the fever is always more severe after the administration of Pepper: the indiscreet use of the remedy has even been productive of fatal consequences: much, however, depends on the state of the stomach at the time. Since the discovery of Piperina, doubts have arisen whether the curative power of Pepper in intermittents is to be attributed to that principle or to the acrid oil. Few opportunities have occurred for trying the effect of perfectly pure Piperina; and certainly the greater part of that which has been hitherto used has not been free from the acrid oil. The oil alone has cured intermittents; but M. Majendie asserts his belief that this is owing to its retaining some Piperina: and this opinion finds some support from the fact that chamomile flowers, which contain no acrid oil, but contain Piperina, cure intermittents. At

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* Journ. de Pharm. tome ii, p. 52.

† The root of Piper *longum* possesses the virtues of the fruit in a weaker degree: it is employed by the native Hindostanee physicians in cases of palsy, tetanus, and apoplexy.

all events, the exciting power of Pepper can only be justly ascribed to its acrid fixed oil.

As a topical remedy, I have found the acrid oil of Pepper very useful in relaxed states of the uvula. On touching the uvula with it, that organ suddenly contracts. Pepper may be administered in the entire state, two, four, or six of the Pepper corns at a time: or it may be given in powder, to the amount of six, eight, or ten grains for a dose. Black Pepper is a component in two external preparations: an ointment ordered by the Dublin College, and the compound plaster of Cantharides of the Edinburgh Pharmacopœia. The Long Pepper forms a part of the confection of Opium, of the aromatic powder, the compound powder of Chalk, and the compound tincture of Cinnamon of the Pharmacopœias.

MUSTARD. *Sinapis Semina.* L. D. *Sinapis Albæ Semina.* E. D.—These substances are the seeds of the Sinapis *nigra* and *alba*, plants which grow wild in almost every part of the world, and are cultivated in many countries. Both plants are members of the natural order Cruciferæ*.

The seeds of both species of Sinapis are small and globular; those of S. *nigra* have a dark-brown colour; those of S. *alba* are pale yellow. When bruised, they have a very pungent odour, although in the entire state they have scarcely any: their taste, when masticated or bruised, is acrid and biting. M. Thibierge has analyzed Mustard, and obtained from it the following products:—1, a *soft fixed oil*, procured by pressure, of a dark greenish-yellow colour, soluble in alcohol and ether; 2, a *volatile oil*, obtained by distillation, of a golden-yellow colour, heavier than water, having a hot acrid taste, soluble in alcohol, and depositing sulphur. It is this oil which irritates the eyes and excites tears, in mustard prepared for the table, and which vesicates when Mustard is applied to the skin; 3, an *albuminous vegetable principle;* 4, a large quantity of *mucilage;* 5, *sulphur;* 6, *nitrogen;* 7, the seeds, incinerated, appear to contain *phosphate* and *sulphate* of lime and a litte *silex*†.

The fixed oil has a sweetish taste, and a slight nauseous odour; it is soluble in 32 parts of alcohol and 16 of ether, is lighter than water, having a specific gravity 0.8815; and, when boiled with litharge, is changed into a soft, yellow, transparent viscid substance, which dries like varnish. The seeds yield $\frac{1}{5}$ of their weight of this oil, which, in large doses, operates as a pur-

* Woodville's Medical Botany, third ed, p. 403, pl. 146. London Dispensatory, art. Sinapis. Richard, Hist. Nat. Med. tome ii, p. 648.

† Journ. de Pharm. tom. v, p. 439. M. Henri, jun and M. Gavot have discovered a peculiar acid in mustard, which they term *sulpho-synapic*, in which sulphur is supposed to exist in a peculiar state of combination. Journ, de Chim. Med. tome i.

gative. The marc is more pungent than the seeds previously were; on which account, the seeds are submitted to pressure previous to being formed into flour of mustard to be used as a condiment. By afterwards distilling the marc with as much water as will prevent empyreuma, some volatile oil is procured: its specific gravity is 1.0387. M. Guibourt supposes that this volatile oil is not present in the seeds of Mustard, as bruised Mustard seeds exhale no odour until they are moistened: but the fact, that a portion of the acrid principle is expressed with the fixed oil, is at variance with this opinion. If the seeds be triturated with lime, ammonia is exhaled, probably owing to some decomposition taking place, which yields hydrogen to combine with the nitrogen of the seeds*.

Notwithstanding the stimulant property of mustard, it is astonishing how much the stomach resists its action. In moderate doses, as a condiment, it is a wholesome Excitant; in a weakened state of the stomach, it rouses its sensibility, and promotes chymification: in large doses it interrupts digestion, and irritates the nervous system. Van Swieten relates the case of a strong healthy man, attacked with a quartan ague, who swallowed a large quantity of bruised mustard-seeds steeped in hollands: inflammatory fever followed and carried him off in three days†. In intermittent fevers, however, the union of the exciting influence of the Mustard with tonics has proved highly beneficial.

Callisen advises the combination of Mustard and Cinchona in the low stage of typhus‡: its utility is manifested by a gentle perspiration, an increased secretion of urine, and an abatement of delirium: occasionally, it causes vomiting§.

As a local Excitant, the influence of flour of Mustard is well known. Mingled with boiling water, and applied hot, as a cataplasm, the mixture excites the skin powerfully, causing redness, great heat in the part, and, ultimately, vesication. With the intention of causing revulsion, by exciting action in a distant part, Mustard cataplasms are applied to the soles of the feet, and the calves of the legs, in fevers with local determinations to the head or the stomach. Such cataplasms are also useful in cases of atonic gout affecting the stomach, the heart, or the diaphragm, and in apoplexy. In such cases they are preferable to blisters, from the promptness of their action. In cases where a less degree of excitement is requisite, the flour of Mustard is mixed with crumbs of bread softened with water. With the same intention, it is also added to the pediluvium. In some instances, the volatile oil of Mustard has been employed as a rubefacient.

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* Journ. de Chim. Med, t. i. † Commentaries, vol. ii, p. 30.

‡ Acta. Soc. Med. Hafn. t. i, p. 364. § Acta. Reg. Societat. Med. Hafn. t. i, p. 364.

PELLITORY ROOT. *Pyrethri Radix.* L. E. D.—In Pellitory root, the acrid principle is of a more fixed character than in Mustard; it is combined with inulin and gum.

Pellitory is the root of Anthemis *Pyrethrum*, a member of the natural order Compositæ. It is indigenous in the south of Europe, on the coast of Syria, and on that of Barbary*.

The roots, as imported into England, are in pieces of four or five inches in length, and about one-third of an inch in diameter, slightly curved, and of a dirty whitish grey-colour, breaking with a short resinous fracture. They are inodorous, and, at first, apparently insipid; but, soon afterwards, the taste is extremely pungent, not unlike a mixture of salt and acid, with a pricking or thrilling sensation on the tongue and lips, which excites powerfully the excretory ducts of the salivary glands. In a longitudinal section of the root, a multitude of vesicular cells may be perceived, in which the acrid fixed oil is deposited. According to the analysis of M. Gauthier, 100 parts of Pellitory root contain—of fixed acrid oil 5.0, yellow colouring matter 14.0, gum 11.0, inulin 33, muriate of lime a trace, lignine 35.0, and water 2.0†.

The acrid principle is readily extracted by ether; it is odorous, reddish, has a hot, acrid taste, exciting salivation, and resembling a mixture of resin and fixed oil. When it is taken up by ether, the rest of the substance of the root is left almost insipid.

Pellitory root is a powerful Excitant; but its employment is confined to cases in which a local stimulus is necessary, as in paralysis of the tongue, and of the internal organs of deglutition, arising from circumstances affecting, partially only, the nerves of these organs. It is chewed, in a more or less bruised state, according to the power of mastication enjoyed by the patient.

d. BITTER EXTRACTIVE.

CONTRAYERVA ROOT. *Contrajervæ Radix.*—The plant, of which this is the root, the Dorstenia *Contrajerva*, belongs to the natural order Urticeæ‡. It is a native of Peru, Mexico, and the West Indies. It was first known as an antidote against the bites of serpents, and is still used as such in Brazil, whence the name *Contrahierba*, the Spanish for antidote. The root is an irregular tubercular substance, covered with scales on its upper part, and furnished with slender fibrils on its lower part. In its dried state, it is of a reddish-brown hue, has a peculiar, not dis-

* Woodville's Medical Botany, third edition, p. 50. pl. 20. London Dispensatory, art. Anthemis. Richard, Hist. Nat. Med. t. ii, p. 221.

† Journ. de Pharm. 1818, p. 33.

‡ Woodville's Medical Botany, third edition, p. 705, pl. 240. London Dispensatory, art. Dorstenia. Richard, Hist. Nat Med. tome i, p. 554.

agreeable, aromatic odour; and a warm, bitterish taste, leaving an impression on the tongue which does not soon leave it. Its infusion does not affect the protosulphate of iron. The watery decoction of the root is extremely mucilaginous, owing to the great quantity of fecula it contains; on which account, it is requisite to add chalk or some dry material in powdering the root.

Contrayerva root was at one time highly esteemed as an excitant in the low stage of typhoid fevers: but, like many things too highly extolled, it lost its credit, and has been as undeservedly neglected as it was improperly vaunted. When taken into the stomach, it augments the appetite and the powers of that organ, and quickens the general circulation. In conjunction with cretacious powders (*Pulvis Contrayervæ compositus.* L.), it is found to be useful in those complaints of children in which the skin does not act, from a languor of the heart and circulating organs; and, while its bitter aromatic principle stimulates moderately, the mucilaginous matter of the root involves the acid of the stomach. The dose of the powdered root is from gr. xv to ʒi.

e. STRYCHNIA.

This Alkaline substance, which was discovered by Pelletier and Caventou in 1818*, exists in the fruit of the Strychnos *Nux vomica*, that of Strychnos *St. Ignatia*, Strychnos *Colubrina*, and *Upas Tiente*. The S. *nux vomica* is the officinal plant of the British Pharmacopœia. It is a magnificent tree, a member of the natural order Apocyneæ, a native of the islands of the Indian Archipelago, of the coast of Coromandel, Cochin China, and several other parts of the East Indies, where it is known by the name of *Caniram*. The seeds, from which the Strychnia is procured, are flattish, depressed in the centre on one side and convex on the other; covered on both sides with a velvety down, and containing a horny, semi-transparent perisperm, which encloses an embryo with two cotyledons†.

All the parts of S. *nux vomica* are extremely bitter; and, more or less, contain Strychnia; but it is from the seeds that this active principle has been extracted. It exists in combination with a peculiar acid, the Igasuric. One pound of seeds of Nux Vomica, well managed, should yield 34 grains of pure Strychnia; the same quantity of the Bean of St. Ignatius, properly treated, should yield 102 grains. Besides the Igasuriate of Strychnia, the other components of *nux vomica* are—2, a *yellow colouring matter;* 3, a *concrete oil;* 4, *gum;* 5, *starch;* 6, a

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* Mem. Sur. un Nouv. alkali veget. trouvé dans la feve de Saint Ignace, &c. &c.

† See Woodville's Med. Bot. 3rd. edit. p. 222, pl. 79. London Dispensatory, art. Strychnos. Richard, Hist. Nat. Med. tome ii, p. 146.

small proportion of wax; 7, *bassorine;* and 8, *lignine.* The seeds yield their active principle to boiling water, but much more abundantly to alcohol. The decoction is precipitated greenish by subacetate of lead; green by the sulphates of iron; pea-green by sulphate of copper; and opaline by infusion of gall-nuts. This precipitate, which is again dissolved at a temperature of 120° Fahrenheit, is a tannate of starch.

There are various methods of obtaining the Strychnia. The most economical process is to macerate the rasped seeds in successive portions of cold water; then to evaporate to the consistence of a syrup, and throw down the gum by alcohol. The tincture, thus formed, is to be evaporated in close vessels by the heat of a water bath: a yellowish-brown coloured extract is left, which is to be dissolved in cold water, to remove a little fatty matter; and the Strychnia is lastly to be precipitated by lime water from this solution heated, and afterwards taken up by alcohol. The Igasuriate of Strychnia is thus decomposed, and the Strychnia obtained by crystallization. It is, however, seldom procured in a pure state by this process, for it generally contains some *Brucia*, which is rendered evident when a blood-red colour is communicated to the salt by nitric acid. It may, however, be effectually purified by maceration in diluted alcohol.

Strychnia is procured also by precipitating a strong infusion of the seeds with acetate of lead, which leaves the Strychnia and Brucia in solution as acetates, mixed with some undecomposed acetate of lead, which can be easily separated by sulphuretted hydrogen gas. The fluid is then to be filtered, boiled to expel the superabundant sulphuretted hydrogen, and magnesia then added in excess: this decomposes the acetates of Strychnia and of Brucia, and forms a soluble acetate of magnesia, whilst the excess of magnesia carries down with it the nearly insoluble Strychnia and Brucia. This precipitate is next to be well washed with cold water, and, when nearly dry, to be treated with boiling alcohol to separate the Strychnia. The alcoholic solution, filtered whilst boiling hot, is next to be evaporated to dryness, and the extract macerated in weak alcohol, which takes up the Brucia and colouring matter, and leaves the Strychnia in a pure state, but not crystallized. By re-dissolving it in boiling alcohol and leaving it at rest to cool, the alkaloid is crystallized.

When pure, Strychnia exists in the form of minute, elongated, tetrahedral, prismatic crystals, terminated by a pyramid: but, when it is rapidly crystallized, it is in a granular form. It is inodorous, and has so very intense a bitter taste, that one grain of it gives a perceptible bitterness to eighty pounds of water. Like the other vegetable alkaloids, Strychnia is scarcely soluble in water, requiring 6667 parts of that fluid, at 50° Fahrenheit, for its solution, and 2500 parts of boiling water. It is not very soluble in ether and in cold alcohol; but it is very so-

luble in boiling alcohol, and in volatile oil at 60°. Strychnia is unalterable in the air; but, when exposed to heat, it is decomposed, swells, becomes black, and furnishes ammoniacal products. It is seldom procured free from Brucia; but this may be removed by maceration in dilute alcohol. Its purity is easily known by testing it with nitric acid, which colours it red if Brucia be present. If it is required to ascertain the quantity of Brucia, the specimen of Strychnia must be mixed with hot water in a glass tube, and any acid added until the solution be complete; the solution is then to be boiled, and whilst it is boiling the Strychnia precipitated with ammonia. If the Strychnia be pure, the precipitate will be pulverulent; if it contain Brucia, it will adhere to the sides of the tube. By weighing the tube before the experiment, and after the powdery precipitate is washed out of it, the quantity of Brucia thus adhering is indicated by the excess of weight.

Like the other vegetable alkaloids, Strychnia combines with acids, forming crystallizable soluble salts. The Igasuric acid, with which it is united in *nux vomica*, when obtained in a separate state, is characterized by precipitating ammoniaco-sulphate of copper green. The salts of Strychnia are precipitated white by oxalates and gallates of alkalies; as, for instance, the oxalate of ammonia, and the gallate of potassa.

Besides combining with acids, Strychnia unites with iodine, forming very important compounds in a medicinal point of view.

According to the experiments of Pelletier, and those of Liebig, Strychnia is an azotized product, consisting of—

	Pelletier and Dumas.	Liebig.
Carbon	78.22	76.43
Nitrogen	8.92	5.81
Hydrogen	6.54	6.70
Oxygen	6.32	11.06
	100.00	100.00

or—Carbon $30\frac{1}{2} = 183$ + Nitrogen $1 = 14$ + Hydrogen $16 = 16$ + Oxygen $3 = 24$; making the equivalent 237*. The Igasuriate, as it exists in the plants which contain it, consists of three atoms of Strychnia and two atoms of acid; and the same proportions enter into all its salts.

The Igasuriate of Strychnia is the active principle of Nux Vomica: the following remarks, therefore, may be regarded as applicable to Strychnia, both in its combined state in Nux Vomica, and in its separate or pure state.

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* Brucia is much less active than Strychnia; it is distinguished by tinging nitric acid a deep blood-red colour, passing gradually into yellow, which, on the addition of protomuriate of tin, changes to a beautiful violet. It consists of Carbon 33 = 198, + Hydrogen 18 = 18 + Nitrogen 1 = 14 + Oxygen 6 = 40, making the equivalent 278.

Strychnia in all its forms, pure or combined, is a powerful Excitant, displaying its influence, first by an increased energy of the whole system; and, next, chiefly on those tracts of the Medulla spinalis which give origin to the motor nerves. The nerves of sensation, however, are also involved in this action; for, along with the muscular contractions and convulsions which supervene, the surface of the body is so morbidly sensitive, as to be susceptible of the slightest impressions: even the motion of the air becomes a source of uneasiness, nearly as considerable as in hydrophobic cases*. Before any twitchings

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* This effect on the nerves of sensation is most remarkably displayed in reptiles; and, as it was particularly demonstrated in the following experiments, I trust I shall be excused inserting them in this note.

May 30, 1832.—An incision was made near the spine of an ordinary green snake, about eight inches from the tail, and one grain of powdered Strychnia rubbed into the wound. The part oozed out only a little blood. The reptile was strong and lively. For nearly an hour afterwards it seemed little disturbed; but, after that time, it became extremely irritable; hissing and rearing itself as if about to strike at any one who attempted to touch it, and moving about with a restless, anxious movement. In three hours it became irregularly convulsed four or five inches above and below the wounded part: it then lay still, except on being touched, when the convulsions were immediately renewed, At the termination of eight hours, the tail had become nearly insensible; and, even when pinched severely, scarcely moved: the greater part of the body was also now insensible. The head and neck, to the extent of ten inches, remained morbidly sensitive; and, for four hours, this sensibility was so great that the convulsions which affected the head and neck were excited by merely blowing the breath upon the animal or agitating the air near it. Dr. Marshall Hall, who witnessed this part of the experiment, satisfied himself of this effect of agitating the air by interposing a pane of glass between the animal and his mouth, and then blowing upon it: no convulsions supervened. The slightest noise also caused a renewal of the convulsions. At this time the head and neck were convulsed every minute; the convulsions continuing for the space of fifteen seconds, then ceasing for four or five seconds, and again recurring for three successive times; after which the animal would remain still for the remainder of the minute. These convulsions were preceded by a sudden expiratory effort, expressed by a low, hissing sound, which continued for three or four seconds; when the head was raised from the ground, and rapidly removed in a lateral direction. At the termination of twelve hours from the insertion of the Strychnia, the convulsions became less frequent, recurring only once in several minutes; but the sensibility was still morbidly acute.

May 31.—The upper part of the body was now very languid; and convulsions occurred only when the reptile was touched: the tail had, however, recovered its sensibility, and moved briskly when touched near the spot where the Strychnia was inserted.

June 1.—Every thing continued nearly in the same state as yesterday. Wishing, therefore, to shorten the sufferings of the animal, a quarter of a grain of pure Strychnia was introduced about four inches from the head. Soon afterwards, the irritability and liveliness of the reptile returned; but, after an hour, it gradually subsided; and, on the following day, the snake was found firmly coiled up and apparently dead in every part. On the following day, however, the animal was still alive at the head; but the tail and the body had been perfectly dead, from the tip of the tail upwards, for the last twenty-four hours. The head and about six inches of the body moved; but the lower part of it was completely motionless. On the following morning, June 4th, the snake was found completely dead.

The same morbid susceptibility of the surface was observed in experiments on three frogs, a toad, and two newts. For some time the influence of the poison was manifested only on the side of the reptiles into which it was inserted. In the newts, the wounded side was completely dead, whilst the animal was yet able to swim with the other side. How far this effect is to be ascribed to some peculiar disposition of the nervous system in these reptiles, I am not prepared to decide.

or tetanic convulsions, also, are excited during the administration of Nux Vomica and of Strychnia, sensations of heat, prickings, formications, and other uncomfortable feelings, are felt in the limbs. Neither these sensations nor the irregular muscular actions proceed with an unvarying intensity; they 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.

On the stomach, the first obvious effects of the administration of Strychnia, in any form, is an increased energy in the digestive powers; the appetite improves, assimilation is better effected, and the person becomes fat, more healthy in appearance, and stronger. Although the circulation is not perceptibly affected, yet, if the dose be large, the respiration soon becomes oppressed, the respiratory muscles suffer a clonic contraction, and the person feels as if about to be suffocated. The urinary organs are little influenced; but the cutaneous system, besides the increased susceptibility of impression already noticed, has its capillary vessels also powerfully excited, and copious perspirations occur during the operation of Strychnia.

Such are the physiological effects of Strychnia. Before noticing its therapeutical employment, it may prove useful to take a passing view of the effects which it has produced upon the lower animals: for, by having a complete knowledge of the power of any medicinal agent, when the dose is carried to its utmost limits, we are enabled to reason more correctly upon its powers, and to avoid errors in practice which could only be learned after events that are always to be regretted have occurred, and which might be prevented by studying the effects of the medicine upon quadrupeds.

When dogs swallow from twenty to thirty grains of powdered Nux Vomica, they are quickly attacked with all the symptoms of tetanus, distension of the limbs, tremors, convulsive movements of the face and eyelids, immobility of the eyes, and a complete rigidity of all the muscles of the body. There is, also, an involuntary emission of urine. The convulsions are renewed by sudden noise or the slightest touch; but there is no delirium; and, if we may speak of the mind of a dog, the mental faculties remain entire. Many other animals, cats, rats, foxes, and some birds, are similarly affected: but some animals —hogs, for example, and goats—eat the Nux Vomica with impunity. M. Desportes found that it produces very little effect upon poultry.

Desportes, Delile, and Majendie, applied the Nux Vomica and its extract to wounds, and to mucous and serous surfaces. M. Delile injected a solution of twelve grains of the extract into the pleura of a dog: tetanus supervened in less than a

minute, and the animal soon died. Applied to wounds, it produced the same effect: but no convulsions followed when it was applied to the sound skin. One grain and a half of the resinous extract were smeared on a small piece of wood, and a dog wounded with it in the thighs: tetanus supervened in seven minutes, and proved mortal in five minutes after the first attack. Introducing the watery decoction of Nux Vomica into the circulation, by injecting it into the jugular vein, produced immediate tetanic symptoms, which rapidly proved fatal. Post-mortem examinations did not display any inflammatory appearances in the stomach; yet the poison has always been found in the stomach or the duodenum. One appearance, however, invariably presents itself, whatever may be the surface to which the poison is applied: that is, there is a general contraction of the whole arterial system, which is so obvious in the large vessels, that, in my experiments with Strychnia, I have found the aorta of a strong dog reduced in diameter to the size of a crow quill; and black blood in all the arterial cavities.

M. Delile and M. Majendie maintain that the influence of Strychnia is not communicated through the nervous system, but that the poison is absorbed and conveyed by the blood to the spinal column, on the anterior nerves of which its immediate influence appears to be exerted. There is much plausibility in this reasoning; but, reflecting on the effect of the Tincture of Iodine, which acts as an antidote to the poison of Strychnia, by changing the nature of the poison as it exists in the stomach (for we cannot suppose that the change induced, which is of a chemical nature, is likely to take place after the poison has been absorbed), and also on the additional fact, that the influence on the poison is suddenly checked if the stomach can be emptied by a powerful emetic—I cannot agree with these distinguished physiologists, and I must continue to believe that the active principle of this vegetable production operates solely through the intestinal nerves, until more decisive proofs be afforded of its absorption into the blood.

That Strychnia acts, when given in too large doses, directly upon the origin of the motor nerves is evident; first, from the nature of the symptoms that follow—for instance, violent tetanic convulsions, rigidity of the voluntary muscles, as well as those of respiration, thence immobility of the chest, and consequently the deficiency of the decarbonization of the blood; and, secondly, from the evidence afforded by an experiment of Fœderé, who found that, on exposing the spinal marrow in an animal to which Strychnia had been given, he could arrest the convulsions by pressure on the anterior segment of the spinal cord. Experiments have also ascertained the fact, that Strychnia produces no effect upon the system when the spinal marrow has been previously destroyed.

Strychnia produces the same effect on man as on quadrupeds. This fact is of importance in two points of view: it leads us to be guarded in the administration of this substance, when its exciting influence only is required; and it enables us to take advantage of even its deleterious properties, and to turn them to account in the cure of diseases. In doses from gr. ss to grs. iv of the Extract of Nux Vomica, prepared according to the formula of the Dublin College, it produces some degree of nausea, a sensation of weight at the epigastrium, occasionally colic, and irritation at the anus. These symptoms are followed by weight in the head, giddiness, pain of the eyes, a sensation and pricking in the urethra, prostration of strength, and apathy; and if the dose be carried beyond grs. iv, tetanic convulsions supervene.

Accidents, and a variety of circumstances, evidently affecting the spinal marrow, early demonstrated the fact that paralysis of the lower extremities may occur without any affection of the brain; and led pathologists to refer this disease, under all circumstances of its occurrence, to some morbid change, or impression on the motor tract of the spinal cord. It is not necessary, for our purpose, to enter into a discussion of the argument whether it is ever produced by diseased impressions on the brain itself—an opinion which was entertained by Dr. Baillie and Sir James Earle, and is still maintained by several distinguished physicians; and which, if it be correct, does not affect our position, that some morbid change or impression on the anterior portion of the spinal cord is the most general cause of Paraplegia or palsy of the lower extremities. It is often induced by powerful sedative impressions on the extremities of the nerves supplied by the intestinal canal, as in painter's Colic produced by the carbonate of lead taken into the stomach; and, as this palsy is cured by Strychnia, it affords another proof of the truth of my opinion, that this alkaloid operates through the medium of the intestinal nerves. Supposing Paraplegia, therefore, to depend on a paralysis of the anterior nerves of the spine, and knowing the influence of Nux Vomica on this set of nerves, Dr. Fouquier, of the Hospital de la Charité in Paris, was induced to try its effects as a remedial agent in this disease. He administered it both in the form of powder and that of extract with decided advantage. In the dose of gr. ii of the extract, it sometimes produced contractions in the paralysed muscles, more or less permanent: sometimes these were sudden and transient; at other times they were more slowly induced, and several doses of the extract were required; but a more permanent effect was the result. It is a curious fact, first remarked by M. Fouquier, that the paralytic parts appear always more sensible to the action of Nux Vomica than the sound parts.

The success of M. Fouquier's treatment induced physicians

in different parts of Europe to try Strychnia; and, from the whole of the experience recorded, although mischievous effects have occasionally resulted from its injudicious and indiscreet employment, yet, there is ample authority for regarding it as a most valuable Excitant in palsy of the lower extremities. As far as my own experience authorizes me to form any conclusions on this subject, I am disposed to regard Strychnia, or the Extract of Nux Vomica, most useful in those cases of palsy that proceed from sedative impressions on the intestinal nerves; such, for example, as occur when carbonate of lead is taken into the stomach; and, indeed, in every case of palsy of the motor nerves only, which is readily known by the sensibility of the paralytic limb remaining after the power of motion is lost, and by the entire state of the sensorium commune.

The action of Strychnia and Extract of Nux Vomica differs in one respect, which is not easily explained. Extract of Nux Vomica determines powerfully to the head; pure Strychnia and its salts produce scarcely any obvious effect on the cerebral circulation—a fact of great practical importance, as it authorizes us to prescribe Strychnia and its salts in cases where, although paralysis may have arisen from pressure in the brain, yet, there is reason for thinking that benefit may be derived from the influence of so powerful and direct an Excitant on the nervous system. In cases, however, in which plethora exists, the previous use of the lancet is requisite, to prevent an over-distension of the venous system likely to result from the powerful contractile influence of the Strychnia on the coats of the arteries. In very few instances I observed that the administration of pure Strychnia, or its salts, has been followed by headache. In one case, symptoms closely resembling those of intoxication supervened on the third day after commencing the use of the remedy, which was repeatedly discontinued, and when renewed was always attended with a return of this effect. I am disposed to regard this as an instance of idiosyncracy, rather than a result of the medicine likely to occur in others.

From these facts, there is every reason for preferring pure Strychnia, or its salts, to either the powder or the Extract of Nux Vomica. Various causes, also, may occur to render the powder or the Extract uncertain in its operation; whereas the proper apportioning of the dose of Strychnia to the condition of the patient, and the severity of the case, must always afford a more certain result than we can expect from it when clogged with other vegetable constituents, as in the powder and the Extract.

With respect to the mode of prescribing Strychnia, it is necessary to bear in remembrance its great insolubility, and the variation of activity of the salt according to the acescent state of the stomach at the time. The greater the quantity of acid pre-

sent in the stomach, the more active will the Strychnia prove. To obviate this inconvenience, it may be administered in the form of acetate, which is easily produced by dissolving one grain of pure Strychnia in f℥i of distilled vinegar, so that six minims of this solution contain one tenth of a grain of Strychnia, the dose of the medicine which should be given at first. Such a solution, also, enables the dose to be more gradually increased than can be effected when the medicine is in the state of powder. The extent of the dose to which it has been carried in some instances, can only be explained by the little solubility of the medicine, and the defect of acid in the stomach of the patient. Given in the form of the acetate, I have in no instance been able to carry the dose to the extent to which Dr. Bardsley has carried it: indeed, I have never been able to exceed thirty minims of the solution, a dose equivalent to half a grain of the Strychnia, three times a day. The usual forms, however, of giving Strychnia are those proposed by M. Majendie. He directs grs. ii of the pure salt to be carefully beat up with grs. xxx of conserve of roses, and divided into twenty-four pills, each of which should thus contain one twelfth of a grain of Strychnia. He also orders it in the form of tincture, composed of grs. iii of pure Strychnia dissolved in f℥iss of strong alcohol, so that three minims of the solution contain one tenth of a grain of the salt. The sulphate has, also, been occasionally employed.

Strychnia, its salts, and the Extract of Nux Vomica, besides proving useful in paraplegia, have been found beneficial in other varieties of palsy*. Thus the Extract of Nux Vomica has been advantageously given in rheumatic paralysis, in doses of half a

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* The following case is one among many which might be selected to illustrate the action of Strychnia in paralysis: Mrs. R. a widow lady, aged seventy, of a spare habit, and delicate frame of body, was attacked, in November 1830, with hemiplegia of the right side of the body. She was attended by a respectable general practitioner, by whom she had been very judiciously treated prior to my advice being requested. I found that Mrs. R. had lost the power of motion in the whole of the right side of the body; the mouth was drawn to the opposite side of the face; the upper eye-lid on the affected side was depressed; and the articulation was so much impeded, that her answers to my questions were scarcely intelligible. The sensibility, however, of the paralyzed side was entire, and its temperature not lowered; the pulse was quick, but feeble; and although the bowels were torpid, yet, they answered to the stimulus of purgatives; whilst the bladder performed, naturally, all its functions. After freely evacuating the bowels, the acetate of Strychnia was prescribed, in doses of one sixteenth of a grain, to be continued at intervals of six hours, and the dose gradually increased until it amounted to a quarter of a grain. In a few days after the administration of the acetate had been commenced, the patient regained the power of raising the arm at the shoulder joint; in ten days she could move the affected leg; the drawing of the mouth disappeared in this time, and she articulated her words distinctly: in three weeks she could use the fingers of the paralyzed hand: and, in another week, she was able to walk about the room with the assistance of a servant. After the tetanic convulsions occurred, and the medicine was discontinued, she improved so rapidly that she was able, before the end of December, to get into her drawing room; and, before February the 21st, 1831, she walked out, and had nearly as much voluntary power over the muscles of the affected side as she ever enjoyed.

grain every night and morning, until three grains were taken for a dose. The result is, as usual, involuntary movements, attended with pain; but, on these ceasing, the power of volition generally returns by degrees to the limb affected, and the patient is able to walk in three or four weeks. It must, however, be acknowledged, that Strychnia has failed in many cases of this description, and that even although it has frequently greatly relieved cases of hemiplegia, yet it has not always succeeded in completely restoring the lost power of the affected side.

M. Frisch, a German physician, has affirmed that, in robust persons who are attacked with ague, when the sulphate of quinia fails, it may be rendered efficient by combining it with Nux Vomica. He prescribes from six to ten grains of the rasped seed, mixed with two ounces of Cinchona bark, or twelve grains of Sulphate of Quinia, to be taken in divided doses in the intervals of the paroxysms. Dr. Bardsley supposes that it may prove useful in amenorrhœa; and he has detailed several cases in which its administration was followed by the reappearance of the catamenia in its natural state. Dr. Bardsley ascribes this effect "to the power which the Strychnia possesses of stimulating the vessels of the uterus, and of improving the tone and vigour of the system*." This theory of the beneficial influence of this Excitant in amenorrhœa is not perfectly satisfactory. If the flow of the catamenia is to be regarded as a secretion, an ample supply of arterial blood to the organ must be requisite for the due performance of its functions—an effect not likely to result from the use of Strychnia. At the same time, whatever improves the tone and vigour of the system, must necessarily aid the functions of the uterine organs; and, consequently, we are constrained to admit this view of its influence in effecting the cure of amenorrhœa.

The exciting power of Strychnia, in changing morbid into health action in the digestive organs, is well illustrated by its influence in pyrosis. It has also proved useful in chronic diarrhœa and dysentery; but its efficacy depends on the period of the disease in which it is administered. If given early, and during the continuance of inflammatory action, it is always injurious; but, on the decline of the inflammatory symptoms, by changing the action of the diseased surface, it removes the irritability of the intestinal canal and increases the powers of the digestive organs. M. Frisch asserts that no medicine is so efficacious as Nux Vomica in that form of chronic diarrhœa which is kept up by a subacute state of inflammation of the villous coat of the intestines, and which is marked by viscid mucous evacuations and considerable tenesmus. In this complaint, he com-

* Hospital Facts and Observations, &c. by James Lomax Bardsley, M.D. p. 57.

bines it with small doses of ammonia and mucilaginous drinks, particularly Salap*.

Nux Vomica, when administered in the form of powder, has been carried to the extent of fifty grains a day. Of the alcoholic Extract, two grains are at first given at night and in the morning; and one grain is added every day, or every second day, until the specific influence of the remedy displays itself with an intensity sufficient to lead to a salutary result.

With respect to the effects of an overdose of either Strychnia or of the extract of Nux Vomica, the fatal consequences seem to proceed partly from the poison exhausting the irritability of the heart, partly from asphyxia. When it operates as a poison, the first effect is tremor: this is followed by stupor and a sense of intoxication, which is quickly succeeded by general symptoms of tetanus, stiffness of the muscles of the neck, lock-jaw, severe pain under the ensiform cartilage, violent spasmodic contraction in the intercostal, the lumbar muscles, and those of the whole spine, so as to produce opisthotonos and laborious respiration, complete asphyxia, and death. As, in all cases of poisoning, the first object is to get rid of the offending cause, the second to destroy the virulence of the poison, the use of the stomach-pump or emetics must be resorted to as quickly as possible; after which, tincture of Iodine should be freely administered. This antidote was discovered by M. Donné, who found that the ioduret of Strychnia could be given in doses of gr. iiss to a dog with impunity; whereas gr. ss of Strychnia was sufficient to kill the animal. He therefore tried Iodine as a counterpoison, and gave the tincture of it to dogs to which a grain of Strychnia had been given. In seven cases, one case only resisted the antidote; and in this it was not administered until ten minutes after the poison had been swallowed.

I have had no opportunity of trying this antidote on man, except in one case in which the tetanic symptoms arising from the employment of Strychnia, in a case of paraplegia, were very alarming. The spasms certainly appeared to abate more rapidly than usual; but I cannot positively refer this effect to the use of the Iodine. Its influence, however, in this respect, in quadrupeds, is a strong reason for trying it in man.

When death has been the consequence of an overdose of Strychnia, the post-mortem examinations have displayed scarcely any traces of inflammation even in the stomach; but the venous system of vessels is found to be always gorged with blood, whilst the arterial is nearly empty.

ALCOHOL.—Syn. *Rectified Spirit of Wine.*

Alcohol is a powerful and most valuable Excitant, both in its

* The prepared tubers of Orchis *mascula*.

combined and *uncombined* state. As we must examine it in both states, we shall understand it better if we first obtain a correct knowledge of it in its purest form.

Alcohol in its purest state, that which is supposed to be quite free from water, *absolute Alcohol*, has a specific gravity of 0.796, at 60° Faht. It is a limpid, colourless liquid, of an agreeable, penetrating odour, and a hot taste; its fluidity resists every degree of temperature above—110° Faht.; at which degree Mr. Hutton is stated to have frozen it in 1813*: but there is, nevertheless, still reason for believing that the fluidity of absolute alcohol resists every known degree of cold, artificial or natural. Pure alcohol is extremely volatile, and produces great cold during evaporation. It is highly inflammable, its vapour catching fire on the approach of any ignited body, and generating a large quantity of water and carbonic acid. The bluer the colour of the flame, the stronger the alcohol is accounted. Absolute alcohol boils in the open air, at 168° Faht. and in vacuo at 56°. It has a great affinity for water, attracting it from the atmosphere, mixing with it in every proportion, and evolving heat, owing to the density of the mixed fluids, being greater than the mean of the densities of the unmixed fluids. Thus, if alcohol at 796 and water in equal proportions, be mixed together, the sp. gr. at 60° Faht. will be 917; but the mean density would indicate only 896. According to M. Theodore de Saussure, pure or anhydrous alcohol consists of—

Carbon	51.98 or	52.17 or	2 equivalents (6×2)	$= 12$
Hydrogen	13.70	13.04	3 equivalents (1×3)	$= 3$
Oxygen	34.32	34.79	1 equivalent . . .	$= 8$
	100.00†	100.00		$= 23$

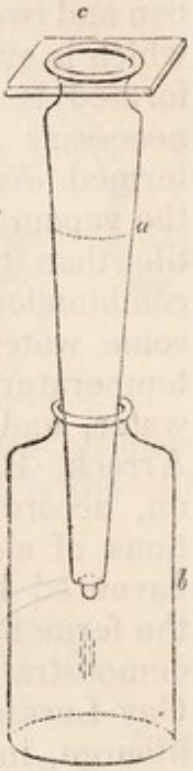
or 2 equivalents of Olifiant Gas $(7 \times 2) = 14$, + 1 equivalent of water $= 9$; $= 23$.

Alcohol is a solvent of many substances—namely, Iodine, Camphor, Resins, Balsam, Volatile Oils, Castor Oil, Sugar, Manna, Tannin, pure Potassa, Soda, Ammonia, the vegetable Alkaloids, and many other vegetable constituents:—it is therefore much used as a pharmaceutical agent. The alcohol employed by the directions of the London Pharmacopœia is of sp. gr. 815, and contains 93 parts of anhydrous alcohol and 7 parts of water: the rectified spirit, sp. gr. 835, contains 15 per cent. of water.

Strong alcohol is prepared from weaker alcohol, by adding to it substances which have a stronger affinity for water than alcohol has. The best of these is dried carbonate of potassa.

* Nicholson's Journal, vol. xxxiv. † Ann. de Chimie, tome lxxxix.

Other substances, such as dry chloride of calcium, quick lime, or dry alumina, may also be employed with advantage. They should be put into a retort in small pieces, and the alcohol of commerce poured over them in the proportion of ℔ii for every ℔i of the substance used. The mixture is then left at rest for some time, and afterwards distilled, removing the product at different periods; the strongest being that which comes over first, and each portion becoming weaker towards the conclusion of the process; until at length, by pushing the distillation to dryness, little more than water is obtained. This process was invented by Richter. The method I employ is more simple: I put the dry substance in rough powder into *a*, a narrow glass funnel, the lower extremity of which is plugged with cotton, and placed in the bottle, *b*; the spirit is then poured over the saline matter, and the top of *a* covered with a piece of glass, *c*; as the fluid percolates the mass, its watery part is arrested, and only the strong alcohol passes.



Various means have been contrived to determine the quantity of water contained in different specimens of alcohol: all of them are founded on the same principle, the relative specific gravity of a spirit at a given temperature. The hydrometer of Beaumé is one of the most convenient instruments for ascertaining this point.

Such is alcohol in its uncombined state. I shall defer noticing its effects on the living system, and its therapeutical uses, until I have examined it in its combined state.

Alcohol exists, in a combined state, in *Ardent Spirits;* combinations of alcohol and water, flavoured by volatile oils, on the nature of which the varieties of Spirits depend.

Every vegetable substance which contains sugar, gum, fecula, ferment, or similar principles, when diluted with water and exposed to a certain temperature, undergoes fermentation; during which the ultimate components of these principles enter into new combinations, the result of which is the formation of alcohol and carbonic acid. The saccharine matter which disappears is exactly equal to the combined weights of the alcohol and carbonic acid. Now, if we suppose that three parts of sugar are requisite to form one part of alcohol and one of carbonic acid, the changes may be thus demonstrated—

Sugar . .	3 parts	= 3 Hydrogen	+	3 Carbon	+	3 Oxygen	= 45.
Alcohol .	1 part	= 3 ———	+	2 ———	+	1 ———	= 23.
Carb. Acid,	1 part	= 0 ———	+	1 ———	+	2 ———	= 22.
		3		3		3	45.

In this case, the whole of the hydrogen, two parts of the carbon, and one of the oxygen, of the three parts of sugar, combine to form one part of alcohol; whilst the remaining one part of carbon and two parts of oxygen united constitute the carbonic acid, which is evolved in the form of gas. But, as the alcohol thus formed is mixed with much water and other ingredients, it is necessary to separate it; the process for effecting which is termed *distillation.* The whole is boiled in close vessels, and the vapour condensed; so that the alcohol, which is more volatile than the water and the other ingredients, is obtained in combination with a small portion of essential or volatile oil, and some water: and by the repetition of the process, at a lower temperature, the alcohol is freed from another portion of the water, and then constitutes ardent spirits, which are named Arrack, Brandy, Geneva, Rum, Whiskey, Koumiss, and so on, according to circumstances. All of these are modifications of alcohol and water, tinged with colouring matter, and flavoured by some essential oil. The alcohol is the product of the fermentation, and merely separated by the distillation; a fact demonstrated by the experiments of Mr. Brande* and those of Gay-Lussac†. Into wine a quantity of acetate of lead, or of litharge, in fine powder, was introduced, and the mixture agitated until the colour nearly disappeared; after which it was filtered: the colouring matter remained in the filter. Dry and hot carbonate of potassa was then put into the filtered fluid: the liquor divided into two distinct portions, which could easily be separated from one another by decantation. One of these, on examination, was found to be alcohol; thus demonstrating the fact, that alcohol is ready formed in vinous or fermented liquors, and merely separated by distillation from a large portion of the water with which it is combined.

It does not appear that the process of distillation was known to the Hebrews, or any very ancient people; nor was it known to the Greeks, who, amidst the effulgence of genius which brightened the best period of their history, were utterly ignorant of chemistry. Even the essential oil of pitch, which was collected by them, was procured by spreading the fleece of a sheep over the pot in which the pitch was boiled, and afterwards wringing out the oil collected in the wool. They procured fresh water at sea by suspending large sponges in the mouths of brazen vessels in which the salt water was boiled, and, when the sponges were saturated, they squeezed out the fresh water. This certainly may be regarded as a species of distillation in its rudest state; but it was not until the time of Geber, who lived in the seventh century, that any process which may be justly called *dis-*

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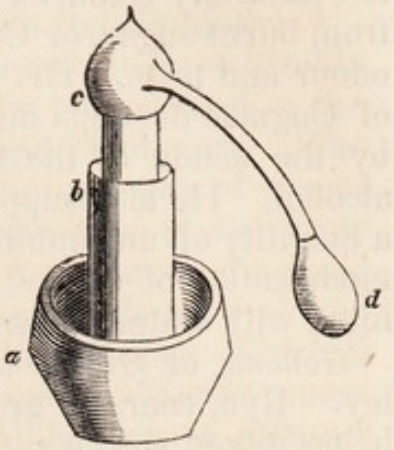
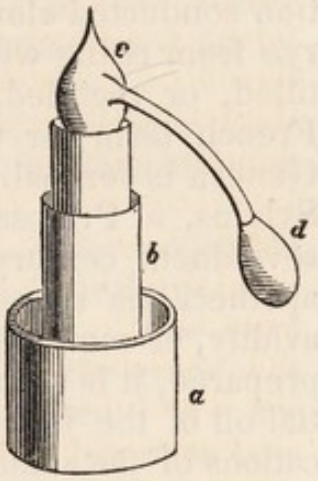
* Phil. Trans. 1811, 1813. † Mem. d'Arencill. vol ii.

tillation was known. In the second book of his work, entitled "Liber Investigationis Magisterii," some very accurate ideas of distillation are given, with figures of the apparatus. These figures display the rude condition of the apparatus, but they demonstrate that the nature of the process was understood. In the marginal cut, *b* is the body of the still, *c* the capital, *d* the recipient, and *a* the fire-place. It is evident, therefore, that distillation must have been invented before the time of Geber, who merely mentions the process which was then in use. The following marginal figure displays how slow the progress of improvement is; as this is the still which was employed at a much later period. Indeed, it has been pretty accurately ascertained that the Alembic, for the purposes of distillation, was invented by the Saracens; and to their efforts in search of the Elixir vitæ, the world is indebted for the greatest curse, next to war, ever inflicted on the human race—the discovery of ardent spirits.





The art of distillation is now almost universally understood. In Nubia, a spirit called *Bouza* is distilled from barley; in Persia and in Morocco, Brandy is distilled from fermented raisins, and also from the fig, and called *Mahayagh;* in Tartary, a spirit called *Araka* and *Arika* is distilled from fermented mare's milk, or Koumiss: in the Mysore, it is procured from *jaggory*, a coarse sugar made from the juice of the Palm The Burmese and Siamese distil spirits from Palm wine, as well as from rice and other grain, and call it *Lau.* The inhabitants of Java, Sumatra, China, and the peninsula of India, all distil *Arrack;* and one of the gifts bestowed by Europeans upon the natives of the Sandwich Islands, and many of those of the Pacific oceans, is the art of making Rum, which the natives call *y-wer'a*, literally *hot water.* It would be impossible to proceed thus with the statement of the nature of the distilled spirits made in the more civilized countries of the world. I will, therefore, confine myself to a few remarks on the nature of the four ardent spirits most generally drunk in Europe—namely, *Brandy*, *Geneva* or *Hollands*, *Whiskey*, and *Rum.*

Brandy is made chiefly from wine. It is a mixture of various proportions of alcohol and water, flavoured by a volatile oil contained in the skin of the grape, which is taken up, in a small degree, during the process of the fermentation of the

wine, and rises with the alcohol in the distillation. Brandy is not naturally coloured; but receives its brownish orange hue from burnt sugar, or Caromel, which imparts to the spirit both odour and taste. Dr. Paris supposes that the peculiar flavour of Cogniac depends on the presence of an etherial spirit formed by the action of the tartaric or acetic acid of the wine on the alcohol. He also supposes that newly distilled Brandy contains a quantity of uncombined acid, which disappears by age. This modification of diluted alcohol, in moderate doses further diluted with water, is *cordial* and *stomachic*.

Geneva, or *Hollands*, is distilled from fermented, malted barley. Rye, coarsely ground, is added to this malt; and, both being mixed with a sufficiency of water, the fermentation is promoted, until the liquor has become transparent, and hot and acrid to the taste; when it is put into the still, and the distillation conducted slowly at first, to prevent the essential oil of the rye from rising with the spirit. This crude spirit is then redistilled, or rectified, over juniper berries; and it is from the French term for the Juniper, *Genevre*, that the English name Geneva is derived. The discovery of this spirit is attributed to Sylvius, a Professor of Leyden, who lived in the middle of the seventeeth century. It was at first sold as a diuretic in the apothecaries' shops; but, as the common people drunk it with avidity, it soon became an article of trade. When properly prepared, it is a pure diluted alcohol, flavoured with the essential oil of the juniper. Scotch and Irish Whiskey are modifications of the same spirit, devoid of the juniper oil; and the English Gin is also the same kind of spirit, of an inferior quality, rectified with oil of turpentine.

The early communication of the Phœnicians with Ireland very probably introduced the knowledge of distillation into that country; Usquebagh was known, and drank there, long before Aqua Vitæ was even used as a medicinal cordial in England. The origin of the name Whiskey, which is a mere corruption of *Usque*, shows at once the source whence the Scots obtained their knowledge of ardent spirits. The Irish *Usquebagh*, as well as the English *Aqua Vitæ*, were compound spirits, and, according to the Red Book of Ossory, in which there are receipts for making them, they were compounded with saffron and some spices. They were supposed to operate in preserving health, dissipating humours, strengthening the heart, curing colic, dropsy, palsy, quartan fever, stone, and prolonging life, and were, therefore, eagerly sought after: but, although this spirit was then emphatically termed Aqua Vitæ, its evil tendency in an over-dose was also known. One of its Irish appellations was *builceann*, head-maddener, a name to which it has not forfeited its title by leaving out the saffron and spices.

The best specimens of Scotch and Irish Whiskey are little

more than pure diluted alcohol. They operate as simple Excitants, and, when properly diluted, increase the secretion of the kidneys, and are, consequently, received into the circulation.

Rum is prepared chiefly from fermented uncrystallizable sugar or molasses, and the scummings of the boilers used in the manufacture of sugar in the West Indies and Demerary. The chief peculiarity in this spirit is the large proportion of essential oil which it contains, derived from the raw juice of the sugar cane, and the fragments of the cane, which are mashed up and fermented with the other materials; for sugar, when employed alone, does not produce a spirit flavoured like Rum. This oil is extremely stimulant, and acts on the cutaneous vessels, causing diaphoresis. Age renders it mild, and bestows a softness and a rich flavour on Rum*. This oil appears, also, to have a very powerful and deleterious effect on the nervous system, before age amalgamates it fully with the alcohol; as the greater intoxicating property of new Rum cannot be accounted for by the alcohol which it contains.

Such are these four spirits; all the others, whatever their denomination, may be regarded as merely modifications of these four.

Wine, the next combination of alcohol with other vegetable principles, is necessarily of much older origin than Spirits; as it must be produced before spirits can be formed. The very first mention of Wine on record, shews us that the grape was the substance from which it was originally produced. We are told that soon after the universal deluge, Noah began to be a husbandman, and planted a vineyard; and he drunk of the wine and was drunken. The descendants of Noah appear to have neglected no opportunity of improving the beverage of the antediluvian world, thus introduced by their progenitor: indeed, it is very obvious that alcohol, in its combined state, is regarded by every description of mankind as one of the essentials of life; and the only inhabitants of the globe who do not manufacture an intoxicating liquor, are the New Zealanders, and the wretched natives of New South Wales and Van Dieman's Land.

Before examining the general effects of alcohol upon the living system, both in a dietetical and in a medicinal point of view, it is proper to take a passing view of the manufacture of wine, and its chemical properties.

The VINE, Vitis *vinifera*, the type of the natural order Vitis†, was introduced into Europe from Persia, its supposed

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* The name Rum is supposed to have been derived from the abbreviation of the Latin word, *Saccharum*; but this is not very probable, as the liquor has alwas been known among the native Americans by the name of *Rum*.

† Woodville's Med. Bot. third ed. p. 144, pl. 57. London Dispensatory, art. Vitis. Richard, Hist. Nat. Med. t. ii, p. 704.

native country*, through the successive stages of Greece and Italy. It was carried to France by a colony of Phœnicians, who founded the city of Marseilles; and into England, probably, by the Romans. It thrives only in those parts of Europe, the temperature of which is high in summer, although the winters be rigorous; but it is a plant easily naturalized. From some change in the climate of England, the Vine cannot be advantageously cultivated here, otherwise it would be attempted†.

Like all plants that have been cultivated from time immemorial, the Vine varies greatly in the character of the fruit which it yields. The grapes in some instances are green or greenish-yellow, in others red or purple. In some varieties they are an inch in diameter, in others scarcely the size of a pea. Although it is a climbing, slender plant, yet Strabo mentions a Vine, the trunk of which two men, with their arms outstretched, could not embrace. The extent to which it spreads, is also occasionally astonishing: one branch of the Hampton Court vine is 120 feet long: the whole vine, a few years ago (1829) covered a surface of 120 square yards; and in 1816 the crop weighed one ton. Pliny mentions a Vine which was 600 years old.

Wine is the juice of the fruit of this plant, pressed and fermented: and although every saccharine vegetable product, if fermented, will yield wine, yet none equals the grape. The quality of wine differs greatly. The kind of grape, the nature of the soil, the exposure, elevation, and degree of latitude, exercise a decided influence upon the chemical character of the juice of the grape, and consequently on the wine which it forms; the quality and flavour being as various as the countries, exposure, and soil, in which the Vine is cultivated. That wine which contains the largest quantity of aroma and of intimately combined alcohol, is regarded as the most generous; but the wines of France and those of the Rhine possess agreeable properties, which cause them to be preferred for the use of the table to those of a stronger quality. The grapes ripened in warm climates, as they are more impregnated with saccharine matter and possess more aroma than those of cold climates, if properly managed, always yield the best wine.

The expressed juice of the grape contains a large quantity of very soluble sugar, a small quantity of mucilage, some tannin, bitartrates of potassa and of lime, and sometimes sulphate

* At Shiraz, Sir R. Kerr Porter (Travels in Georgia and Persia, vol. i, p. 706) describes the grapes as growing to a size hardly to be matched in other climates: but these, Mr. Morrier (Journey through Persia) says, are surpassed by those of Casvin. Indeed they everywhere abound in Persia, and their quality is excellent.

† Independent of wine, nearly 8000 tons of raisins, yielding to the revenue £160,000, and undried grapes in sufficient quantity to give a revenue of upwards of £10,000, are annually imported into England.

of lime. After this expressed juice, or *must* as it is termed, has remained at rest for some time, at a temperature of 55° Fahr. the whole becomes moderately warm*, and undergoes decomposition; much carbonic acid gas, in small bubbles, is evolved; an intestine motion is raised, and the soft parts are thrown upwards, and form a thick scum which collects on the surface, and is emphatically called the hat. This intestine action is accompanied by a hissing noise, and a farther increase of temperature; the mixture, which was before sweet, soon loses its saccharine properties, in a great degree, and acquires a vinous taste, a deeper colour than before, and an odour of alcohol; the intestine motion then gradually diminishes, and soon, apparently, ceases altogether; the liquor becomes clear, and, being now wine, it is put into casks. The marc, or insoluble part, is next submitted to pressure; and, as the wine obtained from it has been very imperfectly fermented, when it is added to that in the barrel or the tun, the fermentation is renewed, and is continued for many months in a state of less activity than before; throwing up slowly a scum similar to that already mentioned. This scum at length sinks to the bottom of the vessel, carrying with it a certain quantity of the colouring matter, some bitartrate of potassa and tartrate of lime, forming a crust called Argol; and the wine is fit for use. Such is the progress of the fermentation by which wine is produced: how can the changes be explained on chemical principles?

Besides the principal constituents already noticed, the juice of the grape also contains an azotized vegetable extractive, which, according to Thenard and some other chemists, acts as a leaven, and is the component which sets on foot the fermentative process. This substance attracts a portion of oxygen from the sugar of the must, and, combining with it, is insoluble and precipitates in the form of lees. The affinities of the constituents of the sugar being thus broken, they enter into new combinations; a portion of the oxygen and carbon unite to form carbonic acid, which flies off in a gaseous state; whilst the remainder uniting with the hydrogen and the rest of the carbon, alcohol is produced, (see p. 195).

Wines differ in colour; the red are coloured by the skins of the grapes employed; for the wine is not coloured if the skins of the grape be not fermented in the must. Wines thus manufactured are not sparkling. To procure sparkling wines, the wine is bottled before the fermentation is completed: but, as this proceeds in the bottle, the carbonic acid, from the resistance which it meets with, is redissolved in the wine, and ready to be extricated the moment the cork is drawn. In some

* The temperature sometimes rises to 99° Fahr. the state of the atmosphere influences this greatly: in cold weather the process languishes.

instances, as for example in Champagne, the wine not being naturally sweet enough, some sugar candy is added.

All wines contain within themselves the principles both of improvement and of decay. When new, they are not wholesome; and it is only after the secondary fermentation has been carried on for some time, under due attention, that the wine becomes mellowed and fit for use. Much, however, must depend on the original quality of the vintage.

Wine is frequently adulterated. When the adulterations are colouring matters or admixture with inferior wine, they are at least innocent: but this is not always the case; for when wine turns sour, it is sweetened with oxide of lead*. This is detected by various re-agents:

Water impregnated with sulphuretted hydrogen gas throws down a black precipitate.

Chromate of Potassa, a yellow precipitate.

Gallic Acid, yellowish-white precipitates.

But there may be copper as well as lead; which is, however, easily detected by a brown precipitate being obtained with ferrocyanate of potassa.

Arsenic is sometimes used instead of the oxide of lead; it is detected by saturating with nitrate of silver in excess, which throws down any muriate or sulphate; and then, when the solution has become perfectly clear, touching the surface with a glass rod dipped in ammonia: a yellow precipitate, arsenite of silver, will immediately fall from the point of the rod. To demonstrate that this precipitate arises from arsenious acid, we have only to add ammonia in excess; when, if it be arsenious acid, the precipitate will be dissolved.

In examining the effects of Alcohol as an Excitant on the animal œconomy, I will adopt the same arrangement as in the investigation of its physical and chemical properties; first taking into consideration its effects in its uncombined or pure state, and, afterwards, those which it exerts in a state of combination.

If Alcohol in its pure state be applied to dead animal matter, it acts as an astringent, lessening the bulk of the substance and condensing it; but this effect is due, in a great degree, to its powerful attraction for water, and the augmented density following the abstraction of the water. Owing to this power of increasing the cohesiveness of dead animal matter, the substance upon which Alcohol has acted is undoubtedly less liable to un-

* This practice of using litharge to sweeten sour wines appears to have first attracted attention in 1696, when mention is made of it in an ordinance of the French police.

ergo the decomposition that all dead organized matter rapidly uns into; and on this account strong Alcohol is said to exert n antiseptic power. The same property of attracting water estows on Alcohol the power of coagulating albumen in animal natter; and, in proportion to the insolubility of animal matters, hey become more permanently capable of resisting the impression of other agents. The consideration of this influence f Alcohol, on dead animal matter, induced some to believe that t acts nearly in the same manner on the living body: but this s not the case; for, while vitality continues, no power with which I am acquainted can coagulate the fluids.

When diluted uncombined Alcohol is applied to the living body, the first effect is excitant; it acts upon the nervous nergy, increasing the tone of the part, diminishing the capacity of the blood-vessels, and adding to their power of carrying forward the blood which they contain. This effect is in he direct ratio of the strength of the Alcohol, and the susceptibility of the part to which it is applied; thence, in parts of he body in a state of inflammation, Alcohol, applied as a local xcitant, relieves the state of congestion, or over-distension of he vessels that characterizes that morbid condition. When pplied however to healthy surfaces, particularly to those in which there is much sensibilty, the impression of increased nergy, and the contraction which suddenly takes place and enders the portion of the surface acted upon pale, is of short ontinuance; the vital energy is rapidly exhausted, and inflammation is the consequence. This is not the proper place to nter into an enquiry regarding the theory of inflammation; ut it is impossible to see these effects of the application of concentrated Alcohol to inflamed and to healthy surfaces, without orming in the mind some explanation of the phenomena passing before us.

The exciting property of concentrated Alcohol becomes obious to our senses, by the effect which it produces on the organs f taste and of smelling. When taken into the stomach in large loses, its primary effect is local on the organ itself; it inflames he mucous membrane and soon destroys its vitality; the shock s communicated through the nerves to the brain; and the individual often dies before there is time for absorption to have aken place. The truth of this remark has been demonstrated by the experiments of Mr. Brodie. When he killed animals by injecting Alcohol into the stomach, he always found, on dissection, that the organ displayed marks of severe inflammatory action, and that blood was extravasated between the coats; ut, except a gorged state of the vessels, no preternatural appearances were remarked in the brain; the inference, therefore, that the fatal shock is altogether on the nervous energy, is

strengthened by dissection. But this state is only the result of the admission of Alcohol, in its highest state of concentration, into an organ of extreme susceptibility, although of little sensibility: when it is partially diluted, it acts with less energy, is taken into the circulation, and merely produces that state which is termed intoxication.

It is not easy to explain, very satisfactorily, the condition of the brain under these circumstances; whether it can be regarded as one of activity; or, as in some kinds of delirium, a state of stupor, in which the mind acts as it were independent of the material organ with which it is connected, and ideas succeed one another in certain associations. In examining the effects which follow the introduction of a large quantity of moderately diluted alcohol into the stomach, we find that the first is the local excitement of the viscus, indicated by a sensation of heat in it, an effect the result chiefly of the impression of the alcohol on the gastric nerves, increasing the sensibility of the organ: this impression is next conveyed to the brain, spinal marrow, and entire nervous system; ideas of unusual brilliancy pass through the mind; there is, as it has been beautifully expressed, a soft tumult of the soul; Fancy is awakened, and creates, from uninterrupted associations, new combinations and a world of its own: and it is at this moment, between sobriety and intoxication, that the poet sometimes pours forth his sublimest conceptions and most harmonious strains. As the power of the stimulus however increases, all controul of the will is suspended; the ideas are then irregular; and, instead of being combined in such a manner as to produce even agreeable conceptions, they arise in the most incongruous order; the extent of the excitement of the cerebro-spinal centres becomes apparent in the unusual vivacity of the eye; the swelling of the veins of the neck; and the beating of the carotids: but new symptoms, indicating cephalic congestion, quickly follow; namely, pain in the frontal region; the head drops upon the chest; the eyes lose their expression, and are half closed; the physiognomy is altered and vacant; the voluntary muscles cease to act; the arms are pendent, or their movements are irregular; the legs cross one another in the effort to walk; vertigo supervenes, and delirium follows. The exhausting influence of such a state is too great to continue: in a short time collapse, and sleep resembling that of apoplexy, follow. Under certain states of the habit, this sleep may prove the prelude to death; but, in the majority of instances, Nature adopts this method of restoring the exhausted excitability; yet the individual does not awake in his usual state; his hand is tremulous; his limbs are weak and unsteady; his surface is susceptible of the slightest impressions; his stomach nauseates all kinds of food; his thoughts are gloomy; his temper

irascible; and, if the moral principle be not blunted by the frequent repetition of this vice, his mind is overpowered with the most distressing sense of degradation. By degrees, however, the system recovers its usual condition.

The tumult, which the administration of a large quantity of even diluted alcohol on the living system causes, is thus rendered very obvious; and, as I shall afterwards prove, depends chiefly on the impression of the Excitant on the nervous system, although not wholly independent of absorption. The truth of this position is maintained not only by the fact that intoxication is produced more rapidly and by a much smaller quantity of spirits, when it is taken into the stomach in such a manner that the nerves of the mouth, and those of the tongue and fauces, shall be topically acted upon; but by the fact that a person who is intoxicated becomes often suddenly sober after vomiting.

The Burmese and Siamese become inebriated by sucking Soura through a reed; and even two or three glasses of wine will cause intoxication, if the fluid be sipped and allowed to pass slowly over the tongue. That this is the effect of alcohol on the extremities of the nerves, is well illustrated by the following anecdote. A merchant, who had collected furs on the Mississippi, when Louisiana was yet almost in a state of nature, carried the cargo to Jamaica to sort the furs before transporting them to Europe. He hired a store in Kingston, in the yard of which were several casks placed on end in the sun, and employed as labourers several soldiers of the garrison, to assist in landing his furs, men who had been in the habit of drinking freely of new rum, and were able to sustain, with impunity, very copious libations of ardent spirits; nevertheless these men were drunk every day before noon. On investigating the cause, the merchant discovered that they had broached one of the casks, all of which contained Madeira wine, and that they became intoxicated by sucking the wine through straws.

The stomach and nervous system may resist the deleterious influence of occasional intoxication; but a regular train of intemperance never fails to produce its baneful influence both on the body and the mind. By degrees the mucous membrane of the stomach, suffering under repeated attacks of inflammation, and even the other coats of that viscus, undergo changes of structure, and indurations supervene, which occasionally degenerate into cancer of the pylorus; or, inflammation of the liver, palsy, dropsy, epilepsy, and many other bodily ailments, overpower the vital energy of the habit.

When a fit of severe intoxication is induced, it is not easy to anticipate the result. Mr. Bedingfield, however, has directed attention to one symptom which is likely to aid our prognosis. "If the iris," says he, "retain its contractile power, the patient will generally recover, however overpowered the senses may

be; if, on the contrary, it remain in a state of extreme dilatation when a strong light is directed upon it, only a feeble hope of recovery can be entertained*." The first object, in a case of intoxication, as in every case of poisoning, is to dislodge the offending matter as quickly as possible; and the stomach-pump should be employed in these cases as in other instances of poisoning. Our second object is to obviate the impression made on the nervous system; and, to effect this, nothing answers better than the acetate of ammonia, in doses of ʒii or ʒiv, in a glassful of water, repeated once in ten or fifteen minutes. This seems to exert almost a specific effect upon the habit, and prevents those uncomfortable feelings which invariably accompany the transition from drunkenness to sobriety.

Amongst the diseases which follow a course of intemperance in the use of ardent spirits is *delirium tremens;* a disease involving the whole of the nervous system, accompanied with restlessness, inappetency, confusion of ideas, wildness of look, tremors of the extremities, sometimes extending to the trunk, and delirium. These symptoms can be invariably referred to habitual intoxication: for the excitement which alcohol impresses on the stomach is communicated to the nervous centres; the renewed irritations of the brain exhaust its powers; and the organ of intellect being no longer in a healthy state, the mind itself suffers; the memory and the judgment become enfeebled; and, as during every debauch there is a temporary aberration of intellect, the frequency of these, when a disposition to insanity exists, at length shakes Reason from her seat for ever. It may be said that some men have lived to a good old age who have been habitual drunkards: this is true, but it is an exception to a rule†.

With respect to the influence of alcohol on the nervous system in producing these effects, there can be no doubt. The first impression made upon the nerves of the stomach is communicated to the cerebro-spinal centres, and simultaneously from them to the whole system: but this sympathetic action is soon augmented by the absorption of the alcohol and its immediate application to the organs themselves. According to the experiments of M. Ségalas, diluted alcohol injected into the veins or the bronchial tubes, or applied upon serous membranes, produces intoxication as rapidly as when it is taken into the sto-

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* Bedingfield on Medical Practice.

† This resisting power of some constitutions is well illustrated by the Poet of the Seasons:

> "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."

mach; and this effect is retarded or accelerated by circumstances that retard or quicken absorption*. Even the muscular tissue becomes impregnated with alcohol in habitual drunkards: and if the relations of spontaneous combustion which have been published are authentic, they are probably owing to the manner in which this fluid pervades every texture of the body†. Those individuals who have thus perished, emit at every point a strong odour of alcohol; and all of them have indulged in the immoderate use of ardent spirits: the vital powers of the system have been thus greatly lowered, which, in conjunction with the natural debility of age, for they have all been advanced in years, may produce some pathological state which favours the phenomenon, although we are ignorant of its nature.

If the abuse of alcohol produce such melancholy results, the medicinal employment, and the moderate use of it, under certain circumstances, are of great benefit to the human race. Temperately taken, diluted alcohol operates as a wholesome stimulant; rousing the action of the heart and arteries, diffusing an agreeable increase of temperature over the body, assisting the powers of the stomach, promoting the various secretions, and exalting the nervous energy. It may be reasonably asked, however, of what benefit is even the temperate use of ardent spirits to a healthful individual, who requires no additional excitement either of his mental or corporeal energies? To this question no satisfactory reply can be offered: and, notwithstanding the universal propensity of the human species for intoxication, and the ingenuity exercised in obtaining means to effect it, yet ardent spirits can be justly regarded in no other point of view than as either a medicine or a poison.

As a medicinal agent, alcohol is a most powerful and universal Excitant. Although its action is followed by sedative and narcotic effects, yet its exciting influence is too great to permit us to employ it as a narcotic. Diluted alcohol can be used only in those fevers, and in those periods of fever, which indicate much depression of the powers of life: even in the lowest fevers, the dilution must be very considerable: one part of ardent spirits to four or five parts of water, sweetened with sugar and acidulated with lemon-juice, form an excellent substitute for wine; nevertheless, it is more heating and less tonic than the fermented juice of the grape.

Alcohol, however, although so powerfully exciting, yet, when properly diluted, may be employed, under certain circumstances, in the phlegmasiæ, if no vital organ be affected. In passive

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* Revue Med. tome ix, p. 476.

† Breschet, on opening the bodies of criminals shortly after their execution, observed that, in those addicted to drinking spirits, a strong odour of eau de vie exhale from every part: and Dr. Marc has recorded the case of a shepherd, addicted to the same vice, who, during his last illness, eructed inflammable gas which smelt strongly of alcohol.

hæmorrhages, the use of diluted alcohol has been sometimes advised: if it can prove in any way useful in these cases, we must look for the cause of the benefit in the exciting property of the alcohol, which enables it to apply those curative powers that, without adopting the wild doctrines of a *vis medicatrix naturæ*," tend to restore every diseased state of the functions to the natural condition, or that of health.

In all chronic diseases, which are generally those of debility, alcohol, properly diluted, may be administered. It is very commonly employed, in dyspepsia, for removing the supposed debility of the stomach; and for this purpose is given in conjunction with bitters, aromatics, and tonics in the form of tinctures: but much caution and great judgment are required for prescribing it in these cases. In dyspepsia, too, little attention is given to ascertain the real state of the stomach and other digestive organs: debility is often inferred when the symptoms proceed from subacute inflammation; in which state there can be one opinion only with respect to the impropriety of prescribing Excitants under any form. When dyspepsia is accompanied with vomitings, colic, or hiccough, depending on some morbid action of the brain and the spinal marrow, then the powerfully inciting influence on the stomach may prove beneficial, by inducing, as it were, a revulsion, and breaking, in a short time, the morbid train of diseased action present in the stomach, the intestines, or the diaphragm. A singular therapeutical effect of the internal use of alcohol may be here noticed. The natives of the Friendly Islands, when Captain Cook first visited them, manufactured an intoxicating beverage from the root of the Kava plant, which they chewed and mixed with water. Although it is extremely intoxicating, and so destructive to health, that on the second visit of Captain Cook, he saw many of the natives reduced to mere living skeletons from its use, yet, we are told that it is a remedy for syphilis; a disease which the intercourse with Europeans has entailed on these Islanders. When first taken as a remedy, a scaly eruption breaks out over the skin; by degrees the scales fall off in the order of their formation, leaving the cuticle smooth and clear, and the system free from disease: at least, such is the account given by a gentleman who visited these islands some years since*.

As an external application, alcohol is an admirable Excitant; gently constringing the vessels and communicating a new stimulus to inflamed surfaces. Thus, it forms an excellent lotion, when moderately diluted, in erysipelas, in erythema, in burns and in scalds while the cuticle is yet entire, and in sprains and recent bruises. In these cases, it allays pain, affords by its

* Literary Gazette, 1821.

evaporation a sensation of cooling to the inflamed surface, and stimulates gently the overloaded vessels to carry forward the blood with which they are oppressed.

Wine not being a simple substance, but containing alcohol, acids, bitartrate of potassa, tannin, and colouring matter, it cannot, when taken into the stomach, be regarded in the same point of view as simple alcohol diluted with a large proportion of water; something must therefore be referred to the chemical properties as well as to the stimulant operation of these substances. If the wine contain much acid, and particularly if this be malic acid, the tendency to decomposition, in the temperature of the human stomach, and to increase the acescency in the other contents of the viscus, when the vital action is languid, are well known; and consequently we might conclude that wine, instead of promoting, tends to disturb the powers of digestion in the dyspeptic. It is a curious fact, also, that these disadvantages are augmented when the wine contains uncombined brandy. Some explanation of this may be obtained from the fact, that the addition of a certain portion of free alcohol, instead of checking fermentation, favours it. When the alcohol is intimately combined with the other ingredients of the wine, and the acid is the tartaric, at least when the malic and acetic acids do not abound, then, instead of interrupting digestion, the moderate use of wine tends to promote it by stimulating moderately the nerves and the muscular coat of the stomach, thus promoting the proper secretion of gastric juice as far as regards both its quantity and quality. This wholesome stimulus will, nevertheless, vary in proportion to the nature of the aromatic principles contained in the wine, even when the alcohol is, as it were, disarmed of any deleterious properties by its intimate combination. The nature of this combination, into which alcohol enters, influences also the effect of wine in causing intoxication; for, if we take the same quantity of brandy or alcohol contained in a given quantity of wine, and merely mix it with water, it will sooner and more effectually produce intoxication than when it is taken in the shape of wine. This, however, does not arise from the mere presence of the other ingredients; for alcohol, mixed with these in the same proportions as they are found in wine, is equally deleterious and inebriating. It is, therefore, evident that the dietetical properties of wine depend greatly on its nature and quality.

Something is due, in reference to its effects, to the time at which wine is usually drunk. Custom has consecrated to this purpose the time immediately after our principal meal, in this country; but, if we reflect that the stomach is then loaded with food, that the process of chymification is a natural one, and is likely to be rendered imperfect, either by any thing which can interrupt the series of changes which it is intended to produce, or by altering the affinities of the components, or by overstimu-

lating and consequently hurrying the secretion of the gastric fluid, we can scarcely imagine a worse-selected time for drinking wine than after dinner or after supper. It is true that this custom has been followed from time immemorial; and neither the moralist nor the physician is likely to have influence sufficient to alter it: but, if the physician cannot interfere with the habits of the healthy, he can at least warn the invalid of his danger, and point out to him the proper time of taking wine when this is necessary for promoting the powers of digestion*. Now, if our object be to excite the stomach, so as to enable it to secrete a better description of gastric juice, it is certainly more rational to effect this before the stomach is called on for the performance of its digestive functions than at the moment when it is in the actual execution of the function for which the improved secretion is intended. In a dietetical point of view, therefore, wine should be taken before dinner, or at some period of the day when chymification is not in its progress; but the number of cases of dyspepsia depending on mere want of tone in the stomach are few; and it is in such cases only that wine or alcohol, in any form, can be properly prescribed. In dyspepsia, in general, there is a morbid determination of blood to the mucous coat of the stomach and the intestinal canal: this is marked by heartburn, irregularity of appetite, nausea, depression of spirits, dreaming, weight and pain in the head, vertigo, and uneasiness, if not pain, in the stomach itself. At such a time, the effect of the administration of wine is likely to be subacute inflammation of the stomach and intestines; if gout, erysipelas, anasarca, or some other disease, do not supervene as a salutary process to relieve the digestive organs: but custom is too powerful an opponent of the doctor; and, therefore, the physician can only direct the choice of that wine which is least likely to interfere with the healthy functions of the system. There are four distinct descriptions of wines dietetically employed in this country: *sweet* wine; *brisk* and *sparkling*, *light* and *subacid* wines; and *dry strong* wines.

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* Although excessive drinking is more prevalent among barbarous than civilized nations, yet the most refined, both of ancient and of modern times, have not been free from this vice. This was the case in Greece and Rome; and, towards the decline of the Roman Commonwealth, even the ladies drank to excess. The quantity taken by the men was quite incredible: Novellus Torquatus received from Tiberius the title of *Tricongius*, because he could quaff three gallons of wine at a draught; and it is stated that the emperor Maximin could drink six gallons of wine without feeling its effects. Strabo informs us that the Lusitanians sometimes exhausted a whole vintage at one feast; and Charles the Great published an edict obliging the Judges on the bench and the pleaders at the bar to remain sober: indeed, the feasts of the Gauls ended generally in conflicts, and frequently in bloodshed. With regard to our own country, when we observe the daily abuse of spirits by the lower classes in the present day, it is melancholy to compare this statement with the following account of our countrymen in the beginning of the seventeenth century:—

"In general the greater and better part of the English hold all excess blameworthy, and drunkennesse a reproachfull sin."—Fynes Moryson's Itinerary, part iii, p. 152.

The *sweet* wines in occasional use in England are *Mountain*, *Malmsey-Maderia*, *Constantia*, *Tent*, *Lisbon*, *Frontignac*, *Tokay*, and some others. All these wines are exceedingly apt to disorder the stomach, owing to their imperfect fermentation. They do not intoxicate so freely as some other wines; and, as the ancients used them in preference to the other wines*, and diluted them with hot water, it is probable that their powers of drinking large quantities of wine with impunity depended, in a great degree, on this choice of their wine. When new, the sweet wines are very apt to disorder the stomach; in their more perfect state, they may serve as agreeable and useful cordials; but as in every condition they promote acidity, they should be drunk only in very limited quantity.

The *brisk* and *sparkling* wines are the produce of Champagne chiefly; but, of late years, a brisk wine has also been manufactured in Burgundy. These wines seem to affect the nervous system very rapidly, and intoxicate sooner than dry wines which contain a much larger proportion of alcohol. This may depend on the alcohol combining intimately with the carbonic acid which they contain and rising with this gas: the alcohol of the wine is thus more directly applied to the extremities of the nerves of the stomach, in a form peculiarly well calculated to make a powerful impression upon them. But, if these wines intoxicate more rapidly than other wines, their effect is more transitory; they pass off rapidly by the kidneys, the recovery from inebriation from their use is quicker, and the subsequent exhaustion less, than from other wines; thence a fair inference may be drawn, that, in this respect, they are undoubtedly more wholesome. In some hypochondriacal diseases, and what are termed nervous affections, they may be drunk in moderation; and few opinions are more fallacious than that which regards them as injurious to gouty habits. Something, however, must be attributed to the nature of the wines, in deciding on their wholesomeness. When they effervesce greatly, it is a proof that they are either too new, or that they contain substances, such as sugar-candy and cream of Tartar, introduced expressly to promote their briskness. Indeed, the still wines of Champagne, or those that effervesce only moderately, are always to be preferred.

The *light* wines of the Rhine and of the Bordelais are certainly much less likely to influence, injuriously, the nervous system than any others. They are less intoxicating, and generally possess diuretic properties. Those of the Rhine also, although acidulous to the taste, are less likely to ferment on the stomach

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* In the Grecian feasts a portion of sweet wine was presented to the guests in the middle of the repast by a female attendant, generally selected for her beauty, who bore it in a rich silver vessel of a peculiar fashion, from which each guest drunk in his turn.

than stronger wines; both because the acid which they contain is the tartaric, and also because their alcohol is more intimately combined with the other principles of the wine. Those of the Bordelais possess less aroma and spirit than even the Rhine wines: but either kind is certainly the safest for daily use. The anathema often pronounced against them as productive of gout is unjust: sound Hock and Claret, when good, may be drunk with as much impunity by the gouty patient as Madeira.

The *strong* wines, such as *Port*, *Sherry*, *Madeira*, and the spirituous and highly aromatic wines of Burgundy, are the least wholesome, although the most generally drunk in Great Britain. Much of the potency of Port and Sherry* arises from uncombined brandy, which is mixed with them previously to their exportation. The large quantity of tannin and gallic acid which they contain renders them hurtful as a daily beverage: they, also, intoxicate much sooner than the light wines; and, from the nature and quantity of their volatile oil, they affect the brain in the same manner as narcotics; not exhilarating and enlivening the fancy, except in the very outset of their influence, but producing a sluggish state of the system and an evident tendency to apoplexy. The light wines of Burgundy and some of the wines of Spain and Portugal are free from these injurious properties; but they are, nevertheless, more pernicious in their effects than the wines of France and the Rhine.

These observations apply equally to ale, porter, cider, and mead. In the ale and porter the saccharine matter furnishes vigour to the system, by the bitter of the hops aiding its digestion: but their daily use disposes to plethora, and produces a tendency to apoplexy. Cider and mead act on the stomach like the lighter wines.

With regard to the therapeutical use of wine, man seems very early to have viewed it as a medicinal cordial: thence we find some references to its employment in disease in the history of almost every people. The Pramnian wine of the Greeks was a medicinal wine, on which account it was sometimes named *Pharmacites*†. The Chian wine was also prescribed as a reviving cordial by the physician. Among the Roman wines, that of

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* Sack, immortalized by Shakspeare, was a sweet variety of Sherry, and was formerly the favourite wine in England—

"—— Sack says my bush;
Be merry and drink Sherry; that's my posie."—*New Inn. Act* 2.

† The Pramnian formed the cordial in the draught administered by Hecamede to Machaon, when he received his wound.

"—————— the nymph of form divine
Pours a large portion of the Pramnian wine;
With goat's-milk cheese a flavorous taste bestows,
And last with flour the smiling surface strews;
This for the wounded prince the dame prepares."
Pope's Homer, ii, xi, 780.

Cæcuban was noted for its restorative virtues*. The *Surrentine* and the *Massic* were also medically recommended. The *Faustian* was of so spirituous a nature that it would burn with a pure and bright flame. The *Falernian*, so celebrated by Horace, is known by reputation to every one who has had the happiness of a liberal education: it was strong and rough, and could not be drunk until it was ten years old: even then it was necessary to dilute it with a weaker wine. It was also medicinally used; but, according to the advice of Galen, not before it was twenty years old; after which time it became bitter and nauseous. Dr. Henderson† is of opinion that it resembled our sherry. The *Signinum*, which was rough and astringent, was also chiefly used as a medicine.

In continued fevers, wine is often the only remedy upon which we can with confidence rely; but where there is much irritability present, all violent diffusible and transient Excitants are hurtful, as their first effects are followed by a correspondent debility; and much injury was formerly done by the inconsiderate use of such agents. Wine, however, under proper management, is well adapted for the advanced stages of continued fever. Its exciting powers are of primary importance, and it is agreeable to the palates of most patients. Various circumstances, however, are necessary to be attended to in its administration.

1. The habits of the patient must be known. If, during health, he has been in the daily use of wine, it will be more necessary, proper, and safe, than if his habits were abstemious.

2. Its use in continued fever is indicated by the advanced stage of the disease, by a frequent, small, and compressible pulse, symptomatic of great debility; by low muttering delirium, and by that twitching of the limbs which is known by the term subsultus tendinum.

3. The appetite, and desire for it, must also be attended to. In continued fever, reason is often suspended, and instinct seems again to resume its sway; if the patient has, therefore, a strong instinctive desire for wine, it seldom happens that the indulgence of this is improper. Sir John Pringle pointed out strongly the necessity of attending to this desire: "when the low state of the fever," says he, "was present, the sick had frequent cravings for cordials and wine; they drank the wine greedily; but, when they were in a state in which the use of cordials was questionable, they were careless about the wine."

4. The effect of the wine must be watched. If it do not disorder the functions of the stomach, nor increase the heat of

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* Capaciores affer huc, puer, scyphos,
Et Chia vina aut Lesbia;
Vel, quod fluentum nauseam coërceat,
Metire nobis Cœcubum.

† History of Ancient and Modern Wines, p. 91.

the surface, but fill the pulse and lessen its frequency, mitigate delirium, and remove restlessness, then we may conclude that it is not only proper, but absolutely requisite.

5. When the disease arises from contagion, when the pulse is languid, and the spirits are oppressed; and when there is no phlogistic diathesis, wine may be given in any stage, even in the earliest, of continued fever. The quantity must be determined by the judgment of the practitioner. A bottle of Rhenish or of Claret may sometimes be taken even by females unaccustomed to wine; but two bottles of the strongest wines have been administered with advantage. The powers of the healthy body to bear wine are no criterion of what may be borne in typhus fever. It should be given in small quantities and frequently repeated; and when advantage is obtained from its employment, it must not be rapidly withdrawn, but gradually diminished as the febrile symptoms abate and the system becomes more susceptible of its impression.

6. With regard to the kinds of wine, Claret and the Rhenish are more proper than the stronger wines in the earlier stages of fever; and the stronger, such as Port and Sherry, in the later or sinking stages. The lighter wines tend rather to open than to confine the bowels; the stronger, to check diarrhœa.

7. The form of administering the wine will greatly depend on the state of the stomach, and on the taste and inclination of the patient. If a dislike be taken to the wine, it should be warmed, sweetened with sugar, and slightly acidulated; and the lips of the patient moistened with it: by this plan he rarely fails, in a short time, to relish it, and to take the quantity that is necessary. In general, it is prudent to dilute wine, especially in the earlier stages of fever; and to many febrile patients it is most grateful when diluted with cold water. It is also very much so when given in the form of negus and of whey. In cases of obstinate intermittent fever, which have worn down the strength of the patient, wine is useful, as it tends to reestablish the healthy action of the nutritive functions and to improve the vigour of all the organic tissues. Wine proves hurtful in neuralgic and rheumatic affections.

Upon the whole, we may say of wine, as of every thing else, it is a medicine or a poison, according to the discretion and moderation with which it is used, and the skill and judgment which direct its medicinal employment.

g. SULPHURIC ETHER.
L. E. D.

Sulphuric Ether is prepared by distilling equal parts, by weight, of Sulphuric Acid and Alcohol in a sand bath previously heated to 200°, and carrying on the distillation until a

white fume begins to appear in the retort; at which time Sulphurous Acid is disengaged and oil of wine generated. On adding more alcohol to what remains in the retort, and continuing the distillation, an additional quantity of Ether is obtained. The distillation should be commenced immediately after mixing the acid and the spirit. Such is the general outline of the process for procuring Sulphuric Ether; but as, in this state, the product, besides pure Ether, contains also some alcohol which passes over before the mixture boils, a small portion of water, and sulphurous acid, potassa fusa or dried chloride of lime is added: these unite with the water and sulphurous acid; and, by a second distillation, pure Ether, the *Æther rectificatus* of the Pharmacopœias, is procured. Pure Sulphuric Ether is perhaps the most volatile and inflammable substance in nature. Under the common temperature of the atmosphere it is converted into vapour, and in assuming this form produces great cold. Its specific gravity, as it is usually procured, is 0.730: but in its purest state it does not exceed 0.632. It is colourless, has an agreeable odour, and a hot, pungent taste. Ether of the specific gravity of 0.730 boils at 98°, under the usual pressure of the atmosphere: but in the vacuum of an air pump, it boils at a temperature under the freezing point; and the vapour into which it is converted, has more than double the specific gravity of atmospherical air, being to air as 2.586 to 1.000. This vapour, when approached by any incandescent body, inflames; and, when united with oxygen, it explodes violently, forming water and carbonic acid. Ether, exposed to light in a vessel partially filled, absorbs oxygen, and acetic acid is formed. Water, when agitated with pure Ether, takes up one fourteenth only of its weight: but Ether unites with alcohol in all proportions. It has no action on the earths which are medicinally employed, nor on the fixed alkalies; but it combines in all proportions with pure ammonia. It dissolves corrosive sublimate, and may be employed for detecting small quantities of this salt in aqueous solutions: the Ether is agitated with the fluid, and, after being left at rest, is decanted off and evaporated; if any sublimate be present, it will be left in the form of a white powder. Ether dissolves the fixed and the volatile oils, resins, bitumens, the white of egg, and the active principles of many plants*.

In order to understand the rationale of the production of *Ether*, we must recollect that alcohol consists of 2 prop. of Carbon, 1 of Oxygen, and 3 of Hydrogen. Now the process of the formation of Ether seems to depend on a change being effected by the acid on the alcohol, and, after that is over, a

* One useful quality is due to Ether from its volatility: if a few drops be put into a damp phial, it quickly evaporates and leaves the phial completely dry.

change on the acid itself. Thus the alcohol is divided into two parts; the first passes into the state of Ether by losing one half of its Oxygen and one sixth of its Hydrogen, and the new combination of its altered proportions of ultimate components produces the Ether. The changes which the acid undergoes are not yet well understood. According to this theory, Ether differs from alcohol merely in the difference of the proportions of the ultimate constituents. This is rendered evident by comparing the proportions of the constituents of the two bodies.

	Alcohol, two atoms.	Ether, one atom.
Carbon . .	4 prop. = 24	4 prop. = 24
Hydrogen .	6 —— = 6	5 —— = 5
Oxygen . .	2 —— = 16	1 —— = 8
	Equiv. 46	Equiv. 37

Abstract 1 of Hydrogen = 1
1 — Oxygen, = 8—9

Ether = 37 is left.

According to the theory of M. Dabit*, the surplus Hydrogen and Oxygen lost by the two parts of alcohol may be thus accounted for: the 1 prop. of Hydrogen causes the sulphuric acid to pass into the state of sulphuretted hydrogen; whilst the 1 prop. of Oxygen unites with the second portion of the Alcohol, and constitutes a new vegetable matter; the elements of which, reacting on the sulphuretted hydrogen, decompose it, and form sulphurous acid gas, carbonic acid gas, oil of wine, carbonated hydrogen gas, and the carbon which is deposited and forms the black residue in the retort†. But a simpler mode of comprehending the theory of the formation of Ether is to consider the composition of Alcohol and of Ether in reference to the proportions of water and of olefiant gas which each contains. Thus, if we admit that Ether consists of two equivalents of olefiant gas and one equivalent of aqueous vapour, and that Alcohol consists of one equivalent of each, we can easily imagine that, by abstracting one equivalent of water from two equivalents of Alcohol, the result will be Ether; and this the action of the sulphuric acid on the Alcohol is well calculated to produce, owing to its powerful affinity for water.

The purity of Ether is best determined by its specific gravity; but it is also determined by other means. Thus, if it redden litmus, or precipitate the muriate of baryta, it contains

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* Ann. de Chimie. t. xxxiv, p. 289; and t. xliii, p. 101.

† The formation of a new acid in the production of Ether was discovered by M. Dabit of Nantes in 1800: he named it Sulpho-vinic Acid. Vogel and Gay Lussac suppose it to be a compound of hyposulphuric acid and a vegetable matter.

sulphuric acid: if it produce a milky solution with phosphorus, it contains Alcohol.

As a medicinal agent, Ether operates as an Excitant on the animal œconomy. When it is taken in large doses, it acts powerfully on the nervous system, causes vomiting and diarrhœa, increases the force of the heart and arteries, and produces temporary intoxication. Like other diffusible Excitants, its effects are rapidly propagated over the system, and soon dissipated. Its exciting influence is probably augmented by its volatility, as it distends the stomach and bowels, and is thus applied to every portion of the sensitive surface. It is also probable that it is absorbed in its state of vapour, and is, consequently, directly applied to the nervous centres.

The diffusible nature of the stimulus of Ether renders it well adapted for producing sudden excitement; but as its effects soon disappear, the dose requires to be frequently repeated.

Ether has been used both as an external and an internal remedy. Externally, it acts as a counterirritant; thence it relieves toothache when applied to the jaw and retained on it with the hand. In the same manner it eases earache, not caused by local diseases of the internal ear; and it is very beneficial in all rheumatic pains. Internally administered, Ether, in doses of twenty drops or more, in a glass of cold water, stimulates the gastric nerves, checks the vomiting which often occurs in dyspeptic affections, and aids the digestive powers of the stomach. When given in smaller doses, frequently repeated, its influence is decidedly cordial. In fevers of a malignant kind, it is useful in allaying twitchings of the tendons, hiccough, and other symptoms dependent on the morbid state of the nervous system. It is beneficially prescribed on the approach of the accession of the paroxysm in intermittents; and it often succeeds in preventing the attack; or, if it do not at first effect so much, the return of the paroxysm is marked by slight fever only, without any rigor; and this gradually disappears by continuing the use of the remedy.

M. Bourdier has employed Ether as a vermifuge. He gives a drachm of it in a glassful of cold decoction of the male fern: soon afterwards, two drachms, in a sufficient quantity of the same decoction, are administered as an enema, so as to fill the whole intestinal canal with vapour of Ether; and, in another hour, two ounces of castor oil are swallowed by the patient. The worms are thus first destroyed and afterwards expelled. Ether may be administered either pure, on water, or it may be combined with the volatile oils or with resinous substances. The medium dose of Ether is f℥i; and it is seldom given in larger doses, the repetition of the dose being more useful than its extent.

The only officinal combinations of Ether which operate as simple Excitants are the *Spirit of Sulphuric Ether* and the *Aromatic Spirit of Ether*. The former is composed of one part of Ether combined with two parts of alcohol: it is a limpid, volatile liquid; and, like Ether, it excites the living system, acting powerfully on the nervous system as well as being absorbed. It is extremely useful, in low febrile complaints, in allaying nausea and vomiting and diminishing thirst, which it accomplishes by stimulating the salivary glands. The Aromatic Spirit of Ether, in addition to the Spirit of Sulphuric Ether, contains the volatile oils of cinnamon and of cardamoms, long pepper, and ginger. It is used as an Excitant instead of the pure Ether, and answers every purpose for which that medicine is prescribed.

INORGANIC SUBSTANCES WHICH OPERATE AS EXCITANTS.

The first of the medicinal agents of this division of Excitants is one of great power—namely, Electricity.

ELECTRICITY is a material agent, which, like caloric, is diffused over the whole of nature; the earth and every body with which we are acquainted containing a certain quantity of it. As long as they contain what may be termed their natural share, *Electricity*, like insensible caloric, remains dormant in them, producing no sensible effect; but it can be abstracted from one body and communicated to another in a degree much beyond their natural share. In bodies charged with it, remarkable effects arise; and the bodies are said to be electrified. Those bodies, also, which are thus overloaded, as it were, with the electric fluid, and those, also, that have been exhausted of it to furnish this charge, are both said to be *insulated*, when the condition of the surrounding bodies prevent either from altering their state. In this respect, the laws which regulate the motions of the electric fluid differ from the laws that regulate those of caloric. It has, nevertheless, been supposed that Electricity is a modification of the material agent which produces the phenomena of heat and light: it is unnecessary to enquire into the probability of this hypothesis. Bodies which are charged with electricity, or electrified, being in a state fitted to impart a portion of what they possess to other bodies, attract light bodies, which receive a portion of their load, and are then immediately repelled. Thus, if a piece of amber, a glass tube, or a stick of sealing wax be rubbed with fur, or silk, or flannel, a feather will be attracted by it; and, upon contact, it will immediately again fly from it to discharge its now redundant electricity on

the nearest conductor*. But if, instead of a glass tube, a metallic tube be used, no such phenomenon takes place.

All bodies, in reference to their electrical relations, are regarded as conductors or non-conductors. By this term, *conductor*, is meant bodies which are easily traversed by the electric fluid, as is the case with all metals, plumbago, charcoal, water, plants, the animal body, and animal fluids; whilst substances which are not so readily traversed by it, but on which it can be accumulated, such as *glass*, *sealing wax*, *sulphur*, *baked wood*, *dried animal substances*, *resins*, *oil*, and *air*, are *non-conductors*. The best conductors of electricity, among the metals, are silver and copper; the worst is lead†. Moisture is an admirable conductor; thence, in moist weather, electrical experiments rarely succeed, because the moisture prevents the accumulation of the fluid in *non-conductors*, which are rendered *conductors* by its presence. Thus, a green twig is a conductor, a dry or baked twig a non-conductor; moist silk is a conductor, dry silk a non-conductor. There are no perfect non-conductors.

Electricity may be accumulated on any body which is surrounded with non-conductors: it is then said to be isolated; and it is on this account that persons in whom we wish to accumulate electricity are placed upon stools with glass feet, glass being a non-conductor. This isolation will be as complete, if, instead of glass, the supporting body be silk, or a cake of sulphur, or resin, or sealing wax, or bees' wax.

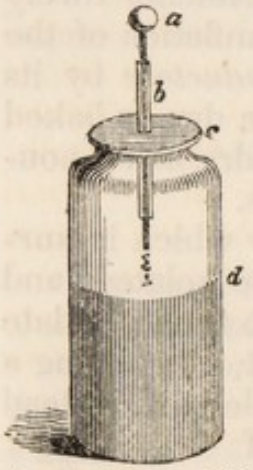
When glass rod, *a*, is rubbed by silk, and approached to two small pith balls, suspended each by a silk thread, *b*, these repel one another: but if the excited rod be approached to one ball, and the silk with which it is rubbed to the other, then, instead of repelling, the balls will attract each other. These two opposite powers have been termed *vitreous*‡ or *positive*§, and *resinous*‡ or *negative*§. Electricities which are of the same name, repel; those of contrary names attract each other: in either case, the force varies in the inverse ratio of the square of the distance. When a body is charged, the electrical fluid is confined solely to its surface: but its distribution is never equable, except when the body is a sphere.

Electricity is most readily excited in bodies by friction. When two substances, which are non-conductors, are rubbed together, the electrical matter cannot be diffused; but, if another substance which is a conductor be presented to them, the elec-

* The term electricity originated in the observation of this fact by Thales of Miletus; the name of Amber in Greek being ἤλεκτρον.

† Phil. Trans. 1827, part i, p. 21. ‡ Dufay's terms. § Franklin's terms.

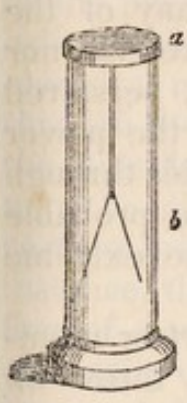
trical matter is abstracted from them and diffused over this conductor. On these principles the electrical machine is constructed. The electricity evolved by it is derived from the earth; thence the necessity of maintaining a communication between the rubber of the machine and the earth by means of a metallic chain: through this the electricity which is given to the glass by the rubber is supplied from the earth*. It is necessary always, before using an electrical machine, to make it perfectly clean and dry, for which purpose it should be placed before the fire and rubbed carefully with silk or flannel. There are many other modes of exciting electricity; but it is unnecessary to describe them here.



The most common and most useful instrument for accumulating electricity is the Leyden phial or jar†. If the electrical machine be turned, and the knob, *a*, of the jar be held near to the prime conductor, the electrical matter collected from the earth passes into the jar, and is accumulated on the coated surface of its inside; and, as no communication exists between its inside and the outside, the charge will remain there for a considerable time: but, if a connection between the two coated sides be established, by means of any conducting substance, the electricity will immediately pass from the inside, that on which the electricity of the conductor has been accumulated, to the outside which is oppositely charged; or, in other words, from that side which is electrified *positively*, to the other side, that which is electrified *negatively*, and both will be brought to an equilibrium, or return to their natural state. The passage of the fluid in this case is rendered obvious by a brilliant spark and a sharp snapping sound. No quantity of matter, provided it be of a nature capable of favouring the current of the electrical fluid, can obstruct this passage, and the time occupied is not perceptible. Thus, if a person holding the end of a chain connected with the outside of a Leyden jar join hands with another, and this with a third, and so for a thousand, and the last in the circle thus formed touch the knob communicating with the inside of the jar, it will be discharged, and the passage of the electrical matter be sensibly felt by all the persons at the same instant. The extent to which this may proceed remains undetermined; but it has been ascertained, by actual experiment, that the charge of a Leyden jar

* The following amalgam is usually applied on the rubber: Tin, one part; Zinc, two parts; Mercury, six parts.

† Named from having been first used at Leyden. It consists of, *d*, a glass jar, coated with tin foil on both sides to a certain height, leaving a space uncovered: a metallic rod, terminated by a knob, *a*, descends through a glass tube, *b*, fixed in the cover, *c*, of the jar, and touches its bottom, which is coated.



has passed through a space of 1300 feet in a space of time too small to be appreciated. If, instead of the Leyden jar, a living being be placed on a stool with glass feet, and hold a chain communicating with the prime conductor, electrical matter will be accumulated on his body, and sparks may be drawn from him in the same manner as from the prime conductor. The fact of electricity being thus accumulated in the person isolated is also proved by the gold leaf, electrometer *a*, diverging, as at *b*, when his hand is held over it.

On this, the very threshold of our enquiry, the question arises, what is the cause of these phenomena? One reply only can be given: "Electricity is matter regulated by certain laws." Experience has taught us this, and also that the material cause of electrical phenomena is spontaneously excited by evaporation, by fusion, heat, and cold, and is also generated in some animals. This is strikingly illustrated in the torpedo, and the electrical eel, both of which have an apparatus, forming part of their living system, by which they possess the power of giving a shock, through the medium of the water in which they swim, sufficient to affect other fishes and animals that come near them: and this is a voluntary function.

The influence of electricity on the animal frame varies according to its mode of application. It may be applied in five different ways.

1. If an individual, placed on an isolated stool*, hold a chain passing from the prime conductor of an electrical machine, the electricity excited by the working of the machine passes into his body, and is prevented from passing out of it by the isolation of the stool on which he stands or sits. The electrical fluid is therefore accumulated in him; and his body will attract light substances, such as feathers and pieces of paper. This is called the *electrical bath*. Electricity, thus accumulated, increases the action of the heart and arteries, both in force and velocity: and that this does not depend on any mental feeling, is obvious from the fact, that electricity may be applied to animals asleep, and in them the pulse is quickened. The temperature of the body is also augmented, and perspiration excited—circumstances, however, not depending upon the heating power of electricity, but upon the increased velocity of the circulation†. A clergyman,

* A stool or a chair supported upon glass feet; or suspended by silken cords.

† The loss of weight by the perspiration induced by this means is greater than in ordinary perspiration. The Abbé Noillé electrified a cat for four hours, and found that it lost from fifty-eight to sixty-six grains. Plants transpire profusely when they are electrified. "J'ai vu," says De Candolle (Physiologie Végétale, tome iii, p. 1094), des plantes perdre en quelques heures d'electrisation une quantité supérieure du quart ou du tiers à celle d'une plante non electrisée."

in whom I could never produce perspiration by any of the ordinary diaphoretics, and who never perspired by exercise, nor the heat of summer, when isolated and electrified, perspired freely. This effect on the skin has been ascribed to the power which electricity possesses of increasing the flow of fluids through capillary syphons; but, in the living body, it is more probable that it depends on the excitement extending to the extreme vessels.

2. The next method is to present the affected part or member to the prime conductor of the machine, and thus throw on it a succession of sparks; or the patient, placed in a chair, not isolated, may be thus electrified by means of a director*, connected with the prime conductor by a chain. As soon as the knob is brought within an inch, or even two inches, of the body of the person, a *spark* will be perceived: a sensation of pungency, also, is felt on the part, accompanied with slight muscular contractions; and, if the application be continued for some minutes, redness and inflammation are produced. This is more or less powerful, according to the distance at which the knob is held from the body; and the sparks are greatly diminished in size, if the part be covered with a non-conductor, as, for instance, a piece of flannel.

3. The patient placed on an isolating stool, and connected with the prime conductor by means of a chain, may have sparks drawn from the affected part, by presenting to it an unisolated director. This method conjoins the *bath* with the influence of the spark.

4. Another method of electrification is the *aura.* When this is to be employed, the person who is to be electrified must be placed on the isolated stool; but, instead of holding the chain from the prime conductor, the electrical fluid is to be applied by connecting a pointed director, or one armed with a wooden point, with the prime conductor of the electrical machine, and holding it about an inch or two inches from that part of the body intended to be electrified while the machine is worked. A titillating sensation, resembling that caused by a stream of air, is felt upon the part; and, if the application be continued, both the irritability and the sensibility of the part are augmented. This mode is chiefly applicable to delicate organs, namely, the eye or ear, and excoriated and ulcerated surfaces.

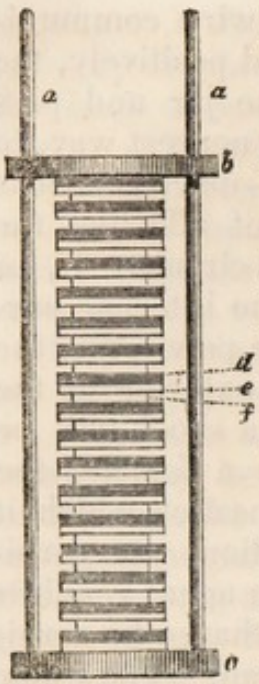
5. The *shock* is the fifth mode of electrifying. The body is made a part of the electric circuit through which the electric matter is to pass from one side of a Leyden jar to another. Thus, if a charged jar be held in one hand, and the other hand

* A brass rod, about a foot in length, terminated at one end by a ball of the same metal, and at the other fixed in a glass handle. The ball should be made to screw off, and points of brass, plain and varnished, and of baked wood, should be made to screw on, when it is removed.

of the person holding it touch the knob of the wire communicating with the inside of the jar, which is charged positively, the electrical matter will rush from the inside of the jar and pass through the arms and chest of the person, as its nearest way, to the outside. To apply this to our purpose:—electric shocks may be given to any part of the body, without affecting the rest, by bringing that part only into the electrical circuit. If, for instance, the knob of the wire connected with the internal surface of a coated jar be applied to one side of the pelvis, and the extremity of a chain communicating with the exterior of the jar be applied to the opposite side of the pelvis, a shock will be sent through the pelvis; and, if the person be a female, the uterus will be powerfully stimulated. The sensation which it excites is unpleasant, and the muscular contractions are considerable. This mode of applying so powerful an agent requires caution, as animal life may be destroyed if the charge be considerable and the shock passed through a vital organ. The whole energy of the nervous system is suddenly exhausted, and immediate death follows. The bodies of animals thus destroyed undergo rapid putrefaction, and the blood does not coagulate after death. It has been supposed that the nerves are the parts of the body which conduct better than any other; and the truth of this opinion is supported by the discoveries in that modification of electricity which has been denominated Galvanism, and which, from some phenomena attending it, has given rise to an hypothesis, that the influence of the brain and nerves upon the muscles is of an electric nature. Even common electricity sent along a nerve, either in the living or the recently dead body of an animal, causes contraction of muscles, and, at the same time, in the living animal, a sensation of pain is felt.

The modification of electricity named Galvanism was accidentally discovered by Galvani, a Professor of Anatomy at Bologna. For some time, however, although this new power was acknowledged to be electrical, yet it was attributable to the animal system, and consequently regarded as *animal electricity*. New experiments, particularly those of Professor Volta of Pavia, soon displayed the error of this opinion; and, by meditating on the development of electricity at the surface of contact of different metals, Volta invented that instrument which is well known by the name of the *Voltaic pile**. This instrument (see marginal cut, p. 224) consists of a number of metallic discs, either silver and zinc, or copper, *d*, and zinc, *e*, of the same form and dimensions, and an equal number of discs of card, or cloth, *f*, soaked in salt water, of rather less diameter than the metallic discs. These discs are arranged in a specific order; for example, on

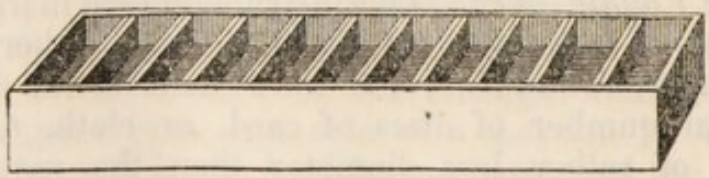
* Phil. Trans. 1800.



the top of the silver disc is placed the zinc, and on that a cloth disc, until the pile is completed, which is kept together by the wooden frame *a*, *b*, *c*. If a finger of one hand be dipped in water, or rather in salt and water, and applied to the undermost or silver disc, and a finger of the other hand, similarly moistened, be applied to the uppermost or zinc disc, a distinct shock will be felt in the arms resembling that from a small Leyden jar. If the cuticle of the fingers thus applied be abraded, a very acute sensation will be experienced in the fingers.

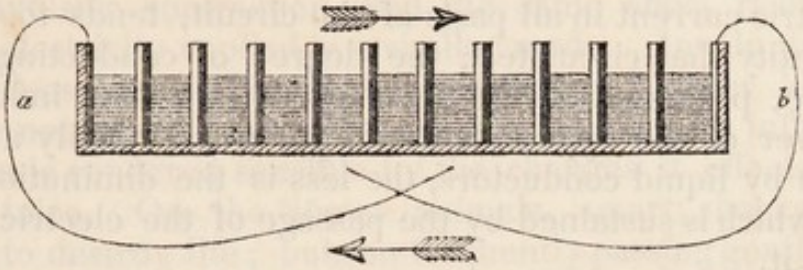
Notwithstanding these effects of the Galvanic pile, it was ill adapted for medical purposes; and, therefore, no progress was made in the application of Galvanism as a therapeutical agent, whilst the pile remained the only instrument for exciting electricity by chemical action; although its chemical effects were so powerful, that, with a pile of two hundred pairs of five-inch plates, Van Marum and Pfaff fused an iron wire twenty-eight inches long, and burnt platina wire when drawn out to a fine point.

In 1802, Dr. Wollaston having established the fact that the oxydation of one of the metals, the zinc, in the pile of Volta, is the cause of the disturbance of the electricity, and that its activity exists as long as the chemical action between the zinc and the fluid continues; the Galvanic trough, the instrument now employed for the application of this variety of electricity as a curative agent, was invented. Mr. Cruikshank, the inventor, constructed it on the principles of the Voltaic pile: the metal plates are arranged in the same manner as in the pile; and the only difference is, that instead of moistened discs of cloth or of card, an acidulated fluid is introduced between each pair of the metallic plates, so as to bathe the zinc on one side and the copper on the other. Various modifications of this trough are employed for chemical purposes; but the trough, consisting of plates of a moderate surface, is still regarded as the best fitted for medical use. In it, the electrical action becomes evident as soon as the acid fluid, which is a dilute solution of sulphuric acid in water,



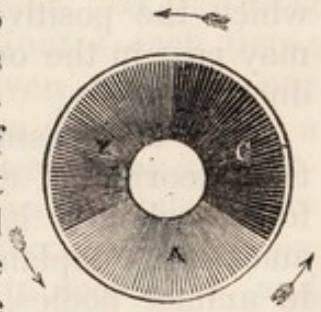
with about $\frac{1}{50}$ of nitric acid, begins to oxidize the zinc. Whatever metals are employed in the construction of the trough, or whatever be the nature of the fluid used, the metal which is

most energetically attacked is *positive* in reference to the other; and the current of the electrical fluid sets in the direction from it to the other, so as to establish a circle. Thus, if we suppose *a* to be a wire proceeding from the zinc plate, and *b* a wire proceeding from the copper plate, by bringing these together the Galvanic circuit is completed, and the current of electricity passes in the direction of the arrows.



Although the theory of Galvanism is still involved in obscurity, yet it has been accurately ascertained that the primary agent in the evolution of this species of electricity is the force of *chemical attraction*. Now, assuming that this is true, we find that chemical action occurring between a solid and a fluid is always accompanied by the disturbance of the electrical equilibrium; and the natural electricity of the bodies is changed from a latent into an active state. Thus, if copper and zinc be placed in diluted sulphuric acid, the surface of contact between the zinc and the acid is that at which the chemical action and the development of electricity takes place, and the copper merely acts the part of a *conductor* between these two substances. This is the case in all the combinations of oxidizable metals, every metal being positive with regard to another metal which is oxidizable in a less degree: zinc, for example, is positive in reference to *iron* or *copper; iron* to *lead*, *copper* to *silver;* and so on.

The marginal diagram is well adapted to elucidate this subject. Suppose the letters A Z C the three elements essential to Galvanic action. "Between the two first of these, A and Z, some chemical affinity must exist adequate to produce combination and development of electricity; while the same degree of action is not exerted between the third element C and either of the former*." One of the two first bodies must be a solid and a conductor of electricity; and, as chemical action requires that one body at least should be in a fluid state, A must, therefore, be a fluid; whilst C may be either solid or fluid. It is requisite, also, that all these bodies



* See an excellent Treatise on Galvanism, published in the Library of Useful Knowledge, of which Dr. Rogett is the reputed author.

be in mutual contact, so as to compose a circle. Now, if we suppose Z A C to be respectively zinc, acid, and copper, the surface of contact between Z and A will be that at which the chemical action, and consequent development of electricity, takes place; and C will act only as its conductor. The current will therefore circulate in the direction of the arrows, or from A to C, and thence to Z.

Every circumstance which tends to facilitate the passage of the electric current in all parts of the circuit, tends to increase the quantity that circulates; the degree of conducting power, therefore, possessed by the fluid, has an important influence on the power of the apparatus: and the more readily a metal is acted on by liquid conductors, the less is the diminution of intensity which is sustained by the passage of the electric current through it.

This apparatus, the Galvanic trough, is the best instrument for the application of Galvanism as a medicinal agent. The effect it produces is more or less, in proportion to the number of plates employed; but it does not follow that the greater the power the greater the number of plates: on the contrary, a certain proportion exists between the number and the surface of the plates, to produce the maximum of power; and increasing either the size or the number, indefinitely, is always followed by a diminution of power. A trough of fifty plates, each containing four square inches of surface, is sufficient for every purpose that can be expected from the influence of Galvanism as a medicinal agent. In using the trough, if shocks are to be given, the fingers should be dipped in salt and water; but, if a stream of electricity is to be passed through any part of the body, brushes dipped in salt and water are to be employed. One is to be held to the part of the body opposite to that at which the positive wire is to be applied, so that the current may pass in the ordinary circuit, the nerves forming the conducting media.

It is unnecessary, for our purpose, to say more regarding the theories of either modification of electricity in its usual form; whether it is excited by friction, or by chemical action: and having explained the manner in which it can be accumulated in animal bodies, or abstracted from them, or passed through them as a part of the electrical circuit, it will be more useful to examine the physiological action of Electricity, and its influence as a therapeutical agent in the cure of diseases.

Electricity, whether *common* or *Voltaic*, applied to the animal system in a moderate degree, increases excitement; in a large quantity, it destroys life. That it operates on the nervous system is shown in the production of sensation, by muscular

contraction, and by altered secretion. The electrical current of a Galvanic trough passed through any part of the body, if continued, is all along accompanied with an aching pain; and, if the cuticle be denuded, a sensation of burning or acute smarting is experienced; and this is more severe when the electricity flows out of the body, or is on the negative side of the pole. When an electrical current from a common machine is passed along a nerve, distributed to any muscle of volition, the muscle is thrown into convulsive contraction, and the same effect results from Voltaic electricity applied in a similar mode. Involuntary muscles are less easily affected by electricity of either kind; but they are not wholly insensible to this excitant. Its influence on secretion is rendered sensible by the changes it effects on the gastric juice. On the lower animals, smart shocks appear quickly to destroy life; but, on frequently passing gentle shocks through the heart of the animal thus apparently dead, oscillations of the muscles take place; and if these be continued for some time, the animal recovers; if they be too soon suspended, it relapses and dies. The vital organs are more excited by slight shocks than by strong shocks. As an excitant, therefore, electricity acts equally on the sensibility and the irritability of the system; and it is upon these grounds that it has been employed in the treatment of diseases. It is highly diffusible; is quickly propagated over the system, and excites the action of the most distant parts: and, after its effects are produced, it leaves the body free from those secondary results which more or less follow the action of other excitants. As an excitant, it is indicated in all diseases of debility. Much, however, depends on the mode of applying it. In all cases, the simple *accumulation* of it ought to be first tried; then the *aura* used; next proceed to *sparks;* and, ultimately, when the body has accommodated itself to the Excitant, if requisite, *shocks* may be given. If the *aura* be preferred, it should be applied for ten minutes each time; seldom more than twenty *sparks* should be given at once; nor should more than ten shocks be passed in one direction. In a very delicate frame, a strong shock may do mischief, by exhausting too greatly the excitability; thence, in nervous habits, it may not only induce syncope, pain, vomiting of blood, and paralysis, but so exhaust the strength of the patient as to accelerate, and even cause, death*.

Little benefit can be expected from a short continuance of electricity, few cases occurring that do not require it to be continued for several weeks. The electrization should be peformed daily, with the occasional intermission of a day. Both internal and external medicines may be employed at the same time.

In intermittent and continued fevers, electricity has been

* Percival's Essays, vol. i, p. 393.

employed; but it is not likely to be ever generally used in such cases. In some instances of atonic inflammation, as in scrophula, the sparks and aura have been found useful when repeated three or four times a day. In recent cases, the excitement restores the energy of the part and reduces the swelling; in those more advanced, suppuration is hastened. Hoarseness, arising from relaxation of the muscles of the glottis from repeated inflammatory attacks, has often been speedily cured by the daily use of the electrical aura. In gout, both sparks and the aura have been employed; but much caution is requisite; and still more in acute rheumatism. In the chronic form of rheumatism, much good, however, is obtained from it: sparks should at first be drawn through flannel; and, when rheumatism partakes of paralysis, gentle and frequent shocks be afterwards given. Electricity has been much lauded for the relief which it affords in sciatica; and there is little doubt, where this affection is rheumatic, that it may prove useful: but pains resembling sciatica arise from various conditions of the part; when there is phlegmonous inflammation, or when it is the attendant of affections of the kidneys and the urinary bladder, Electricity is more hazardous than beneficial.

In the Neuroses, Electricity is an Excitant to be depended upon. Its good effects have been often observed in paralysis in all its forms: at the same time, although paralysis is a disease of debility, yet it has been occasionally seen connected with an opposite state of the system, as in sanguine and plethoric persons; and when the disease is at all accompanied with a tendency to determinations to the head, this agent should not be employed. Thence it is more likely to cure old and long-standing than recent cases of paralysis; partial than general paralysis; paraplegia, particularly that kind arising from the poison of lead, than hemiplegia following apoplexy; and, generally speaking, it is well adapted for all cases depending on simple atony of the nerves. Cases have occurred in which no benefit has been received for five or six months, and yet a cure has been ultimately obtained. "Patients," says Dr. Percival, "are frequently discouraged, by the painful sensation which large shocks excite, from persevering in an electrical course:" but these are unnecessary; and our experience accords with the observations of this ingenious physician, that few cases "which resist the power of small and repeated shocks, yield to great and terrifying ones. There is an amazing difference in the sensibility of different constitutions to the electrical stimulus. Quick, lively people feel the most from it; those the least who are dull and slow of apprehension*." In

* Percival's Essays, l. c.

the employment of Electricity, its powers are often greatly promoted by the use of external rubefacients.

In Asphyxia, gentle shocks passed through the region of the heart have proved beneficial; and this is one of the diseases in which Electricity is always indicated. In spasmodic affections, it has been much employed; but certainly without any very evident advantage.

In local affections, arising from nervous atony, Electricity is likely to prove beneficial. Thus it is useful in atonic deafness, in which sparks should be taken from the internal part of the meatus by a metal conductor passed through a glass tube: the effect is swelling of the part, with a flow of ceruminous matter; and in a short time the faculty of hearing is improved. Cases of thirty years' standing have been thus relieved. In many instances, organic diseases of the ear have been mistaken for this condition of the auditory nerve, and no benefit has resulted from the Electricity.

In Amaurosis Electricity has been employed; it proves useful when the disease arises from simple defective sensibility of the optic nerve: sparks may be taken 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, or any thing pressing on the nerve at its origin, or in its course, no benefit can be expected from Electricity.

In contractions and rigidity of the muscles, no remedy is equal to Electricity; and here both sparks and slight shocks may be employed.

In Amenorrhœa, when other means fail, we may almost always resort with confidence to Electricity. It is especially indicated when the disease accompanies a pale leucophlegmatic condition of the habit. In this case, shocks should be passed directly though the uterus. Here it is easy to comprehend how Electricity, operates independent of its general influence on the constitution. If we suppose that the deficiency of the uterine action depends on the atony of the organ, the excitement afforded by making it a part of the electrical circle in discharging the Leyden jar through the pelvis, will act exactly in the same manner as when moderate shocks are applied to any other organ; the current of the blood will be determined to the uterus; and its secretory power be consequently augmented. The visible effects observed in this employment of Electricity are, a copious flow of perspiration, a more than usually open state of the bowels, and deposites in the urinary secretion. In an opposite state of the system, however, when there is plethora and rigidity of fibre, with a high sanguine complexion, Electricity is a very hazardous remedy in amenorrhœa, until antiphlogistic measures, bleeding and purging, have been employed. The remedy should be at first used in the form of sparks, and these employed for a considerable time before

we venture upon the use of shocks. In every affection of the uterine organ, care must be taken to ascertain that pregnancy be not present; as, in such a condition, Electricity may cause either miscarriage, or, if the period be advanced, premature labour and the death of the fœtus. In uterine affections, where Electricity is even decidedly indicated, more than common caution is requisite; the *sparks* should be drawn for a few minutes only on the first and second days; and the period lengthened daily, in a manner proportioned to the nature of the disease and the temperament of the patient. If inflammation or a tendency to it exist in the uterus, dangerous results are sure to follow the application of Electricity.

It is in cases in which there is evident diminished action that Electricity proves useful; it is a stimulus both to the irritability and the sensibility of the living system; but it must always be kept in remembrance that sedative effects follow its application; and that these are the result of its stimulant powers exhausting the excitability; the proportion and the quantity of stimulant power must therefore be regulated in applying Electricity, for the same reason as in the employment of other Excitants: if too powerful shocks be given, danger may result; if too weak, no benefit will accrue from its use.

The effects of Galvanism on the animal tissues differ in some respects from those of common Electricity. On the skin it produces a sensation of burning, which, if the application of the agent be long continued, is followed by redness and tumefaction of the part. The sensation is more lively upon the lips, in the ears, and upon the globe of the eye, than on the hands, which are defended by a thick epidermis. Like common Electricity, Galvanism accelerates the pulse, augments the secretion of the kidneys and of the skin, as well as communicates activity to the other secretions and excretions; peculiar contractions are excited in the intestinal canal when one conductor is introduced into the mouth and the other into the rectum; and when the current of the fluid is directed towards the brain, wakefulness, and restlessness, indicating much cerebral excitement, are perceived.

Galvanism has been more employed as a remedy on the Continent than in this country. Alibert tried its effects at the hospital of St. Louis, in Paris, in purpura and other petechial eruptions, accompanied with great languor and anxiety. In one case, which had resisted every other means, the patient was completely cured in a month by the daily use of Galvanism; the period of its application being gradually lengthened. In chronic rheumatism Galvanism has failed. It has been more successful in scrophulous obstructions and other diseases of diminished nervous energy. The only cases in which I have had an opportunity of observing its effects closely, are several of dyspepsia and asthma. In these diseases I have employed

it in conjunction with Dr. Wilson Philip, whose experiments on digestion led him to conceive that great advantage might be derived from the excitement afforded to the pneumogastric nerves by Galvanism; but truth obliges me to say that, even as an auxiliary, its influence in this disease is very slight.

From the powerful influence of Galvanism in rousing the energy of the respiratory nerves, and those of expression, in animals suddenly killed, and from the consideration of the function of the eighth pair of nerves as the chief agent in effecting the chemical change of the blood in respiration, and the deficiency of this change in asthma, I had formed sanguine expectations from the employment of Galvanism in this painful disease. The experiments of Sir Charles Bell have thrown much light on the direct influence of the eighth pair of nerves in the chemistry of respiration, and with it the other respiratory nerves, those concerned in the muscular movements of the diaphragm, the intercostal and other muscles of the thorax, respond altogether in the performance of their functions: thence, when the decarbonization of the blood is not effected in a proper manner, the muscular energy is paralyzed, and suffocation is threatened. Again, if the par vagum be divided on each side of the neck, in a quadruped, the consequence is asphyxia and the death of the animal; and whatever diminishes the influence of that nerve on the respiratory process tends to produce this effect; whereas, the lesion of the phrenic nerves, the spinal accessary, and external respiratory nerves, although it impedes the mechanical dilatation of the thorax, yet does not produce fatal effects; and the function they perform may be aided by other parts being called into action. When the eighth pair of nerves is divided, in the lower animals, and asphyxia has supervened, from the circulation of uncarbonized blood, in both vascular systems in the lungs, if the continuity of the nerve be re-established by means of a Galvanic circle, the blood resumes its arterial character, and life is maintained. The knowledge of these facts led me to form the most sanguine anticipations from the use of Galvanism in asthma: but experience has not confirmed my expectations; and in the greater number of instances, no advantage whatever has resulted from its employment: I was consequently induced to examine more closely the pathology of asthma, both the humid and spasmodic variety. In the first, the effort required to excrete the redundant mucus is not of that kind which can be aided by Galvanism, the effect of which is more likely to produce an increase of the mucus of the bronchial tubes than to diminish the overabundance. In the second place, with respect to spasmodic asthma, although it cannot be doubted that the sense of suffocation depends on the change of the venous blood not being properly

effected in the lungs, yet it does not follow that the deficient energy of the eighth pair of nerves depends on defect of stimulus in that nerve. Convinced of the correctness of this view of the subject, and observing that, in cases in which the asthma was not of very long standing, the breathing was difficult in proportion to the degree of febrile excitement present, I was induced to believe that the theca of the spinal chord is more or less in a state of subacute inflammation, and, consequently, instead of the stimulus of Electricity, that I should recommend cupping over the dorsal spine. Experience has demonstrated the truth of my reasoning.

The disease in which I have seen the most benefit obtained from the Galvanic stimulus is Paralysis from Colica pictonum.

b. CALORIC.

Caloric, like some other substances, is known to us only by its effects: it produces the sensation which we term *heat*. We therefore conclude that it is an Excitant. Some philosophers maintain that Caloric is merely a property of matter; it would be out of place here to examine the truth of this opinion: it is sufficient to say that the idea of the materiality of Caloric prevails.

Caloric is unknown in its perfectly free or uncombined state; for it pervades all bodies and passes from one only to enter into another. For practical purposes, we may use the term *free* or *sensible caloric*, to imply that state of its existence by which its presence in any substance is obvious either to our senses or to the thermometer: and that of *combined* or *insensible caloric*, to imply its presence when it is neither evident to our senses nor to the most delicate thermometer. Thus, if a quantity of water be placed in the open air, in a freezing day, and remain *perfectly undisturbed*, it will be cooled below the degree at which water usually freezes, and yet remain liquid; but, if it be then agitated, as much caloric will instantly be evolved, as if it were shaken out of the water, as will raise the thermometer to 32°, and the water will immediately freeze. In this case the combined caloric of the water maintains its fluidity; but, on agitating the water, it at that instant becomes *free Caloric*, which raises the mercury in the thermometer, whilst the water, having lost the Caloric that maintained its fluidity, becomes solid or frozen. Again, a quantity of ice, in a pan placed on the fire, melts, but does not raise the thermometer above 32° until the last portion of the ice be melted. In this case, the Caloric which flows from the fire becomes insensible, or is combined with the water to maintain its fluidity; and only the redundant Caloric, received after the whole is melted, affects

the thermometer. Different bodies, at the same temperature, contain different quantities of Caloric: this is termed the *specific Caloric* of bodies; and many ingenious experiments have been made to determine the quantity contained in various bodies*.

It is of importance, for our purpose, to trace the sources of Caloric. The *sun* is one source; but whether the Caloric which reaches the earth's surface be emanated from the sun with the particles of light, or whether the particles of light acquire the Caloric in their passage through the earth's atmosphere, it is impossible for us to determine. The temperature produced in bodies by the direct rays of the sun seldom exceeds 120° Faht.

Combustion is another source of Caloric. It is unnecessary, for our purpose, to inquire whether the heat and the light thus produced arise from the simple union with oxygen of one or more parts of the combustible body, as Lavoisier supposed; or whether, according to Brugnatelli, oxygen unites with bodies in two states: namely, one in which it retains the greater part of the Caloric and light which it contained in its gaseous state; the other, in which the union takes place only after it has parted with these: or whether it is an electro-chemical phenomenon, as Berzelius has supposed. I will not, therefore, pause to examine the theory of this process, during which both light and heat are largely emitted, and rendered subservient for stimulating the animal body, in a degree proportionate to its necessities.

Percussion is the third source of Caloric. It is well known that a rod of iron, rapidly hammered, becomes red hot; and that sparks are elicited by striking flint upon steel.

Friction is a very important source of Caloric. It is produced in organized as well as in unorganized bodies by this means; but it is not easy to explain why Caloric is accumulated by friction: something is supposed to be due to the agency of *electricity*.

Mixture is also a source of Caloric. This is owing to the specific gravity of the mixed body being greater than the mean of its components; as when strong sulphuric acid is mixed with water.

The last source of Caloric is *Electricity*. The spark elicited in discharging an excited body through the air fuses metals and sets fire to combustible bodies.

The chief sources of Caloric, for medicinal purposes, are *combustion* and *friction*. But Caloric is generated by living animal bodies; and it is this faculty which enables man and other

* The specific heat of the solids and fluids of the living body is less than that of water: the quantity of combined Caloric, therefore, in the whole human body is rather less than in an equal quantity of water at the same temperature; for the inferior capacity of the venous blood more than counterbalances the superior capacity of the arterial blood.

animals to resist the extremes of cold. As this is a vital process, it is greatly influenced by the state of the nervous system; but it is, also, in some degree dependent on chemical changes going on under the influence of the vital powers. In this country, the lowest average heat of the human body is 88°; the greatest heat, in the state of disease, 110°.

With respect to the *distribution* of Caloric, bodies which contain more free Caloric than the air and other bodies that surround them, emit it, and continue to do so until the whole come to an equilibrium. This power of Caloric to be *communicated* from one body to another varies according to the nature of the body communicating it: that body into which it most rapidly enters communicates it most rapidly: and it is on this account that bodies of the same actual temperature give a different sensation to the touch: thus, a piece of flannel, a piece of leather, and a piece of iron, all of the same temperature, will seem cold, colder, and coldest, in the order named; the flannel cold, the leather colder, and the iron coldest. The Caloric is given out in straight lines, or is *radiated:* the manner in which this is effected is regulated by laws which it is not my province to explain, but the knowledge of which is important to the physician. Thus, by knowing that surface affects the radiation of heat, if I wish to apply heat by means of hot water rapidly to the living body, I would put the hot water into a tin vessel painted black and covered with linen; if I wish to convey the heat more slowly, but to keep it up for a long time, I would put the hot water into a *bright* tin vessel without any linen around it.

When Caloric enters into a body, it accumulates to a certain extent, and increases the bulk of the body; but the quantity of Caloric which can thus be accumulated, depends on the conducting power of the body. Solid bodies are the best conductors; gases the worst; but all solids, all fluids, and all gases, do not conduct alike. Metals are good conductors; glass is a bad conductor. An iron rod, with one end in the flame of a lamp, will become so hot, in a few minutes, as to prevent it from being longer held; whilst a glass rod may be held in the hand until it is nearly all melted away. The small conducting powers of silk, wool, and feathers, admirably adapt them for clothing, as they do not permit the Caloric, generated in the body, to be rapidly carried off by the cold external air. Animal bodies are bad conductors; thence we are enabled to employ Caloric advantageously in the form of *baths* and *fomentations.*

The following facts are all that are required to be known regarding Caloric as a therapeutical agent:—1st. That it is a material body or substance, contained in all organized and unorganized bodies: 2d. that, when it is contained in a larger quantity in a free state in any body than in other surrounding bodies, radiation takes place, and it passes from it into them:

3d. that it increases the bulk of all bodies into which it passes: 4th. that it becomes free or sensible when bodies pass from a gaseous to a fluid, and from a liquid to a solid state, and vice versa: 5th. that it passes through various bodies with different degrees of velocity; and, finally, that on entering the living animal body, it excites the nerves of sensation.

On the living body, the first effect of Caloric, in the free state, is to stimulate the nervous system, augmenting the irritability and exciting motion. This is obvious, even in the earliest state of organization, as Harvey demonstrated by his experiments on the egg. In a low temperature, the punctum saliens, or vital speck in the egg, beats slow and languidly; in a higher temperature its motion is more vivid; and this alternates according as the Caloric is abstracted or applied. It is on this account that both plants and animals arrive sooner at maturity in the torrid zone: there, women become mothers at ten and twelve years of age; in Lapland not until they are twenty-four. But the excitement caused by Caloric is soon followed by debility and exhaustion; thence the inhabitants of the torrid zone are more languid and feeble than those of temperate climates.

Caloric, when applied to the living body in a degree above 68° Faht., increases the secretions in quantity, and alters them in quality. Thus, perspiration is greater in a warm atmosphere than in a cold; its chemical properties also are changed; it becomes more acrid; and, when a European first visits any country within the tropics, this acrimony displays itself in a cutaneous eruption, Eczema *solare*, or prickly heat. The augmented excretion of the skin lessens the secretion of the kidneys, and renders it more saline and high coloured; thence diseases of the urinary organs are more frequent in warm than in cold climates. In the alimentary canal also, the secondary effects of Caloric are felt: true Dyspepsia supervenes, and Excitants, which Nature has bountifully provided in these climates, become necessary for sustaining the tone of the system. The liver also becomes affected in a high temperature, long continued, particularly in those who go from colder to warmer climates: the biliary secretion is augmented in quantity, and its character altered. Thence Cholera and Hepatitis are the prevailing diseases of warm climates. Heat is also the most general predisposing cause of fevers, by increasing the irritability of the system, producing debility, and thence inducing a vitiated state of the secretions; which, reacting on the habit, produce febrile action. Several of the Phlegmasiæ, besides Hepatitis, are also produced by the direct influence of heat, and are endemic in warm climates. Tetanus is another disease of the torrid zone, depending on increased irritability arising from the continued impression of heat. Dyspnœa is often the result of a hot atmosphere.

Besides increasing the irritability of the system, the intro-

duction of Caloric into it augments, also, its *sensibility*. Thus Caloric passing into the living body produces the sensation of heat; and, at the same time, renders the body more susceptible of every other impression. The intensity of sensation from this cause depends on three circumstances—1, the state of the sentient nerves; 2, the velocity of the impinging Caloric; 3, the nature of the conducting medium.

The influence of the condition of the sentient nerves is daily demonstrated. A body of a temperature under 60° will impress the sensation of warmth or of coldness, according as this temperature be higher or lower than that of another body which had been just previously touched: for instance, if the hands be put into fluids of different temperatures, say 36° and 96°, and then both plunged into water at 60°, to the hand which was in the water at 36° the water at 60° will feel hot, whilst to the other, which had been in the water at 96°, it will feel cold. With respect to the influence to be attributed to the rapidity with which the Caloric flows into our bodies, much depends on the conducting power of the substances applied to the body: if mercury be taken as the standard, and reckoned as 1000, we shall find dry air to be 80, moist air 330, and water 343*. Thence water and air of the same temperature produce very different sensations on the body: thence, also, from the greater conducting power of moist air than that of dry air, we feel cold in damp weather of the same temperature as that which produces an agreeable feeling of warmth when the air is dry: and, if the atmosphere be agitated by wind, we feel colder than would be the case from the actual temperature of the air. On the same principle, we are more sensible of the impression or the abstraction of Caloric from metals, than from wood of the same temperature.

Let us now consider the value of Caloric as an Excitant, when applied through different media. Caloric may be applied to the living body through *aeriform media*, *including vapours; fluid media;* and *solid media*.

1. *Aeriform media.*—When the body is exposed to dry, highly heated air, the Caloric operates as a powerful Excitant, producing headache and accelerating the pulse. Air, however, does not act as an Excitant until it reach 98°. At this temperature, the sensibility and general energy of the nerves, and the action of the heart and arteries are increased; and, as the last effect extends to the cutaneous capillaries, the perspiratory function is also rendered more active; thence therapeutical effects follow, which shall be afterwards noticed. There are conditions of the body in which the direct application of hot air may prove beneficial: thus, in cases of suspended animation from drowning, as

* Experiments of Count Rumford.

hot water is not always ready, hot air may be employed in its stead: it is also an excellent means of communicating external warmth to the body in the cold, blue condition of it which characterizes the state of collapse in Asiatic cholera. In order to increase the stimulant power of hot-air baths, sulphur and other substances of a volatile nature are employed, and form part of the heated atmosphere with which the patient is involved. Baths of this description have of late years been much used for the cure of some cutaneous eruptions, and obstinate cases of chronic rheumatism.

Although the body is less capable of resisting the same degree of temperature in moist air than in dry air, yet a much higher temperature can be borne in *vapour* than in *water*. The heating power of the former is much greater when the vapour is breathed, than when the head is not immersed in it. Those accustomed to the use of the vapour bath—for example, the Russians—can sustain vapour even when breathed at a temperature of from 120° to 130°, some even to 160° Faht. The simplest vapour bath, when the vapour is not breathed, is that of the Hindoos. The patient is stripped naked; and, a blanket being pinned round his neck, so as to envelope the whole body, he is seated on a low stool: an earthen vessel is then introduced within the blanket; and, boiling water being poured into this vessel, the opening of the blanket is well secured by pins. In a few seconds, the patient begins to feel the warm vapour encompassing his body and his temperature increasing, until the system relieve itself by a copious perspiration. If it be requisite to maintain the effect, hot bricks are thrown into the water at different intervals, so as to renew the supply of vapour. The chief recommendation of this bath is the facility of employing it at the bed-side of a patient, even without wetting the floor of the apartment.

But no vapour-baths, to produce a powerful effect, are equal to those of the Russians. In St. Petersburgh, they are on the most magnificent scale, emulating those of ancient Rome*. The first or outer room, in which the bather undresses, is of a temperature between 75° and 100°: at first, this dry heat produces a

* Gibbon thus describes these splendid edifices: "The baths of Antoninus Caracalla, which were open at stated hours for the indiscriminate service of the senators and the people, contained above sixteen hundred seats of marble; and more than three thousand were reckoned in the baths of Diocletian. The walls of the lofty apartments were covered with curious mosaics, that imitated the art of the pencil in the elegance of design and the variety of colours. The Egyptian granite was beautifully encrusted with the precious green marble of Numidia; the perpetual stream of hot water was poured into the capacious basins, through so many wide mouths of bright and massy silver; and the meanest Roman could purchase, with a small copper coin, the daily enjoyment of a scene of pomp and luxury which might excite the envy of the kings of Asia." From these baths the Romans issued, steaming with perspiration, and plunged into the Tiber, in the same manner as after the violent exercises of the Campus Martius.

slight headache and an uncomfortable feeling; but the excitement is soon relieved by a general perspiration; and the heat of the apartment gradually becomes more tolerable. The bather is then introduced into the bath-room, the temperature of which is from ten to twenty degrees higher than that of the outer room; and this increases as the bather gradually, at intervals of a few minutes, ascends different benches, ranged one above the other, until he almost attains to the ceiling of the bath, where the temperature is at least 180°, and, to any one not accustomed to this luxury, is insupportable. The head now feels oppressed and burning; the skin is hot; and the respiration difficult. The attendant, who is termed in Russian the *Parilstchick*, now feels the skin of the bather; and, if it be not bedewed with perspiration, he opens the door of the stove and throws into it a bucket of water. The atmosphere of the bath is instantly pervaded with clouds of vapour; a deluge of perspiration streams from every pore of the skin; the breathing is relieved; the headache disappears; and a general sensation of pleasure is experienced. The relaxation which follows this application of the vapour may readily be conceived: a sort of shampooing, with soap-suds and the inner bark of the lime tree, is now assiduously performed by the *Parilstchick*, pressing on every joint: and the operation terminates by dashing tepid or cold water, at the pleasure of the bather, on the head and even over the body. The Russians, who use this bath at least once a week, are not contented with the highly exciting power of the Caloric, but have the body whipped with twigs of birch; and the poorer Russians, in the state of profuse perspiration, rush out of the bath, roll themselves in the snow, and then return to finish the bathing. The benefit derived from the use of these baths can be attributed only to the Caloric in the first instance exciting the heart and arteries, and afterwards equalizing the circulation by the force with which the blood is thrown into the capillaries. The glandular system is also powerfully stimulated; the secretions are facilitated; and a general impulse is given to the nervous energy. The vapour bath, however, whilst it is more diaphoretic, is less excitant than the hot water bath.

2. *Fluid media.*—Caloric, combined with water, is employed as an Excitant in the form of warm and hot baths.

There are three kinds of warm-water baths:

1, The tepid bath, from 85° to 92° Faht.
2, ——warm bath . . . . 92° to 98° ——
3, ——hot bath . . . . . 98° to 106° ——

Warm baths have been used from time immemorial as an article of luxury; and they have been judiciously imposed as a religious duty upon the inhabitants of Asia, who, living in a warm climate, wearing sandals, and woollen garments which are seldom

changed, require the use of the bath for the preservation of their health. The ablutions, therefore, enjoined by the laws of Moses, and those of Mahomed, were wise and salutary. In modern Europe, the use of the warm bath, except in Russia, can scarcely be regarded as general; and it is viewed rather as the means of removing diseases than of preserving health.

Water, at the same temperature as air, feels warmer to the body, merely because it is a better conductor than air: at a temperature higher than that of the body, it rapidly communicates Caloric; at a temperature beneath that of the body it as rapidly abstracts it. Water feels cool to the surface, on first immersing the body, if the temperature do not exceed 85°; and therefore no bath is termed even *tepid* until it exceeds 85° Faht.

When the body is immersed in the *warm* bath, whether natural or artificial, at a temperature of 92° and 98°, an agreeable sensation of warmth is perceived, the veins on the surface swell, the bulk of the body is sensibly increased, the skin becomes redder than natural, it also softens, and minute scales separate; the action of the heart is augmented, the pulse feels soft and full, but beats quicker; as soon, however, as the person rises from the bath, sweat breaks out, and languor and debility follow; and this even occurs, when the person is in the bath, on those parts of the body not surrounded with the water. These effects proceed partly from the immediate impression of Caloric on the sentient nerves of the skin, and partly from this first impression producing a state of the capillaries which, at the moment, is inconsistent with the perspiratory function—a state somewhat approaching to that of the extreme vessels which checks perspiration in acute fever: but the degree of heat being inadequate to maintain this effect, and the water, now that the temperature of the skin is greater than itself, acting as a cooling medium, relaxation follows; and therefore the warm bath, in its general action, is a cooling agent. On the same account, the warm bath has a peculiar tendency to alleviate irritation, and consequently to induce sleep.

When the *hot* bath is employed, that is, when the body is immersed in water of a temperature between 98° and 106°, or as high as the individual can bear it, the heart and arteries are powerfully excited; the face, as well as the rest of the body, becomes red; the temples throb, and the pulse is felt, even at the finger ends. The collapse, however, is proportional to the excitement; and, consequently, much greater after the hot than the warm bath. We may regard the warm bath a moderate Excitant, when the immersion is not prolonged beyond eight minutes; but, beyond that time, a relaxant and sudorific: the hot bath, under the same circumstances, is strictly excitant.

The first effect of the bath, independent of the impression

which it produces on the nerves of sensation, is the expansion of the bulk of the body: but, whilst we are convinced of this by our clothes feeling tighter than they were before, after having been in the warm or the hot bath, yet it is uncertain to what part of the frame this increase of bulk or expansion takes place. Sauvage exposed the blood to various temperatures, from 32 to 112, and found that it experienced no mensurable increase of bulk; and even between 112 and 212, the increase of volume did not exceed $\frac{1}{300}$th part; the result of Haller's experiments was the same. Neither does any increase take place in the solid living fibre; we must, therefore, refer it in part to the elastic fluids contained in the blood and other parts of the body.

Something is also due to the diminished resistance of the skin relaxed by the bath; and this accounts also for the greater enlargement of the veins than of the arteries; for, as the veins are more superficial, and scarcely contractile, they suffer more readily a temporary congestion and enlargement.

Is any of this increased bulk due to the absorption of water? The experiments of Dr. Currie first threw a doubt on the absorbing power of the skin. He supposed that no absorption could take place unless the skin be eroded by friction; and, if any increase of weight take place, that it must depend on absorption by the lungs. After an hour's immersion in the Buxton bath, at a temperature of 82°, he found that the weight of the body was rather diminished than increased. Many experiments of Seguin tended to confirm this opinion, and to prove that the great impediment is the cuticle; for if this be removed, absorption goes on. Dr. Rousseau of Philadelphia has nevertheless demonstrated, that the skin possesses the function of absorption in a small space (Part i, p. 9); whilst the experiments of Dr. Edwards tend to confirm the general absorbing power of the skin. In a temperature from 50° to 70° Fahr. Dr. Edwards says the exhaling and absorbing powers of the skin are balanced; above 70° the transudation exceeds the absorption*. But as many equally well-conducted experiments exclude all idea of cuticular absorption, it is evident that the subject requires further investigation.

The warm bath, also, softens and smooths the skin. The exterior part of the cuticle rubs off in the form of scales, which are in a partial state of decomposition; for the water used as a bath, in which they are mixed, putrefies rapidly. By the removal of these scales, the function of perspiration becomes freer than before; thence one cause of the benefit derived from the use of the warm bath, even to the healthful.

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* De l'influence des agens Physiques sur la vie. Paris 1824.

Besides this superficial effect, the relaxant influence of the warm bath is undoubtedly extended to the muscular tissue.

It is to the influence of Caloric on the irritability of the system, that we are to attribute the increased action of the heart and arteries in the warm and hot baths. But in what ratio is the arterial action accelerated? In the warm bath, the pulse, at first, is seldom below 96°; but, after some time, this diminishes; and, if the immersion be long continued, it sinks below 68°. In a bath heated to 104°, Dr. Parr found the pulse increase both in vigour and frequency after the person had been immersed for twenty minutes: and, even after half an hour, in a bath at 102°, the arteries beat violently to the ends of the fingers; the breathing became laborious; the vessels turgid; the face flushed; and sweat broke out. In water at 106°, the velocity of the pulse was greatly increased; in five minutes vertigo supervened; and the most copious sweat followed. In fifteen minutes after the use of the bath, the patient being in bed, the pulse returned to its natural standard of velocity; but it remained full for some time*. From these facts we may conclude that the arterial action is augmented in the ratio of the temperature of the bath, and the time in which the patient is immersed; and that, consequently, excitement or relaxation may follow the use of the same bath. To obtain the first, the patient must remain a short time only in the bath; for the second, the immersion must be protracted.

The natural baths which come under the denomination of warm and hot baths, are those of Bath, the temperature of which is from 96° to 106°, although the water issues from the spring at 116°; those of Vichy and Barege, the heat of which is 120°; of Borset, which is 132°; Aix-la-Chapelle, which is 143°; and Carlsbad, which is 165°. The great advantage of many of the natural warm baths is the benefit of locomotion of which they admit. But, in this country, both *warm* and *hot* baths are generally artificial, and much ingenuity has been expended in inventing easy means of heating water for the purposes of baths.

The partial means of using warm and hot water are various. The partial baths are—1, the *semicupium*, or half bath, in which the lower limbs and the trunk as far as the hips only are immersed: 2, the *balneum coxæluvium* or hip bath, which, as its name implies, is fitted to receive the hips only, and has the advantage of requiring very little water; as the bulk of the parts immersed, in proportion to the size of the bath, raises the water on each side so as completely to cover the hips: 3, the *pediluvium*, or foot bath, which takes in both the feet and the lower limbs, and which should always reach as far as the knees: 4, the *manuluvium*, or hand bath; which, in general,

* See Parr's Inaug. Thesis de Balneo. Edin. 1772.

should be used at the same time as the foot bath, when the intention is to relieve the head or the chest by counterirritation*: 5, fomentations by means of flannels wrung out of hot vegetable decoctions, and hot water: and 6, that mode of applying hot water which the French term *la Douche*.

The five first of these partial baths influence the habit nearly in the same manner as the general warm or hot bath, varying in their effects according to the temperature at which they are employed.

The simplest kind of *fomentation* is a flannel cloth or sponge, soaked in hot water, and wrung or squeezed dry before being applied to the part which is meant to be fomented. In order to explain its operation we must have recourse to the laws that regulate the action of Caloric; and we find that those substances, being spongy and involving much air, are bad conductors of heat; that they therefore cool slowly, and thence enable the Caloric, in conjunction with aqueous vapour, to be applied for a time sufficiently long to prove beneficial. It is customary to use vegetable decoctions—namely, those of Chamomile flowers and Poppy heads, with the flannel and sponge; and, although it is pretty clear that these substances are not absorbed, yet it is equally certain that decoctions of Poppy heads add much to the soothing effects of fomentations; apparently from their influencing the sensitive nerves of the skin. A greater quantity of Caloric can be applied in fomentations than can be borne either in the form of water or of vapour as a general bath; but the heat cannot be so long maintained. The temperature of the flannels should not be under that of 100° Fahr.; and, when applied, they should be covered by dry flannel cloths laid over those used to convey the Caloric, to moderate the cooling of the fomentation. The flannels should be at least three yards long, and the ends sewed together: they should be quickly wrung dry by sticks passed through them, and turned in opposite directions; then applied as lightly as possible over the parts to be fomented; and the whole enveloped in dry flannel. Our knowledge also of the radiating powers of Caloric is necessary to direct us to the choice of the colour of the flannels to be employed. Thus, if a sudden heat, without reference to its permanency, be required, black or dark-coloured flannels should be chosen; but if a moderate long-continued heat be desired, white flannel should be used. Poultices are merely modifications of fomentations. They may be made of any substance that is viscid, soft, and spongy; but the best material is linseed meal and boiling water. They should be light, and rather frequently repeated than bulky. The most ancient

* A very important improvement might be made in the vessels employed for these partial baths, by making them double, so that a layer of air, which is a bad conductor, would be interposed between the water in the bath and the external air.

poultice on record was made of figs. It was employed for the relief of Hezekiah, one of the Kings of Israel, who lived 260 years before Hippocrates. The passage is in the Second Book of Kings, in the twentieth chapter and seventh verse—"And Isaiah said, take a lump of figs. And they took it and laid it upon the boil, and he recovered."

The last local mode of applying Caloric in combination with water, is the partial effusion of hot water *(Illisus aquæ)*, or *la Douche**, as the French term it. The principle of its operation is certainly not understood. It consists in pouring upon the part to be douched, water at a temperature within the limits which I have described as constituting the warm bath; and at the same time applying percussion to the part. It excites the vitality, exalts the sensibility, and quickens the vascular action, not only in the affected member, but in the neighbouring parts. The effect is modified by the temperature, the magnitude, and the elevation or descent of the column of water; and the period occupied in its application. The sensation is that of fatigue in the part submitted to the douche; and this is followed by relaxation not only of the rigid limb, but, if the patient be properly managed and a general effect is required, by that of the whole system.

The difficulty of applying Caloric in combination with water in this manner, in private practice, is the almost impossibility of getting the stream of warm water of a sufficient magnitude, and the fall of a sufficient height. Nature has furnished the douching warm baths in several parts of the world: among the most justly celebrated are those of *Aix les Bains* in Savoy; the method of using which is so well described by Mr. Bakewell, that I make no apology for quoting his description nearly at length. "Till the year 1772," says Mr. Bakewell, "the sulphur bath at Aix les Bains was merely a large cave cut in the rock, and divided by a wall into two apartments, one for the men, the other for the women, with an iron ballustrade in front. At that time the King of Sardinia caused the present handsome building to be erected and fitted up, expressly for the operation of douching. Each bath or cell is an arched vault, about thirteen feet long, eleven wide, and twenty-two feet high from the top to the place where the patient sits. There are two apertures, or short tubes, by which the water descends in columns, as large as the arm, from the height of from eight to ten feet; it is carried off by channels in the floor, and runs down into the street. There are two men, called *douchers*, constantly in each cell; and two women, *douchesses*, in each of the women's apartments. Porters are also in attendance to carry the patients in chairs provided by the establishment.

* Doccia of the Italians.

These chairs are placed on poles, with cotton hoods or curtains, so as entirely to cover the patient.

"It is the general custom to begin by taking one or two warm baths at home. To persons who take the douche for the first time, the process is rather formidable. On entering the cell, when the door was closed, I seemed in darkness, and involved in dense vapours and sulphurous odours; but as my eyes became accustomed to the gloom, I could discern a feeble glimmering of light, entering by a little wicket above the door, covered with canvass. I then discovered two silent and nearly naked figures whom I had not before perceived, standing with their bare arms extended, as if ready to seize me the moment I was undressed. It would have required no powerful aid of the imagination, in such a place, and amid the gloom and sulphurous vapours, to have transformed these figures into demons or tormentors of the Inquisition; and the horrid yells of the douchers in the neighbouring cells, to call the porters, might have confirmed the belief, On approaching the flight of steps where I was to descend to take the douche, I drew back my foot, as I could not see where to set it down. This they attributed to fear, and cried out, 'N'ayez pas peur: soyez tranquille; nous vous menagerons doucement comme un enfant gaté.' They then brought me under one of the streams of water that issue from near the top of the cell, and told me to extend my hands in order to break the column of water, and distribute it over my body, as it would be too painful and scalding if received at first in one stream. When I had stood under the water a little time, I became accustomed to the heat. I then sat down, and the process of douching commenced. The water is made to pass through long jointed tin tubes, which are fixed on the two apertures where the streams enter. Each doucher takes one of these tubes, which he directs to different parts of the body on which the water falls.

"The first morning, the douching continued only five minutes: but the time was increased each succeeding morning till I was able to bear the operation for twenty minutes or half an hour." Mr. Bakewell proceeds to describe, in a very amusing manner, and with graphic truth, the mode in which the porters attached to the baths carried him, rolled up in flannel, more like a corps than a living man, to his bed room; and, leaving upon him the wet sheet in which he was first wrapped by the douchers after the operation, placed him in bed. The effects of the douching are thus described:

"A profuse perspiration immediately succeeds, and generally continues till your attendant comes to release you from your confinement, warm your linen, and assist you to dress. Half an hour was considered sufficient in my case; but, for

rheumatism or palsy, the patients sometimes remain in bed three or four hours. The operation is painful and very exhausting: it may be aptly compared to purgatory, when all the peccant humours are to be expelled by the continually modified agency of fire."

Notwithstanding the high temperature in which the douchers remain for so many hours daily during the season, yet they are in excellent health*. The season for douching is from the middle of June till the latter end of September. Before or after that time it is considered dangerous; the mornings and evenings being generally cold. It is seldom that a patient remains longer than a month at Aix; the operation being too severe to be longer continued without intermission.

I have quoted this passage from Mr. Bakewell's Travels, not merely because the subject of it, in strictness, belongs to our present enquiry, but because Nature, having provided the means of carrying on this operation in a more perfect manner than can be effected by art, has also suggested several circumstances, in the conducting of it, which are overlooked in performing the operation of douching in this country. In the first place, those streams of hot water flowing into caves or cells in the rocks, the atmosphere of the place in which the operation is performed is imbued with moisture, at a temperature which we must suppose—for Mr. Bakewell has not mentioned it—nearly equal to that of a vapour bath, within the moderate range. This, as it were, prepares the body for the douching, which can be regarded only as a peculiar method of applying percussion in combination with Caloric and water. In the second place, the fall of the column of water being from such a height as to produce a sensation of pain, followed by fatigue, and the benefit resulting from this being so obvious, we ought, in artificial douching, if I may so express myself, to imitate this by percussion with some elastic substance — as, for instance, a ball of cork affixed on a handle of cane. The pump at Bath is a species of Douche. The temperature of the baths of Aix les Bains is 110°; but this is diminished by the fall of the water in the douching cells. A temperature not exceeding 98°, with percussion, is adequate to fulfil every indication that can be expected from douching†.

3. *Solid media.*—With regard to the application of Caloric

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* One remarkable fact is mentioned by Mr. Bakewell regarding the health of the douchers. "One of them," says he, "told me that he commenced douching at three o'clock in the morning, and should continue till noon." This was a fat old man who had been a doucher for thirty years.

† I have successfully applied my suggestion on this subject to practice; using a cork ball covered with kid leather, and fixed in a whalebone handle to give the blows, whilst the hot water is poured on the part from a height of three or four feet.

through a solid medium, little requires to be said. It is conveyed by means of salt, bran, bricks, and metallic plates, which are wrapped in flannel or linen, according as the Caloric is required to be slowly or quickly transmitted: and this is regulated, not only by the nature of the conducting medium, but also by the colour retarding or facilitating the radiation of the free Caloric. This mode of applying Caloric is more directly stimulating than any of the other methods; and is, therefore, more generally resorted to in local affections, such as sudden attacks of a spasmodic kind, either of the heart or of the stomach. When the mere exciting effects of Caloric are required, the solid medium is preferable to that either of air or of any fluid, as it is not followed by perspiration and relaxation.

In the practical application of baths, as therapeutical agents, some cautions are necessary to be attended to.

In the first place, before employing the warm bath in any form, it is essential to recollect that the effects of the *warm bath* and those of the *hot bath* are perfectly different. If moderate stimulant effects only are required, the *warm bath* may be used for a short space of time; or, if a high degree of excitement be required, then we must have recourse to the *hot bath*. Within the range of these two, from 85° to 86°, we may regulate the stimulus to the necessity of the case: above 108° there is considerable risk; and even at 106° it must be used with much caution; for, when the temperature is so high, if no sweat soon follow, a corrugation of the skin ensues, the perspiration and cooling process are stopped, and the system suffers from accumulated Caloric. When a high temperature, therefore, is required, the vapour-bath should be employed. In deep-seated diseases, the temperature of the bath should be considerably above that which is necessary for relieving superficial affections; but, in this case, topical and partial baths, or fomentations, are preferable to the general bath, as the heat may be carried to the verge of vesication; and the exciting effect may be further augmented by friction and percussion.

If the exciting influence of the bath is intended to be transitory, and to be followed by relaxation, the temperature should not exceed 98°, and the bather should remain in the water more than half an hour. To secure the sudorific effect, the same temperature should be employed, and kept up during the continuance of the patient in the bath, which should be extended until nausea supervene. He is then to be removed and placed between blankets in bed, and the flow of sweat encouraged by tepid diluents. To secure the tonic effects, the same temperature may be employed; but the patient should not remain in the bath beyond fifteen minutes; and brisk exercise should be taken immediately afterwards; or, if he be too weak to take exercise, friction should be applied to the whole surface of the

body. That modification of friction which is called shampooing, an Hindostanee practice, is perhaps the most beneficial.

In the second place, previous to the use of the warm and hot baths, we must attend to the condition of the system. Hot baths are apt to bring on violent headache; thence they are more hurtful to full, gross habits, in plethora, and those predisposed to apoplexy. If warm bathing be necessary for such persons, previous depletion must be resorted to. The temperature of the bath, also, should be at first under 98°, and gradually increased. But in persons of an opposite diathesis, if a hot bath be necessary, the highest temperature may be employed at first, and the person should remain only a short time in the water, that its stimulant influence alone may be obtained.

The opinion that the warm bath is invariably debilitating, has arisen from the careless and indiscriminate use of it. According to Markard, a high authority on the subject of baths, the warm bath is tonic when the temperature does not exceed 90°. At Piedmont, during sixteen years, he saw many debilitated individuals restored to strength and health by baths of this temperature: and, during their use, the bathers always remarked that they felt stronger on the day of using the bath. He relates the case of a lady, who for three years was unable to turn in bed: she employed the warm bath every second day; and, in three months, was perfectly restored both to health and strength. As far as my own experience enables me to judge, I am inclined to extend the temperature to 96°; under which I have generally observed that baths debilitate rather than invigorate the system. Indeed, Markard himself does not deny that the effects are sometimes debilitating at 90°; but he ascribes them to the state of the nervous system.

Persons of a sanguine and melancholy temperament agree better with warm bathing than those of opposite temperaments. In the melancholic it is supposed that the warm bath acts by diminishing the rigidity of the muscular fibres, which are supposed to be greater than usual in those of this temperament. It is scarcely requisite for me to say that this statement of the condition of the muscular fibres in these temperaments is erroneous; and that the effect arises from the impression made on the nervous system, and the sympathetic respondence of the whole frame with the state of the skin.

Children sustain warm bathing better than adults; baths of a moderate temperature are, therefore, much and successfully employed in their febrile affections. In adult age, women bear warm bathing worse than men; a circumstance depending chiefly on the greater irritability and sensibility of their systems. In the state of pregnancy we are cautioned against ordering the use of the warm bath: but, as little attention is paid to this

circumstance in Russia, where the bath is used as a luxury, the necessity of this caution may be doubted.

It was customary with the ancients to anoint the body immediately on coming out of the bath: too rapid evaporation was thus prevented: and the same custom is still employed by the inhabitants of Asia, within the tropics. It is not less useful in cold climates, for preventing the too rapid abstraction of Caloric from the surface. Indeed, the practice is merely following Nature, who has given to the inhabitants of warm climates a perspirable matter more unctuous than that which she has bestowed on the inhabitants of colder countries. Anointing the body was anciently a part of the discipline of the bath; and we find that the Unguentarius was one of the principal officers attached to the public baths of the Greeks and the Romans*. Old or long-kept oil was chosen for the purpose of anointing bathers; and it was rendered saponaceous by an admixture of an alkali and vinegar. "Unctioni," says Celsus, "vero aptissimum est vetus oleum, vel nitrum, aceto et oleo admixtum." When the bather was in a delicate state of habit, the body was anointed, and again immersed in the bath. Indeed, anointing the body was employed under many circumstances by the ancients: thus Celsus says, justly, that it is improper to use the warm bath, in a valetudinary state of the habit, if the temples feel as if bound and the skin be dry; "the bather must," continues he, "be gently anointed, and by all means avoid cold, and be abstemious."

Many accidents occur in Russia from using the warm bath after a full meal; at which time it impedes digestion, and favours determination to the head. If we refer to the custom of the ancients, whose principal meal was supper, and was taken at sunset, we find that they performed all their violent exercises, and bathed an hour before supper. If it be injurious to use the warm bath with a full stomach, I should say that noon is the best period for employing the warm bath. When it is improperly used, it relaxes the frame of body, debilitates generally, causes syncope, hæmorrhages, and dyspepsia; and, therefore, when any of these occur, the use of the bath should be immediately discontinued.

The warm bath is beneficially employed for the cure of diseases. In febrile actions it has been employed from time immemorial, both to prevent their accession and to mitigate their symptoms. In intermittent fever, it has been used before the accession of the paroxysm. As far as regards the practice of the ancients, Celsus lays down the most ample directions in the 17th chapter of his second book "De Medicina;" and, setting

* De balneis omnia quæ extant apud Græcos, Latinos et Arabes, &c. Venet. 1585. Luther de balneis veterum cum inunctione conjungendis. Erford, 1771.

aside the false theories of the fathers of the healing art, many of their ideas upon the subject of warm baths in fever are excellent. They usually employed the bath during the intermission, rarely during the continuance of the paroxysm. Their cautions upon this point are so correct that I will translate the words of Celsus: "The warm bath," he says, "may be employed, provided, however, that the præcordia be not hard nor swelled, nor the tongue rough, nor any pain be felt either in the trunk of the body or in the head; and that the fever be not then increasing." If the warm bath be used immediately before the febrile accession, it operates by determining to the surface, and obviating that state of the extreme vessels which always attends the cold stage. In countries where the warm bath is much used, it is supposed to prevent the accession altogether. During the hot stage of fever, the effusion of tepid, or even cold water, is preferable to immersion of the body in warm water; it more rapidly diminishes the heat of the surface, and, consequently, the force of the heart and arterial system. In those cases, also, of intermittents, in which there is a great determination to the lungs, the tepid bath, at a temperature of 90°, is most advantageously used.

In typhus, the warm bath is employed to allay morbid irritation, and procure sleep. In those countries where it is much used, it is found to alleviate all the symptoms; and, in a special manner, to counteract the great determination to the head. If we employ it with the view of causing perspiration, it will prove most beneficial at the time that the skin is hot and dry, and the temperature increased. The general warm bath is little employed in this country, in continued fever: the local baths, especially the pediluvium, are more resorted to; and, certainly, by the revulsion which they induce, they arrest that determination to the head which brings on delirium. When this is to be obtained, the temperature should be as high as it can be borne: it should even redden the legs; for, unless this be effected, its counterirritant influence will be very feeble. In the commencement of fever, if the general bath be used, the temperature should not exceed 98°, and the patient should remain for, at least, half an hour in the bath: in the advanced stages, after debility has supervened, the heat of the bath should not be under 102°; but the time of remaining in it should be short, and never should exceed the period when the stimulant effect begins to subside. If the pediluvium only be employed, and the fever have run on for some time, it must be used hot for a very short period, and the patient must not be in the erect position; as this, at any advanced period of the disease, is apt to induce syncope. Dr. Currie employed the warm bath freely in continued fevers, if they were not contagious, especially when they were accompanied with affections of the lungs; and his practice was

more successful in these diseases than most men can boast of. This form of bath is also highly useful in hectic, when the heat rises during the paroxysm; and a hot feeling is experienced in the palms of the hands and in the soles of the feet.

In many of those diseases which consist of the inflammation of some particular part, accompanied with general febrile action, the warm bath has been much resorted to. In external inflammations it is often preferable to topical fomentations: easing the pain, lessening the swelling, and allaying irritation. It is most useful, also, in the passage of gall-stones of a large size, in that of urinary calculi, and in every instance of painful constriction in any internal cavity. The topical application of warm bathing, particularly in fomentations, is well adapted for these diseases: but, in general, no directions are given regarding their application, which is left altogether to the nurse; consequently they are seldom properly used. In a practical point of view, fomentations are valuable remedies in all cases of inflammation and spasm on the surface; and even in deep-seated inflammation and spasmodic action, such as occurs in colic. They are highly beneficial in inflammatory affections of the membranes, as in gout and rheumatism; and whenever there is a morbid tension, whether accompanying inflammation or not, from too copious a transmission of blood to a part, and the retention of it, as in piles and many local diseases.

In insanity, the value of warm fomentations was known so early as the time of Cœlius Aurelianus, who ordered warm fomentations to be applied with sponges to the eyelids, under the supposition that their effects penetrated to the membranes of the brain. It is unnecessary to refute the absurdity of this opinion: but, at the same time, we must agree in the justice of the remark, that although "we may not be quite satisfied with the anatomical and physiological knowledge of Cœlius, yet we must recollect that he treats very ably of the cure of *Insanity*, and that he doubtless had experienced good effects from this topical application of warm fomentations*." Much caution, however, is necessary in determining the proper period for using either fomentations or baths in insanity. The warm bath should never be employed in the early stage of mania, at which period, indeed, no temperature exceeding that of the body can be used with impunity. Instead of being refreshed by the bath, of a temperature higher than that of the body, the patient becomes languid; rigors ensue, followed by the dry heat of the skin; restlessness, and often wild delirium. It is in the convalescent stage of the disease in which any advantage can be expected from warm bathing; it then excites the secretory organs, particularly the liver, to healthful action; it diminishes and dissipates the peculiarly offensive fœtor which maniacs always ex-

* Burrows' Commentaries on Insanity.

hale, and re-establishes the cuticular function. The temperature of the bath, for this purpose, should not exceed 98°, and the patient should not continue in it longer than twenty minutes. If any turgescence of countenance or confusion of ideas supervene, a napkin, wrung out of cold vinegar and water, should be wrapped round the head, and the use of the bath suspended.

In a disease of more frequent occurrence, catarrh affecting the Schneiderian membrane, nothing assists so much the removal of the inflammation in the nostrils and frontal sinuses as fomenting the nose and forehead with a large hollow sponge squeezed out of hot water.

Poultices are preferable to fomentations in some cases. They are chiefly used in allaying tension and pain in local inflammation, where the inflammatory action, being confined to a part, thickens it: by keeping up a proper degree of heat for a certain time, the morbid action terminates in suppuration. Poultices operate on the same principles as fomentations and the warm and vapour baths: their use, therefore, may be greatly extended. Thus, for instance, as perspiration is induced on the part, and much soothing follows their application, I would employ them in internal spasmodic affections, accompanied with pain; namely, colic and peritoneal inflammation. For the latter disease, they may be made with a strong decoction of poppy-heads, instead of plain water. In such cases, also, they should be spread out thin upon cloths, and very frequently repeated.

In every species of Cynanché, or sore throat, warm bathing has been found useful; but more especially in croup, Cynanché *trachealis*, a disease very common to children in some places of this island exposed to north-easterly winds. This disease varies in its symptoms: there is, however, generally spasmodic affection of the muscles of the upper part of the trachea, and a strong inflammatory action in the lining membrane of this air tube. The warm bath is applicable for the mitigation of both these symptoms: it diminishes the febrile action; allays the topical inflammation; and, as the warm vapour is also inhaled during its employment, it takes off the tension of the trachea, and checks the formation of the adventitious membrane, which is the most dangerous part of the disease. In children, indeed, as I have already stated, the warm bath exerts a more decidedly beneficial influence than in adults. When the warm bath produces its salutary effects in children, it is always followed by an easy, tranquil, and profound sleep.

In no disease so particularly as in rheumatism, whether acute or chronic, is the warm bath a remedy of great power. In the acute species, however, the phlogistic diathesis must first be relieved by large doses of calomel, tartar emetic, opium, colchicum, and purgatives; or, if requisite, by bleeding. The bath may be applied either generally or topically, according to the nature of

the attack, in the form of vapour, or that of water. The temperature of the general bath should not exceed 98°; and the patient should remain in it more than twenty-five minutes, or until a feeling of approaching syncope supervene. On rising out of the bath, he should be placed in a bed with blankets only, both because they are bad conductors, and because it is requisite to keep up the perspiration for some hours: when sweating is not excited, the use of the bath increases the severity of the disease. The sweating, when commenced, should be maintained for six or eight hours; for, although sweating be one of the symptoms of rheumatism, it does not prevent the necessity of artificial sweating. In the chronic form of the disease, the bath may be hotter; for, as it is a disease of debility, the patient cannot bear to be severely sweated. After the stimulant effect of the warm bath, as a counterirritant, it may be advantageously employed as a tonic, at a temperature of 96° to 98°, the patient remaining in it for a short time only; and taking brisk exercise immediately after coming out of the bath.

In small pox the warm bath has been used from the earliest periods of recorded facts. In Hungary, Markard relates, that when a person falls sick of small pox, he is immediately put into the bath, then wrapped in warm linen and put to bed, where he is sweated; and this treatment is repeated several times, until the pustules appear. While these are out, the use of the bath is discontinued. Dr. Fisher states, that so successful is this treatment, that, in 1727, in a very fatal epidemic of small pox, no child died in the villages and towns where the bath was used. In the writings of De Haen, many successful histories of this treatment are related. In one district in Russia, 116,000 persons were seized with natural small pox in one year: the greater part used the warm vapour bath, and such was its beneficial effect, that not more than twenty-five of the whole number died.

In catarrh, when the cold applied to the surface produces a determination to the lungs and a febrile state of the system, with a dry constricted state of the vessels of the surface, sweating produces a crisis and obtains relief; and warmth to the whole surface is peculiarly useful and agreeable. In such cases the use of the warm bath is too often neglected; and even the pediluvium, which is more commonly employed, is used in a manner seldom or never efficacious.

In dysentery there is a determination to the intestines, and, whilst the disease proceeds, the surface becomes dry and harsh. One of the principal objects, therefore, of the practitioner is to equalize the circulation and determine to the surface. For this purpose nothing answers better than the warm bath, for promoting the cuticular action, and consequently relieving the intestines: and many proofs of its efficacy from the practice of

army physicians—for instance, that of Sir J. Pringle, Sir George Baker, Dr. Rollo, Sir G. Blane, Dr. Dewar, and others—might be brought forward. The temperature of the bath should not exceed 98°; and the patient should remain in it for a considerable time. It is best adapted to the second stage of the disease, after proper evacuations have been procured and the febrile excitement diminished. Warm bathing is equally well adapted for the relief of colic and spasmodic obstructions: and not less so for those affections that depend on some directly sedative or paralyzing cause, such as the poison of lead.

In spasmodic and convulsive affections, the warm bath is one of the best remedies we can employ. Tetanus, in particular, has been benefited by its use. In South Carolina, Dr. Chambers trusted altogether to opium and the warm bath. If the pulse was very frequent, and the heat of surface great, he used the bath at 96°; but if the pulse was not much affected, and the temperature of the skin moderate, he then raised the heat to 102°, and kept his patient in the bath until the pulse became full and soft; and, on taking him out of it, administered opium every half-hour. Dr. Girdlestone employed the warm bath in the same manner in India. When the disease arises from cold, or alternations of temperature, this plan will prove successful: but, in traumatic tetanus, dry cupping should be employed along the course of the spine, alternately with the hot bath at 102°.

In dropsy, warm baths, both natural and artificial, have been long employed, and found to aid the removal of the effused fluid: but it must be remarked, that, if the warm bath does not soon cure, it is likely to increase this disease.

In diabetes, the warm bath has been found a useful addition to other means, acting as a counterirritant, in subduing the irritation, both local and general, which is often so conspicuous, and in aiding the influence of narcotics.

Finally, in no class of diseases is warm bathing more beneficial than in some forms of Dyspepsia; more especially those in which there exists some fixed or local visceral irritation, and a dry unhealthy state of skin, arising from an irregular distribution of the blood. The warm bath in such cases operates both as a soothing agent, and a derivative to the surface, aiding greatly in restoring the due balance of the circulation. Upon the whole, the influence of Caloric as an Excitant, when properly employed, is such as to merit the confidence of the physician*.

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* For further information on this subject, the student may consult the work of Markard, "On the Use and Abuse of Baths," published in German in 1733: those who are unacquainted with that language will find a valuable abstract of it in Dr. Beddoes' work on Consumption: much useful information is also contained in Saunders' Treatise on Mineral Waters; Falconer on the Dietetical and Medical Use of Warm Bathing; Reid on Warm and Cold Bathing; Cameron on the baths of the Romans. Lond. 1772; and Stix—de Russorun balnies calidis ac frigidis—Dorpat, 1802.

c. IODINE.—*Iodinium.* D.

The nature of this elementary substance, and its chemical properties, have been already described (p. 138). It is employed as a general Excitant, both in its uncombined and its combined state.

* *Uncombined Iodine.*—Simple Iodine has been prescribed in the form of pills; but, as there are many objections to this form, it is generally given in the tincture, which is merely an alcoholic solution of Iodine, in the proportion of two scruples of the Iodine to one ounce of Rectified Spirit. This solution is opaque, of a deep brown colour, exhaling the odour of Iodine, and impressing a very unpleasant taste on the palate. M. Lugol employs an aqueous solution of Iodine, which contains from half a grain to a grain of Iodine in a pint of water, held in solution by twelve grains of muriate of soda.

The usual dose of the tincture is ten or fifteen minims: but it may be gradually augmented until sixty minims be taken three times a day. The dose of the aqueous solution is a fluid ounce and a half.

* * *Combined Iodine.*—Iodine combines readily with Sulphur, Potassium, Iron, Mercury, Lead, and Arsenic, forming medicinal Iodurets.

Ioduret of Sulphur.—This is formed by rubbing together eighty-eight parts of Iodine and twelve parts of Sulphur, and exposing the mixture to a moderate heat. The product has a dark, lamillated structure, not unlike metallic Antimony, and exhales the odour of Iodine. It has been employed merely as a local Excitant, in scabies and some other cutaneous affections. Mr. Biett recommends it to be combined with twenty times its weight of Lard.

Ioduret of Potassium (Hydriodate of Potassa).—The only British Pharmacopœia in which this preparation is ordered is the work of the Dublin College. The process, however, which is described by that learned body is objectionable, on account of the preliminary step of making the hydriodic acid; and, in other respects, it is inferior to the following, proposed by my friend and colleague, Dr. Turner*. To a warm solution of pure Potassa add as much Iodine as it is capable of dissolving: this forms a brownish-red fluid, consisting of Iodate and Hydriodate of Potassa, with an excess of Iodine: evaporate to dryness and expose the dry mass, in a platinum crucible, to a red heat, to convert the Iodate into Iodide of Potassium. The fused mass is then to be dissolved out by water and crystallized.

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* Turner's Elements of Chemistry, 4th edit. p. 698.

This solution contains Hydriodate of Potassa, a salt consisting of 100.000 parts of hydriodic acid and 37.426 of Potassa, and which can exist only in solution. In the large way, the simplest mode of making it is, by decomposing the solution of Hydriodate of Iron with Carbonate of Potassa, and evaporating the filtered fluid, being careful not to add an excess of the carbonate. The solution is colourless, slightly acrid, and bitter. When it is evaporated and crystallized, a decomposition takes place, and it is converted into the iodide of potassium, which crystallizes in cubes. This salt is fusible and sublimes unchanged at a red heat: it is deliquescent, consequently very soluble, requiring two thirds only of its weight of water, at 60° Fahr. for solution. It is also freely dissolved by alcohol, and contains no water of crystallization. The Hydriodate in solution dissolves Iodine—a property which is useful in a practical point of view.

Ioduret of Iron (Hydriodate of Protoxide of Iron).—This Ioduret is readily prepared by rubbing together one part of soft iron wire, or very pure iron filings, with three parts of Iodine in a porcelain or Wedgewood mortar, adding distilled water until fifteen parts have been used: the whole is then to be put into a Florence flask with an additional piece of Iron and some more distilled water, and boiled. When the solution acquires a pale green colour, it must be filtered, and gradually evaporated to dryness in a flask, which must be broken to obtain the Ioduret.

When properly prepared, this Ioduret is of an iron-grey colour, brittle, breaking with a foliated fracture, and displaying a crystalline texture not unlike that of metallic Antimony. When perfectly dry, it is inodorous; its taste is simply styptic and wholly devoid of acrimony. It is extremely deliquescent, and in deliquescing is decomposed and converted into Iodine, Peroxide of Iron, and Hydriodate of the Protoxide of Iron. In dissolving it for medicinal use, therefore, the solution should be boiled with a piece of clean iron wire, and then filtered; after which it may be kept. The solution, or aqueous Hydriodate, should be of a pale greenish-yellow colour, when it contains three grains of the Ioduret to one fluid drachm of water.

The solution is decomposed by Chlorine, the mineral acids, Arsenious acid, Meconates, Gallic acid, and Tannin, the Alkalies, the Alkaloids, Carbonates of Alkalies, Sulphate of Copper, Salts of Lead, Mercury, Silver, and Arsenic, Hydrosulphates, Oxalates, and Hydrocyanates, and all infusions containing astringent matter: but it may be prescribed with Sulphates, Nitrates, Muriates, and Phosphates. The dose of the Ioduret is from gr. ii to gr. vi, twice a day.

Ioduret of Mercury.—If metallic Mercury and Iodine be triturated together in equal proportions, these substances combine, and a protiodide of mercury is the result: it is of a *yellow*

colour, and consists of one equivalent of each of its constituents (Hy. + I.), or 1 prop. of Mercury = 200, + 1 of Iodine = 126: equivalent 326. If two parts of Iodine and one of Mercury be employed, the product is a biniodide, of an exceedingly *rich red* colour, the equivalent of which necessarily is 452. The first of these preparations may also be readily produced by adding a solution of the protonitrate to a solution of the hydriodate of potassa: the second, by using the pernitrate, or the permuriate of mercury. In these cases, the nitric acid of the nitrates employed combines with the potassa of the hydriodate, forming nitrate of potassa; whilst, at the same time, the oxygen of the metallic oxides, uniting with the hydrogen of the hydriodic acid, forms water; and the free Iodine and the metal combining produce the iodides. When the permuriate is used, a muriate of potassa remains in solution.

These compounds are insoluble in water, unless the water hold in solution a portion of hydriodate of potassa. The protiodide, when heated, becomes red; but, on cooling, resumes its yellow colour: on the contrary, the biniodide, when heated, becomes yellow, and the particles acquire a crystalline form; but it again changes to red as it cools; and at 400° Fahr. it fuses and sublimes. The dose of these iodides of mercury should not at first exceed a sixth, or a fourth of a grain, which may be given in the form of a pill, night and morning: but sometimes, even in these doses, they cause an uncomfortable sensation of heat at the epigastrium, loss of appetite, and restlessness; under which circumstances their use should be suspended for some days.

For external application, an ointment is prepared with half a drachm of either of the iodides and one ounce of lard.

Ioduret of Lead.—This Ioduret is readily formed by mixing together equal parts of the nitrate of lead dissolved in water and hydriodate of potassa, also in solution: a yellow precipitate is produced. Dissolved in boiling water, this forms a colourless solution, which, on cooling, deposites crystalline scales of a brilliant golden colour and lustre. This ioduret is composed of 1 prop. of Lead = 104, + 1 of Iodine = 126: equivalent 230.

The dose of this preparation for internal use should not exceed a quarter of a grain at first. An ointment is prepared in the proportion of one drachm of the ioduret to one ounce of fresh lard.

Ioduret of Arsenic (Hydriodate of Protoxide of Arsenic).—This is prepared by triturating together 37.7 parts of metallic Arsenic and 126 of Iodine, or boiling these together and evaporating the filtered solution to dryness. The colour of this Ioduret, which is a sesqui-ioduret, is a garnet red, very soluble in water, but only partially in alcohol: it changes to a white, micacious-looking salt when acted on by strong alcohol,

and seems to be converted into a compound of protioduret of arsenic and arsenious acid, which is scarcely soluble in water. The solution of the sesqui-ioduret, or the Hydriodate of Arsenic, is decomposed by the same substance as the Ioduret of Iron. It is a most powerful excitant and active poison, and requires to be administered with more caution than even Arsenious acid. I have prescribed it with advantage in cases of obstinate Lepra, in doses of the tenth of a grain twice a day, gradually increased to one sixth of a grain.

For medicinal purposes, the Iodide of Potassium, in the proportion of thirty-six grains to an ounce of water, forms a solution of the Hydriodate of which from ten to thirty minims are given for a dose three times a day: but the dose may be gradually extended to ten times this quantity. Ten grains of Iodine may be dissolved in this solution, when a more powerful medicine is required. This solution is decomposed by Chlorine, and Nitric and Sulphuric acids, which evolve free Iodine: and by the salts of Mercury and Lead, which form Iodurets.

As a local application, the Ioduret of Potassium is employed with advantage as a friction over scrophulous tumours. The usual strength of the ointment is four parts of the Ioduret, one part of Iodine, and thirty-two parts of Lard. The ointment of M. Lugol is double this strength.

Iodine and its preparations operate as powerful Excitants, entering the circulation and stimulating in a special manner the capillary system. Its primary action is exerted upon the stomach and intestinal canal—a fact which has been fully ascertained by its effects upon persons who have taken it in overdoses, as well as those observed in dogs who have been poisoned by it. Indeed, from the powerful manner in which it attacks the skin, even when largely diluted, its stimulant influence, when internally administered, might have been prognosticated. Pure Iodine, or the Tincture, when taken into the mouth, in moderate doses in solution, impresses a slight sensation of acrimony in the throat, which extends to the stomach and other digestive organs, awaking appetite and promoting the gastric function: but, even in small doses, namely, a quarter of a grain, frequently repeated, it sometimes proves deleterious, in consequence of its absorption and accumulation in the system; for, like some other remedies, particularly Foxglove, it may remain inactive for some time, and then suddenly display its powers with violence. Its absorption is so evident, that its presence can be detected in the blood, in the urine, and in the perspiration. It is supposed that the nervous plexuses and the great sympathetic nerve are particularly acted upon by Iodine; but its chief influence, as an Excitant, is undoubtedly exerted upon the absorbents, which it appears to urge to unusual activity; for, during the continued use of Iodine, all the organic

tissues, particularly the mammæ in women, and the testicles in males, waste: and no gland in the body is exempt from the action of Iodine. M. Lugol has observed a most remarkable discrepancy in the action of Iodine; namely, that women labouring under scrophula, instead of becoming emaciated, as is common during a course of this medicine, gain flesh; and Majendie has observed similar effects to occur. When an overdose is taken, the symptoms are heat and a sensation of weight in the epigastrium, pain at the bottom of the sternum, particularly when pressure is made upon that part, cardialgia, great restlessness, burning heat of the skin, excessive thirst, and frequent purging of dark bilious matter; the pulse feels weak and tremulous; palpitations supervene, with frequent syncope and extreme exhaustion. In irritable habits, even when the dose is not so large as to deserve the epithet overdose, it causes a febrile excitement, often accompanied with nausea, vertigo, and headache; and, occasionally, with symptoms which resemble those of shaking palsy.

As a therapeutical agent, Iodine has proved a successful remedy in bronchocele, and in scrophulous affections*; but, in the modification of scrophula in which the glands of the mesentery are chiefly involved, little advantage has been derived from it. It has been found beneficial also in chlorosis, amenorrhœa, leucorrhœa, and syphilitic cachexia. M. Barbier and some other Continental physicians suggested the propriety of employing Iodine and its preparations in hypertrophy of the heart; but he candidly acknowledges that his hopes were disappointed. In the Hotel Dieu, where cases of hypertrophy frequently occur, no advantage whatever resulted from the employment of Iodine.

Iodine has been proposed as a remedy in phthisis, under the idea that it might cause the absorption of the tubercles, and remove the indurated state of the pulmonary tissue. It has also been suggested as a remedy to arrest the accession of the paroxysm in gout by M. Gendrin; but experience has not verified either of these proposals.

In reasoning upon the causes and the nature of ovarian dropsy, I was induced to think that as the tension of the cyst is probably that state which is natural to, and consequently most favourable for, the morbid enlargement of the diseased organ, and that, whilst this remains, the vitality of the part would always enable it to resist any effort for its removal by the action of remedial agents on the absorbents, but that, were this tension removed, and the cyst to remain flaccid, it would then be nearly in the state of a foreign body within the abdomen; and a powerful excitement of the absorbents might be able, if not wholly to re-

* Lugol, Mem. sur l'Emploi de l'Iode dans les Affect. Scroph. Paris, 1829.

move it, at least so to change the action necessary for its growth as to keep the disease stationary. No Excitant appeared so well adapted to fulfil these intentions as Iodine; I therefore resolved, immediately after tapping, to throw in as much mercury and Iodine as the stomach would bear; at the same time, aiding its action by friction over the abdomen with the ointment of the Iodide of Lead. Of five cases treated in this manner, three have recovered. In these instances, the dose of the tincture was carried to the extent of sixty minims, three times a day.

With regard to the value of the different preparations of Iodine, all of them are powerful Excitants: they combine the properties of the substance united to the Iodine with those of this substance, and operate accordingly; thus the Iodurets of Mercury operate as alteratives; those of Lead as diuretics; and those of Iron and Arsenic as excitant tonics; whether externally or internally employed. But, under whatever form Iodine is administered, its effects must be closely watched; and the use of the remedy suspended on the first appearance of any untoward symptom*.

d. MERCURY†. *Hydrargyrum.* L. E. D.

Mercury was known to the ancients, and used by them in the art of gilding and for other purposes‡. It was, however, regarded by them as a poison§, and consequently not therapeutically employed; and it was not until the attempt of the alchemists to render this metal solid produced an examination of its chemical qualities, that the discovery of its medicinal properties was made. In its metallic form, it exerts no influence on the animal frame; and it must be combined with Sulphur, Iodine, Chlorine, Cyanogen, Oxygen, and acids, before it can operate upon the living frame. When combined with these substances, it enters the circulation, exciting powerfully the whole of the glandular system, and increasing, in a remarkable degree, both the secretions and the excretions.

In preparing Quicksilver for medicinal purposes, the first

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* On the subject of Iodine and its preparations, the student may consult the following works: *Manson*, on the effects of Iodine in Bronchocele, &c. London, 1825.—Archives de Med, tome iv, p. 321. *Boullay*, Ann. de Chimie et de Phys. 1827. *Lugol*, Mem. sur l'emploi de l'Iode, &c. Paris, 1829. *Lugol*, Mem sur l'emploi des Bains Iodurets: Paris, 1830.

† I have not been able to trace the origin of the name Mercury; but it probably arose at that period when the science of chemistry and the art of healing were both encumbered with the ceremonials of religion and the mysticisms of astrology: thence the metals were placed under the influence of the planets.

‡ Aristotle describes a wooden Venus, which moved by means of Quicksilver; αργυροσκυτος, literally *liquid silver*.

§ Paulus Egeneta, lib. vii, c. 3. Arctuarius, lib. v, c. xii.

object is to ascertain its purity ; for, although it is brought pure into this country, yet it is sometimes, afterwards, adulterated with Lead. To detect this adulteration, a portion of the suspected Mercury must be shaken with a little distilled water; then digested in some distilled vinegar, to dissolve the oxide of lead formed by the action of the water, without acting on the Mercury. If, on shaking this fluid with a solution of sulphuretted hydrogen, it throw down a black precipitate, we may conclude that lead is present in the Mercury. To determine the quantity of the adulteration, a solution of sulphate of soda must be added to the acetate, and the precipitate dried: 100 parts of the dry sulphate indicate 72 per cent. of lead. Mercury readily amalgamates with lead in any proportion ; and, when the quantity is small, the appearance of the metal is little altered: but a much larger quantity of lead may be held in solution by Mercury without diminishing its fluidity, if bismuth be also present. The bismuth is readily detected by pouring distilled water into the solution of the suspected metal in nitric acid, when a white precipitate falls down.

The first substance which I shall notice as giving activity to Mercury is *Sulphur*.

* *Mercury with Sulphur.*—We find that sulphur is combined with Mercury both with and without the aid of caloric. In the first, simple trituration of equal weights of mercury and of sulphur is continued until all the metallic globules disappear and a uniform black powder is produced, which is insipid and inodorous. This is the *Black Sulphuret of Mercury*, the Hydrargyri Sulphuretum Nigrum of the British Pharmacopœias. The rationale of the operation is not well understood. It was maintained by Fourcroy that the metal is imperfectly oxidized ; but this opinion was refuted by Proust, by a set of admirably conceived and satisfactory experiments. It is now a well-established fact, that a direct combination between a metallic oxide and sulphur is a rare occurrence. It is probable that the Mercury unites with its full complement of sulphur, and is formed into a Bisulphuret of Mercury, which, in the entire preparation, is united with some uncombined sulphur. This opinion of its composition is confirmed by the fact, that, by boiling the Black Sulphuret of Mercury in a solution of pure potassa, the excess of sulphur is converted into sulphuret of potassa, and thus removed from the Sulphuret of Mercury, which remains in the form of a black powder, insoluble in nitric acid ; and, when exposed to a red heat, it assumes all the characters of the red sulphuret, or cinnabar. Now, as cinnabar requires for its formation two proportionals of sulphur and one of mercury, the conversion of the black powder, remaining after the action of the potassa, into cinnabar, when exposed to a red heat, authorizes the con-

clusion that the mercury in this preparation exists also as a bisulphuret. Mr. Brande regards the Black Sulphuret as a compound of

Bisulphuret of Mercury	58 or 1 prop.	=	232
Sulphur	42 — 1 ——	=	16
	100	Equiv.	248

This is the opinion of Mr. Brande: but Mr. Phillips regards it as a mixture of

1 prop. of Mercury	=	200
1 —— Sulphur	=	16
		216

When heated in an open vessel, it emits sulphurous acid gas, becomes of a deep violet hue, and afterwards sublimes of a brilliant red colour.

This is very uncertain as a therapeutical agent. It is chiefly used as an Excitant to reduce scrophulous swellings; and sometimes in diseases of the skin, and for destroying ascarides. The dose is from gr. xii to ʒiv.

b. Bisulphuret.—The second preparation of sulphur with Mercury, in which heat is employed, is the Red Sulphuret, Hydrargyrum Sulphuretum Rubrum of the London College: the *Minium* of the ancients; the Cinnabar of the moderns. It is prepared by bringing the Mercury into contact with the sulphur in a melted state, and afterwards rubbing the compound into powder, and subliming. It is more simply prepared by subliming the black sulphuret prepared by trituration.

This preparation may be regarded as a bisulphuret, in which the combination of the sulphur and Mercury is more complete than in the black sulphuret. It is in the form of bright red crystalline cakes; is inodorous and insipid, insoluble in water, and is not acted on by sulphuric or muriatic acids. Chlorine inflames it: and a mixture of nitric and muriatic acid decomposes it and separates the sulphur. It is decomposed in a red heat; the sulphur being converted into sulphurous acid and flying off, and the Mercury evaporating in fumes: it is also decomposed by lime, the alkalies, and several of the metals. It consists of

Mercury .	86.2 or 1 prop.	=	200
Sulphur .	13.8 — 2 ——	(16 × 2) =	32
	100.0	Equiv.	232

As a remedial agent in venereal affections, it has been used in the form of fumigation; but it is inferior to the grey oxide for this purpose, and being altogether a very inert and unnecessary preparation, it is now rarely employed, except in some empiri-

cal nostrums, in which Dr. Paris assures us that it forms the chief ingredient.

* * *Mercury with Iodine.*—The combinations of Mercury with Iodine have been already mentioned; and it is only necessary to state here that they may be also formed by triturating the Mercury and Iodine together and afterwards subliming the mixture in a tube. An excess of the Mercury is necessary to prevent any uncombined Iodine from existing in the preparations.

* * * *Mercury with Cyanogen.*—Mercury readily combines with CYANOGEN, a compound substance, consisting of carbon and nitrogen in intimate union. (See Sedatives).

Cyanuret or Bicyanide of Mercury is formed by boiling eleven parts of Peroxide of Mercury with eight of Ferrocyanate of the Peroxide of Iron (Prussian blue) in a moderate quantity of water: a double decomposition takes place; the oxygen of the peroxide unites with the iron and the hydrogen of the ferrocyanic acid; two equivalents of the cyanogen, set free, unite with the Mercury, and produce the Cyanuret, which remains in solution; while peroxide of iron is precipitated.

Cyanuret of Mercury is perfectly neutral, is colourless, inodorous, with a styptic, disagreeable taste. Its crystals are long, quadrangular prisms, having a specific gravity 2.7612; soluble in water, but more so in hot than in cold water: boiling water deposites again the salt on cooling. The solution is decomposed by sulphuretted hydrogen gas; protosulphuret of Mercury is precipitated, and hydrocyanic acid remains in solution. The salt is decomposed by heat; the Mercury is sublimed in the vessel, and the cyanogen escapes in the gaseous state.

Cyanuret of Mercury is composed of 7.91 parts of Mercury + 20.009 of cyanogen; or 1 prop. Mercury = 200, + 2 prop. cyanogen (26 × 2) = 52; making the equivalents 252.

This preparation, now ordered by the Dublin College, is employed on the Continent as a remedy in syphilis, and in suppression of urine*. From gr. xii to gr. xxiv are dissolved in two pints of distilled water; and from one spoonful to four spoonfuls, in a glassful of mucilage of gum, are given twice a day. It is also prescribed in pills containing from one eighth to one sixth of a grain; but it requires to be administered with great caution, as it operates as a virulent poison when given in large doses, producing effects closely resembling those caused by corrosive sublimate.

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* Archives Générales de Medecine, vol. ix. Dic. des Scien. Med. t. xxxii, p. 480. Stucke de Alcaloidibus. Berlin, 1822.

* * * * *Mercury with Oxygen.*—Oxygen unites with Mercury in two proportions; namely, as a *protoxide*, that is, with one equivalent of oxygen, the other a *peroxide*, with two equivalents of oxygen.

a. Protoxide of Mercury. When Mercury is minutely divided by friction, it attracts oxygen and is converted into the *Protoxide.* M. Guibourt and some others have denied that Mercury, thus treated, forms a Protoxide; and contend that it is a mixture of the deutoxide and very minutely divided Mercury. It is a black powder, without any metallic lustre, insoluble in water, and having a coppery taste; and that it is not merely mechanically divided, is evident from its solubility in muriatic acid, which metallic Mercury is not. According to the experiments of Donovan and Sefstrom, this black powder is a compound of

Mercury . .	96.16	or	1 prop.	= 200
Oxygen . . .	3.84		1 ——	= 8
	100.00		Equiv.	208

There is much probability that this statement is true: and one proof of its being an oxide is its striking resemblance to the *grey oxide*, which is prepared either by rubbing Calomel in a mortar with pure Potassa, washing the product with cold water and drying it spontaneously in a dark place, or, as ordered in the London Pharmacopœia, by boiling one part of Calomel with two hundred and fifty parts of lime-water, constantly stirring until the grey oxide subsides. In this preparation a muriate of lime and an oxide of Mercury are formed: the water is decomposed, and its hydrogen, uniting with the Chlorine of the Calomel, forms the muriatic acid of the muriate of lime, whilst its Oxygen, combining with the Mercury, forms the grey oxide. The same explanation accounts for its formation when, according to the Dublin formula, one part of Calomel is rubbed with four parts of hot liquor potassæ. The products are Protoxide of Mercury and muriate of potassa. Thence it is evident that the grey precipitate formed from the Calomel either by lime-water or by potassa is an oxide; and there is reason for concluding that the grey powder procured by trituration, in as much as it resembles that formed from the Calomel, both in its chemical properties and its medicinal influence, is also an oxide.

This protoxide is the base of several of the most useful preparations of Mercury.

Combined with saccharine matter, it forms the *blue pill*, as it is termed; with lard, the *blue* or *mercurial ointments;* and, with the addition of camphor and ammonia, the *liniment of*

Mercury of the London Pharmacopœia; and, with ammoniacum, the *plaster of gum ammoniac and Mercury*. It is this oxide also which forms the active portion of the preparations of Mercury with *magnesia* and with *chalk*. The substances with which the Mercury is triturated in forming these preparations, either by their viscidity or some other quality, facilitate the division of the metal, and consequently its oxidizement.

b. Peroxide.—This is Mercury united with a full dose of oxygen. It is effected either by exposing Mercury or its protoxide to the action of heat and air, at a temperature under 600°, or by decomposing the nitrate of Mercury by means of heat. For preparing the first variety, the London College orders a pound of pure Mercury to be put into a glass vessel with a long narrow neck and broad bottom, which is to be exposed, open, to a heat of 600° until the Mercury is converted into red scales. For preparing the second, three pounds of pure Mercury are to be dissolved in a pound and a half of nitric acid, diluted with two pints of distilled water, and the solution evaporated until a white substance remain. This is to be rubbed to powder and exposed in a shallow vessel to a slow fire, gradually raised until red vapours cease to appear.

In the first mode of preparation, the Mercury is slowly volatilized; and in this state of minute division it attracts the oxygen of the air circulating within the vessel; and, by degrees, the whole is converted into a peroxide. But, if the heat be increased above 600°, the oxygen is again expelled, and the oxide reduced to the state of fluid, metallic Mercury. In the second, when the Nitrate of Mercury is exposed to an augmented heat, nitric-oxide escapes, and a mass of a bright red colour remains. This preparation is generally supposed to be a simple peroxide, arising from the decomposition of the nitric acid; but it always retains a small portion of the nitrate undecomposed, as the degree of heat requisite to decompose the whole would be sufficient to expel the oxygen and reduce the metal. The presence of the nitrate is easily demonstrated by heating the precipitate in a glass tube; if it contain any nitrate, a yellow ring will form above the heated part.

The Nitric-Oxide is of an orange-red colour; for, although its chemical components are the same as those of the peroxide produced by the action of heat and air, yet it has neither the ruby-red colour nor the scaly appearance when it is prepared in the manner ordered in the Pharmacopœias. M. Gay-Lussac has demonstrated, that the difference observed in the grain and the colour depends on the crystalline state of the nitrate employed. If the salt be well bruised, an orange-yellow oxide, dull, and in powder, is the result; if it be in large dense crystals, the oxide will be of a deep orange colour; and, if it be

in small crystalline grains, it will have a scaly or crystalline character, and an orange-red colour*. It is scarcely soluble; but it communicates its metallic taste to water, and changes syrup of violets green. It is slowly decomposed by light.

The Peroxide of Mercury thus prepared is in deep ruby-red, brilliant scales, inodorous, and impressing an acrid, disagreeable taste on the palate. It is soluble to a small extent in water; is poisonous to animal life, causing violent vomiting and purging when taken into the stomach; and, in small doses, it is capable of quickly producing salivation. This oxide contains, as nearly as possible, double the quantity of oxygen contained in the protoxide; or of

Mercury.....	92.6	or 1 prop. =	200
Oxygen.	7.4	.....2 prop. =	16
	100.0	Equiv.	216

The small portion of the nitrate which the Nitric-Oxide contains renders it too acrid for internal use; but it is a useful escharotic when applied externally to fungous growths, and forms an excellent stimulating ointment when combined with lard or any bland ointment. Both of these varieties of the peroxide are sometimes adulterated with brick-dust and red oxide of lead. These substances are easily detected by putting any specific quantity of the suspected oxide into a thin porcelain saucer, and submitting it to a strong heat; if there be any residue, its weight will give the quantity of the adulterating substance. If oxide of lead be this substance, it may be at once detected by submitting the suspected peroxide of Mercury to the action of the blow-pipe on a piece of charcoal; if lead be present, a globule in the metallic state will be formed.

Such are the Oxides of Mercury: they exert a considerable action on the animal economy, whether taken into the stomach or applied to the surface, or inhaled by the lungs in the form of vapour; in all of which modes they are employed as Excitants. They are taken into the circulation and produce a degree of temporary fever, increasing the action of the heart and arteries, elevating the animal temperature, and augmenting the irritability of the nervous system, manifested by a full quick pulse, heat of skin, perspiration, thirst, and restlessness. After a short time, a taste of copper is perceived in the mouth; the breath acquires a strong fœtid odour; the gums swell and become spongy; the tongue enlarges; the teeth loosen; and the saliva is secreted

* M. Brugnatelli prepares it by pouring upon one part of pure Nitrate of Mercury, three parts, by weight, of boiling distilled water; a small part only of the salt dissolves, and the rest is converted into a white concrete powder; five or six parts more of boiling distilled water are then poured on this powder: it instantly acquires a bright scarlet colour, and is red precipitate, requiring only to be washed on the filter, and dried in a dark place.

so abundantly as to run out at the mouth. These Oxides are not much employed: their continued administration, after salivation has continued to a great degree, may augment the fever so as to affect the brain, and even to cause death. When this has taken place, post-mortem examinations have detected metallic Mercury deposited in the mesenteric glands, in the salivary and mammary glands, and in the cancelli of the bones*. During life also, the reduced Mercury is exhaled from the surface; as its amalgamation with silver and gold, worn in the pockets of those under a mercurial course, clearly demonstrates. Now the question is, how has this reduction taken place? and whether is it the oxygen or the entire oxide of the metal that is the active agent? Although the difficulty of determining this point by any direct examination is undoubted, yet we may be conducted to it by collateral evidence. We know, for example, that albumen decomposes corrosive sublimate in the stomach, and reduces it to the state of calomel; it is therefore not improbable that the albumen of the blood may act in the same manner upon these oxides when they are taken into the circulation; and, during their reduction, the oxygen which they evolve may produce that state of excitement necessary for the destruction of the action which forms the venereal virus. This hypothesis derives some support from the effects of other oxidizing bodies in syphilitic affections; such, for instance, as the chlorates of gold and of potassa, which cause salivation under certain circumstances. It is, however, certain, that the Oxides of Mercury, when properly applied to the skin, or when taken with due caution into the stomach, cure the venereal disease, and manifest their influence on the habit by exciting powerfully the salivary glands and their excretory ducts.

* * * * * *Oxides of Mercury combined with Acids.*—The Oxides of Mercury unite readily with acids. The preparations formed by this union are different according to the nature of the oxide, whether it be a protoxide or a peroxide.

a. Protoxide with Nitric Acid.—The British Pharmacopœias order one preparation in which the protoxide is combined with Nitric Acid, the ointment of the Nitrate of Mercury. The salt produced is a pernitrate; but it is partially decomposed or reduced to a protonitrate by the fat and oil combined with it. The London College has ordered this ointment to be prepared with six ounces of lard, and only four fluid ounces of olive oil; but, when these proportions are adhered to, the nitrate is gradually reduced to the simple protoxide; and the ointment is so brittle as to resemble a plaster, and consequently is unfit for use, unless softened by the addition of oil. When no lard is employed, a golden-yellow ointment is the result, which is

* Joan. Farnel, cap. 7, Fallopius, cap. 78, &c.

very long of acquiring an undue consistence ; and it is said that this consistence is never acquired if a larger proportion of nitric acid be employed. Dr. Duncan has suggested that the higher oxidizement of the metal may prevent the decomposition of the nitrate ; and he has published the formula of a Mr. Duncan, as fitted to form a most perfect ointment, equal in colour and permanent softness to the empirical preparation known under the name of the Golden Eye Ointment. The difference between this and the officinal preparation is the larger proportion of acid employed, and the higher temperature applied at the time of the mixture of the mercurial solution with the oily substances*. This ointment is not employed in syphilis, except as a topical Excitant in some eruptions in secondary affections of that disease†.

b. With Acetic Acid.—This is the proto-oxide combined with acetic acid, forming the proto-acetate of Mercury ordered in the Edinburgh and London Pharmacopœias. The formula of the Edinburgh College, although it orders more nitrous acid to be used than is absolutely requisite for the solution of the Mercury, is to be preferred. The proportions are three ounces of Mercury, which are to be dissolved in four ounces and a half of diluted *nitrous* acid, and the solution added to three ounces of acetate of potassa dissolved in eight pounds of boiling water. In this process, the protonitrate of Mercury is first formed ; and this is afterwards decomposed by the acetate of potassa ; the results being nitrate of potassa, with some undecomposed nitrate of mercury held in solution, and a Proto-acetate of Mercury, which, as the solution cools, crystallizes in silky scales, and is easily separated on the filter. It is of importance, in preparing the protonitrate, that a low temperature be employed, as a peroxide might be formed, and a Peracetate, instead of a Proto-acetate, be the result‡. The solution of the acetate of potassa should be tepid when that of the warm protonitrate of mercury is added to it. In washing the crystals on the filter, the water should be slightly acidulated with distilled vinegar, as the Protoacetate is extremely susceptible of decomposition. When the water is not acidulated, particularly if it be warm, a black matter, which is protoxide of mercury, precipitates ; whilst one portion only of the acetate crystallizes, leaving a deutoacetate and free acid in the mother liquor. For the same reason, it should be dried between folds of blotting-paper, not by heat.

This Acetate of Mercury is in silvery, white, silky, elastic crystals, inodorous, acrid to the taste, and requiring 600 parts of

* Edinburgh New Dispensatory, 12th edit. p. 1049.
† Acta Nova Reg. Soc. Med. Harviensis, 1818.
‡ The nostrum of *Keyser* was a peracetate.

water, at 60° Fahr. for their solution. They are insoluble in alcohol; but are decomposed and converted into protoxide of mercury by the alkalies, and also by sulphuric acid, which disengages acetic acid. When exposed to the light, this Acetate is decomposed: this also occurs when it is heated; and, as the metal is reduced, vapours of acetic and pyroacetic acid are exhaled.

This salt is capable of curing syphilis; but it is rarely employed*. Its dose is from one to four grains. In overdoses, it causes a sensation of burning in the œsophagus and stomach, inflammation of the alimentary canal, vomiting and purging, sometimes of blood. The pulse is quick, full, and hard, the countenance flushed; cramps in the stomach and convulsions succeed, and, if relief be not obtained, the result is fatal.

c. Peroxide with Sulphuric Acid.—The Dublin College orders a Persulphate of Mercury to be prepared with six parts of Mercury, six parts of sulphuric acid, and one part of nitric acid. In this process, the nitric acid is decomposed, and gives its oxygen to the Mercury, converting it into a peroxide, which unites with the sulphuric acid. This salt is white, and contains an excess of acid, or is a Bipersulphate; but, when perfectly neutral, it is not pure white, and is in small prismatic crystals. It deliquesces when it contains an excess of acid; and, when water is poured on it, by washing off the soluble persalt, it is converted into the Subsulphate. It consists of 1 prop. Peroxide of Mercury = 216, + 2 prop. Sulphuric acid (40 × 2) = 80, making the equivalent of the salt 296 (Hy. + 2 S). It is used only for making the Subsulphate and the Perchloride of Mercury.

The *Sub-sulphate* (the *Turbith Mineral* of Crollius) is formed in two modes: 1, according to the Edinburgh College, by boiling together two parts of Mercury and three of sulphuric acid, and washing with boiling water: 2, according to the Dublin College, by merely acting upon the bisulphate with hot water. This preparation is too violent in its action to be employed as an internal remedy, and it even requires to be largely sheathed with starch or some bland powder, when it is employed as a topical Excitant, or an Errhine. When it is overdosed, it operates as a powerful irritant, producing violent vomiting, purging, and inflammation of the mucous membrane; but it does not chemically corrode the animal textures.

d. Peroxide, with Muriatic Acid and Ammonia.—The *Hydrargyrum præcipitatum album* of the London Pharmacopœia, the *Hydrargyri submurias ammoniatum* of the Dublin, is prepared by precipitating a mixed solution of the perchloride of

* Cowper's Researches on Keyser's celebrated Antivenereal Medicine, &c. London, 1760.

Mercury and of muriate of ammonia by means of a solution of subcarbonate of potassa. In this operation, it is supposed that the perchloride suffers a change by the decomposition of a portion of the water, the hydrogen of which unites with the chlorine of the perchloride, whilst the oxygen combines with the Mercury thus set free, forming muriatic acid and peroxide of Mercury: the potassa, also, decomposing the muriate of ammonia, the ammonia combines with the peroxide, and shares with it the muriatic acid, thus forming a triple insoluble salt, which is precipitated. It is not improbable that the carbonic acid, in this case, when a subcarbonate is employed, is united with the ammonia, and precipitated with it; but, as Mr. Phillips justly remarks, it is not an essential part of the compound; and the same effect is produced if pure potassa be used instead of the carbonate. The salt, thus formed, is a light, inodorous, insipid, soft, white powder, perfectly insoluble in water. Its composition is stated to be 1 prop. Peroxide of Mercury = 216, + 1 prop. Muriatic acid, = 36.45, + 1 prop. Ammonia, = 17; making the equivalent 269.45. It is sometimes adulterated with white lead or chalk, which are readily detected by exposing some of the preparation to a red heat in a spoon or crucible, when the mercurial preparation is dissipated, and the adulteration remains: this is to be dissolved in acetic acid, and solution of Hydriodate of Potassa added; if lead be present, a yellow precipitate will fall.

This preparation is the base of one officinal compound only, the Unguentum Hydrargyri præcipitati albi of the London College, the Unguentum Submuriatis Hydrargyri Ammoniati of the Dublin College. This ointment is a useful stimulant in itch and some other cutaneous affections, when sulphur ointment cannot readily be used on account of its smell. It may be administered internally as an alterative; but it is inferior in every respect to Calomel.

* * * * * * *Mercury with Chlorine.*—Mercury has as powerful affinity for Chlorine as for Oxygen; and, by uniting with it, produces salts which are the most active medicinal agents among the preparations of this metal. If Mercury be poured into a phial containing chlorine gas, and agitated, the fluidity of the metal is instantly destroyed, and the phial becomes coated as if it contained an amalgam of Mercury; by continuing the agitation for a sufficient length of time, a protochloride of Mercury is formed. When heat is called in to aid the union of the Mercury and the chlorine, the union is more immediate, the Mercury is volatilized, sometimes takes fire, and a bichloride is formed.

a. Perchloride or Bichloride of Mercury.—This is the Hydrargyri Oxymurias of the London College: it is prepared by mixing together 296 parts or one equivalent of the persulphate

of Mercury and 17.40 parts or two equivalents of dried chloride of sodium, and subliming them by means of a strong heat. The theory of this process is thus explained: the metallic base of the chloride of sodium, the *sodium*, is oxidized at the expense of the peroxide of Mercury contained in the bipersulphate, and is thus converted into soda, which unites with the sulphuric acid of the bipersulphate, and forms sulphate of soda: this remains in the bottom of the subliming pot, whilst the chlorine and the Mercury, at the same instant, combine and are *sublimed* in the form of a bichloride. The perfection of the process depends on the preparation of the bipersulphate; for, unless this be complete, a mixed salt, containing both the chloride and perchloride, is the result: the process, therefore, of the Dublin college, into which nitric acid enters and secures the conversion of the Mercury into a peroxide, is to be preferred.

The period when this salt was first made is unknown; it is mentioned in the works of Rhases, Avicenna, and Geber, who lived in the tenth and eleventh centuries. The processes recommended in the British Pharmacopœias are a modification of the process invented by Kunkel, in 1722. In the large way, the bipersulphate and the sea-salt are ground together with black oxide of manganese, and the mixture, after being left for two or three days and dried with a gentle heat, is sublimed in bolt heads, on a sand bath. It is thus procured in the form of a solid cake.

The simplest and most direct method to form this salt is to dissolve the red oxide in muriatic acid*. The solution is effected without any ebullition or disengagement of gas; and when it is left at rest, the salt crystallizes spontaneously. This fact supports the opinion that the bichloride, in solution, is a muriate of the peroxide. Perchloride of Mercury is usually in the form of a white semi-transparent mass, consisting of small prismatic crystals; but, when the aqueous solution is carefully evaporated, it forms in rhomboidal cubes, or quadrangular prisms, with their sides alternately narrower, terminated by dihedral summits. It slightly effloresces in the air. Its taste is extremely acrid, and most disagreeably styptic. Its sp. gr. is 5.200 at 60° Fahr. It is soluble in about nineteen parts of cold water, and about twice its weight of boiling water: alcohol, at the ordinary temperature of the atmosphere, dissolves $\frac{1}{4}$ of its weight. It is soluble also in ether, in sulphuric, nitric, and muriatic acids, without alteration: and, in Ether and Alcohol, Camphor augments its solubility—a great practical advantage. Light decomposes the solution of the bichloride in water, and the protochloride is precipitated. It is decomposed by the fixed alkalies and lime

* Tromsdorff, Berthollet.

water; and an orange-coloured oxide of Mercury is precipitated. Solution of arsenic does not decompose it; but the arsenite of potassa, as well as the tartrate of antimony and potassa, and the nitrate of silver, decompose it. The fixed and volatile oils, the resins, all vegetable infusions and decoctions containing gum, sugar, extractive, the bitter principle, tannin, milk, and gelatine, reduce it to the state of a protochloride: it cannot be long preserved in distilled waters or weak spirits, calomel and muriatic acid being always formed. Acetate and subacetate of lead, sulphuret of potassa, all the hydrosulphurets, and soaps, also decompose it. These substances cannot, therefore, be prescribed in conjunction with Bichloride of Mercury. It is a compound of

Chlorine	26.48	or 2 prop. (35.45 + 2)	= 70.9
Mercury	73.52	— 1 prop. ———	= 200
	100.00	Equivalent	270.9 (Hy. + 2 Cl.)

The London College orders a solution of the bichloride to be kept ready prepared: but, for the reasons above stated, it is a bad preparation.

Bichloride of Mercury is a most powerful Excitant. Unless it be given in very minute doses, and in solution, it causes excruciating pain in swallowing, nausea, and vomiting; quickly destroying the vitality of the stomach, and corroding it; exciting inflammation of the lungs, the heart, and the salivary glands, with oppression of the brain and nervous system. Its vapour is highly dangerous to those who breathe it. In small doses, however, it is a valuable Excitant in secondary venereal affections; and in many cutaneous diseases, particularly leprous eruptions.

Whether this preparation enters the circulation, or, as Mr. Brodie has maintained, acts solely through the medium of the nerves, is undetermined: it has not been detected either in the solids or fluids of the body; but it is possible that it may, nevertheless, pass into the circulation; for every one conversant with chemical investigations, in reference to the detection of medicinal agents in the blood and secretions, must be aware of the extreme difficulty of detecting them, even when they have been injected into the blood. One fact noticed by Mr. Brodie affords some reason for thinking that it is absorbed; namely, its effects are not altered by the division of the eighth pair of nerves, which would be the case did it act solely through the nerves. When it has been taken in an overdose, the best antidote is albumen, and this appears to depend on a circumstance suggested by Dr. Christison, "that compounds, formed by corrosive sublimate with animal and vegetable substances, are either not poisonous, or, at least, very much inferior in activity to corrosive sublimate itself." It is, however, a curious fact, and one which renders albumen a less useful antidote than might be expected,

that in excess it does not effectually clothe the irritant influence of the poison; for the precipitate is redissolved.

As a remedy, Bichloride of Mercury has, occasionally, been a favourite with the leading physicians of different periods. Thus it was highly prized by Boerhaave, Van Sweiten, and their followers; and on their authority it came to be very generally used in syphilis. In the secondary state of the disease, it is useful for allaying the pains; and a gargle made of it, dissolved in a mixture of bitter almonds, is admirably fitted for healing the ulcers of the tonsils. In cutaneous affections it is an excellent remedy, both taken internally and applied externally, when largely diluted. The dose should not, at first, exceed the tenth of a grain: but it may be gradually augmented to one sixth. Mr. Guthrie has lately proposed to employ it in chronic inflammation of the eyes, in the form of an ointment composed of iii or iv scruples of the bichloride, m. xv of the solution of subacetate of lead, and ʒi of cetaceous ointment. As, in this case, the salt of lead reduces the Bichloride to the state of a protochloride, the latter might therefore be used. When administered internally, it acts chiefly on the kidneys; and, on account of its acrimony, mucilaginous and demulcent drinks should be given. The general principles upon which it affects the body are nearly the same as those of the oxides. It is employed externally in the form of lotions, injections, gargles; and on the Continent as baths*.

In chronic rheumatism, chronic laryngitis, mesenteric affections, and some other diseases in which inflammation of a subacute kind has been long continued, lymph is thrown out, and consequent thickening of membranes takes place. In such cases, the administration of small doses of the Bichloride, in combination with antimony and opium, have been found highly serviceable when carried to an extent merely sufficient to produce tenderness of the gums, without exciting salivation. Very soon after the mouth is affected the effused lymph is absorbed, and the whole of the secerning system acquires a new and more healthy action. The Bichloride, in these cases, being given in small doses, enters the circulation and stimulates generally the glandular and capillary systems, giving a new action to the whole. Thence, the further effusion of lymph being checked, that which was effused is taken up by the absorbents, and thrown out of the system. When, however, the morbid action of the capillaries, which has caused these deposits, has been sufficient

* See *Bromfield*, On the use of Corrosive Sublimate, &c. London, 1757. *Gataker*, Essays on Medical Subjects, &c. London, 1764. *Hoffman*, Diss. de Mer. Sub. Virtute in Affectibus Internis: Argent, 1766. *Brodie*, Phil. Trans. 1812. *Planché*, Essai sur l'Action Réciproque de quelques Sels Ammoniaceux par le Sublimé Corrosif: Paris, 1822. Manuel de l'Empoisonment par le Deutochlorure de Mercure: Paris, 1830.

to produce a change in the structure of a part, no benefit follows the use of the Bichloride, nor indeed of any alterative. The prevention of these structural changes and the irreparable mischief to which they give rise, is the object for which the Bichloride is prescribed; and, unless they are thus anticipated, they become highly dangerous. On the same principle, the Bichloride proves beneficial in several cutaneous affections. It is given in doses of from one tenth to one fourth of a grain dissolved in alcohol or in diluted nitric acid. In a highly irritable state, however, of the system, the Bichloride, even in the smallest doses, ought not to be administered.

b. Protochloride of Mercury, Calomel.—* *By sublimation.*—If four parts of the Bichloride of Mercury be triturated with three parts of fluid Mercury, a decomposition of the bichloride takes place; a portion of the chlorine passes to the Mercury, and the whole is converted into the protochloride. This conversion however is imperfect; therefore the mixture must be sublimed to complete it. The Edinburgh College orders a second sublimation. In the London process, four pounds of Mercury, thirty ounces of sulphuric acid, and a pound and a half of salt, are ordered: a persulphate is first formed; and this, being triturated with metallic Mercury, is converted into a protosulphate, which is mixed with the common salt and sublimed. A double exchange takes place, the oxygen of the oxide of Mercury in the protosulphate is attracted by the sodium of the common salt, which is thus converted into soda, and, attaching itself to the sulphuric acid of the protosulphate, forms sulphate of soda, whilst the chlorine of the common salt unites with the freed Mercury and forms the Protochloride or Calomel. The subsequent washing with muriate of ammonia, which is ordered in this formula, is of great importance, as it renders any corrosive sublimate that may have sublimed with the Calomel more soluble, and therefore easily separated; but the water must not be at a boiling temperature, as the newly prepared Calomel is apt to be reduced by it and converted into metallic Mercury and Bichloride of Mercury. Mr. Hennell, of Apothecaries' Hall, supposes that this takes place even at ordinary temperatures*.

It was formerly thought that many sublimations were necessary to form good Calomel; Lemery ordered three sublimations; but, not satisfied with this, it was frequently sublimed seven times, and was then termed *Aquila alba*. In this respect, however, the object is defeated by the sublimations; each giving rise to a fresh formation of bichloride: yet, so late as 1760, Professor

* A natural protochloride occurs crystallized in quadrangular prisms terminated by pyramids. It is called *Horn Quicksilver*.

Alston says, "The oftener it is sublimed, the less it purges, the more easily it enters the lacteals, and so the sooner and more certainly it raises a salivation!"

The protochloride of Mercury, procured in the large way by sublimation, is usually in the state of a dull white mass; but, when it is carefully sublimed, in small vessels, it forms a cake, on the surface of which crystals appear. Calomel is of a pale ivory colour, which indicates its purity, at least the absence of the bichloride. It is inodorous and nearly insipid. Its specific gravity is 7.2.

* * *By precipitation.*—The Edinburgh and Dublin Colleges order the protochloride to be also prepared by the precipitating the protonitrate of Mercury with a solution of sea salt. A double decomposition takes place. The chloride of sodium is formed by solution into muriate of soda, and then into nitrate of soda, by combining with the nitric acid of the protonitrate; whilst the chlorine, attaching itself to the oxide of Mercury, forms the protochloride. There are many objections to this preparation. In the first place, no heat, although directed in the Pharmacopœias, should be employed in any part of the process: in the second place, a much larger quantity of water than is ordered should be employed, to prevent the reaction of the hydrochloric and nitric acids and the consequent formation of chlorine, which, by combining with a portion of the Protochloride, converts it into the bichloride: in the third place, it is almost impossible to obtain this Calomel free from the Protonitrate of Mercury, the acrimony of which causes purging and griping; and, therefore, well-prepared Sublimed Calomel is to be preferred to this precipitated Protochloride.

The Protochloride of Mercury cannot be regarded as poisonous. It requires 1152 parts of boiling water for its solution. It differs from the bichloride in the following particulars: when rubbed in a mortar with caustic potassa, it is changed into black Protoxide of Mercury, owing to the alkali appropriating the chlorine, changed by the partial decomposition of the water of its solution into hydrochloric acid: the bichloride forms a brick-red precipitate. It is changed by solution in nitric acid, and in the aqueous solution of chlorine, which converts it into the Bichloride. Lime-water decomposes the Protochloride, in whatever manner prepared, and forms it into the state of the black oxide: and this is an excellent test of its purity; for, if it contain any of the bichloride, an orange-red tint is mixed with the black on the addition of lime-water. The alkalies and their subcarbonates, solution of sulphuretted hydrogen, the hydrosulphurets, solution of soap, and several of the metals, antimony, iron, lead, copper, and their salts, also decompose the Protochloride of Mercury. It is partially decomposed by long exposure to light. The composition of this salt is

Chlorine . . .	15.25	or 1 prop. =	35.45
Mercury . . .	84.75	1 prop. =	200
	100.00	Equiv.	235.45

This is one of the most useful of the mercurial preparations*. There is, indeed, scarcely any class of diseases for the relief of which it is not more or less employed.

It is curious to observe the extraordinary revolution which has taken place, at various periods, with regard to the doses of this preparation. The ordinary dose, at present, when we are desirous of bringing the system under the mercurial influence, is from one grain to two grains, combined with opium, taken every night, or every morning and evening, or, at the utmost, three times in twenty-four hours, until the gums be affected. Schreder states that, in his time, the dose was half a drachm: Geoffrey makes it from six grains to thirty: Neuterus gave, at first, fifteen grains; for the second dose, a scruple; for the third, half a drachm; and for the fourth, a scruple; which he continued until salivation was induced: and Michaelis Albertus informs us that Helwichius gave five scruples for a dose to two patients, and seventy-two grains to a third, which affected the mouth for a fortnight. Even when it was not intended to affect the mouth, scruple and half-drachm doses were very common in the seventeenth century; and at this day, in India, scruple doses are usually prescribed in the bilious remittents of that climate.

When exhibited as an alterative, Calomel, the *Protochloride*, operates on nearly the same principles as the bichloride. In all chronic diseases, it is advantageously combined with antimonials and opium; but, when it is intended merely to improve the hepatic secretion, it acts better when administered alone, at bedtime, and a mild aperient is taken in the morning. In the hepatic derangements of warm climates, in particular, Calomel produces the most beneficial effects; for, in general, no sooner does the presence of the Mercurial in the system manifest itself by its influence on the mouth, than the secretion of the bile assumes its proper and healthy aspect. It is, however, necessary to be aware that no Mercurial should be administered in acute inflammatory affections of the liver, until depletion has brought down the pulse; but, when this has been effected, it should then be given in such large doses as will rapidly produce ptyalism. When abscess occurs, the Protochloride is injurious.

* The inventor of Calomel is not known; but the process for preparing it was made public by Beguire in 1608. It has been known by a variety of names: for example, Draco mitigatus, Sublimatum dulce, Aquila alba and mitigata, Manna metallorum, Panchymagogum minerale, Panacea Mercurialis, and several other appellations. The term Calomel, although it is more applicable to a black powder than to one of an ivory colour, yet it is a better name, and more effectually prevents this preparation from being confounded with the bichloride, than the appellation *submurias*, adopted by the London and Edinburgh Colleges.

In the fevers of warm climates, Calomel is given in doses of from eight to ten grains every three hours; but, even in such doses, it does not act powerfully on the salivary glands; nor is this required, as salivation would lower the system too much, and produce a very dangerous state of exhaustion. In the fevers of this country, a mild action on the mouth, from Mercurial remedies, is generally the first indication of the safety of the patient. It proves most useful when the tongue is much coated, the mouth clammy, and the stools dark and offensive. In remittent fevers it is less to be recommended than in either intermittents or continued fevers: indeed, we have rarely seen it supersede the febrile action in remittents. In hectic it proves injurious.

During the administration of Calomel in hepatic derangements, it frequently happens that the secretions apparently become worse instead of better; the stools looking green, slimy, and either have no odour or are extremely fœtid. I have indeed more than once seen Calomel produce clay-coloured stools. It would be in vain to look for healthy evacuations, as prognosticating an improved state of the secretions, in such cases; but this is no proof that a beneficial effect has not been produced by the remedy. It is, however, necessary to intermit its use for a few days, in order to ascertain the real state of the alvine ejectments, which show their natural character as soon as the intestines cease to be irritated, by the primary action of the remedy on the biliary and pancreatic ducts, bringing large quantities of badly concocted bile and pancreatic juice into the intestines. In this condition of the habit much advantage may also be derived from diminishing the dose of the Calomel. It, nevertheless, often happens that small doses of Calomel cannot be retained on the stomach when this viscus is in an irritable state; although it retains large doses which act as a sedative. My own experience has afforded me numerous illustrations of this remark; and my observations have been confirmed by a high authority on this subject, Mr. Annesley, as far as regards the employment of Calomel in India. "In large doses," says Mr. Annesley, "Calomel combines with and renders fluid and detaches the viscid mucous secretions attached to the alimentary canal: it diminishes the vascular state of the stomach when this is in excess, and increases the capillary circulation in the mucous coat of the larger intestines. Thence it is useful, in large doses, in increased vascular action of the intestinal canal, indicated by the state of the tongue and the irritability of the stomach, such as occurs in fever, hepatitis, dysentery, and peritoneal inflammation after a full bleeding*." In the dysentery of the Carnatic, when much irritability of the stomach exists, it is given

* Annesley's Sketches of Diseases in India.

in doses of a scruple every night; and this is followed by an oleaginous purgative in the morning as long as the pain continues. It acts most beneficially when the secretions are improved without any specific action being induced on the salivary glands; and, therefore, the purgative in the morning is requisite on this account.

No remedy proves so decidedly useful as Calomel in combination with opium, administered after bleeding and purging, in croup. In the modified form of this disease, also, when it assumes somewhat of the aspect of Angina maligna, the pharynx and fauces being covered with grey, sloughy ulcers, Calomel, in full doses, is the only resource to be depended upon. In pneumonia, Dr. Hamilton, of Lynn Regis, a practitioner of great judgment and experience, after bleeding and purging, gave Calomel, in doses of from gr. i to gr. v, combined with gr. $\frac{1}{4}$ to gr. 1 of opium, every six or eight hours, until the mouth became touched; diluting freely with bland liquids in the intervals: and in few hands have inflammations of the lungs been more successfully treated. Dr. J. Clark, in his work on the Diseases of Long Voyages, recommends this form of Mercury strongly in the intermittents of warm climates, when there is great irritability of the stomach, attended with vomiting of bile: and this practice is supported by the authority of Mr. Annesley, who recommends a scruple of Calomel and two grains of opium in such cases. He combines the Calomel with the opium; and in this form it increases the tonic power of the bark, when the use of that medicine is indicated. In the intermittents of our own climate, I have seen the bark and also the sulphate of quinia given, without any benefit, for several successive days; and, yet, immediately afterwards, they cured the disease when Calomel and opium were administered at bed-time. Calomel is still most useful when the ague is complicated with hepatic affections. It is given in doses of ℈i for several successive nights, each dose being followed by a purgative in the morning, as a prelude to the use of cinchona bark and its salts, in the intermittents of India; and continued, pari passu, with the bark, in small doses, until the tongue become clean*.

Such are the preparations of Mercury. I have purposely refrained from offering many critical remarks on the formulæ, some of which are objectionable; my object being rather to explain the theory of their composition, and their properties on the living system, than to criticise their pharmaceutical composition.

Mercury, in whatever form it is administered, and in whatever manner it is introduced into the living body, acts as an

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* *Wedel*, Diss. de Mercurio dulci, Jena, 1700. *Lysons*, on the Action of Calomel, &c., Bath, 1772.

Excitant; a febrile state of the body is induced, evidenced both by the condition of the pulse and that of the nervous system; and also by an augmented secretion and excretion of the saliva. The action on the salivary glands, however, is only a symptom of this general excitement, induced by Mercurials, and not in itself essential to their curative power: it may not be produced by the administration of Mercurials, and yet syphilis may be cured by them: for the Mercurials are nevertheless taken into the circulation. "I remember," says Mr. Berry, "a young man who took Mercury for a considerable time without producing ptyalism; but, at the same time, a silver watch and money, which he had in his pocket, had become blue*."

Mercury, like every other stimulus long continued, debilitates; and, consequently, emaciation is the attendant of a Mercurial course. In producing their effects, the mercurial preparations, whether *sulphurets*, *cyanides*, *iodides*, *chlorides*, *oxides*, or *acetates*, are decomposed, and the Mercury, in a metallic form, is either thrown out of the body by the skin and the lungs, or is deposited in the glands and the bones. The first of these facts is proved by the whitening of gold worn in the pocket of a person under the influence of Mercury; the second fact has been demonstrated by post mortem examinations, as already noticed.

Many curious stories are related to account for the manner in which Mercury passes out of the habit. Thus Fallopius, in his Treatise de Morbo Gallico, and some other old authors, assert that gold held in the mouths of persons salivated with Mercury has been amalgamated, and the Mercury afterwards expelled from these amalgams by heat. Fourcroy mentions a story of a gilder, who was attacked with an eruption of small cutaneous boils, in each of which a globule of quicksilver was found: M. Tourda and Dr. Cantu of Turin, have published accounts of its being found in the urine; and Zellar declares that he has found it both in the urine and in the bile. These statements, however, are at variance with the experiments of M. Devergie, who could find no Mercury in the blood drawn from a man who had taken 171 mercurial pills, nor in that of another who had taken 184: neither could he detect it in the saliva of many men under courses of Mercury: nor in twenty-two wine pints of urine, in a ward of men under mercurial action. There is less doubt with respect to metallic Mercury being found in the bones. Hufeland states, in his Journal, that the pelvis of a young woman who died of syphilis, preserved in the Lubben Cabinet of Midwifery, is infiltrated with metallic Mercury. That it is decomposed and passes out of the habit in a metallic state, is sufficiently demonstrated by its exhalation from the skin.

* Medical Gazette of March, 1831.

The preparations of Mercury may be introduced into the system both internally and by external application to the cuticular surface: in both cases it is conveyed into the circulation; and, in a short time, produces the peculiar symptoms which have been described. When externally applied,—the mercurial, in the form of an ointment, is rubbed upon the parts of the body where the skin is thin: as, for example, the insides of the thighs and the arms; or it is inhaled in the vapour of fumigation; or the skin is bathed with it in the form of lotions: for internal administration, Mercurials may be prescribed either in substance or in solution.

It was formerly the custom, previous to the administration of mercurials, to reduce the system by bleeding, purging, and low diet. Perhaps this was carried too far: but, for many years, the opposite excess prevailed; and, if any benefit have arisen from endeavours to cure venereal affections without the use of mercurials, it is from the revival of the former preparatory measures, within certain limits. It is necessary, during a mercurial course, that the patient maintain the temperature of the surface uniform by warm clothing; both on account of aiding the action of the remedy on the glandular system, and enabling the Mercury to pass off freely by the surface. The necessity of this is well illustrated by the greater influence of Mercury in curing syphilis in warm than in cold climates. If the stomach and intestines be in an irritable condition, Mercurials are likely to increase this state; and, therefore, opium is to be combined with them. If much sweating supervene, the patient must be cautiously exposed to a cooler air; the clothing lightened; bark and acids exhibited; and the perspirations moderately checked: and this is the more necessary to be attended to if salivation is not to be produced.

Friction with the mercurial ointment is the most frequent mode of exhibiting mercurial remedies in syphilis. It is usual to begin by rubbing ʒss of the ointment on the inside of the thighs. This friction should be performed before a fire, and with some degree of force; as the wearing down of the cuticle favours the absorption of the oxide; indeed, it is probably never absorbed until this take place. The quantity of ointment should be gradually increased; and its use continued until a coppery taste is felt in the mouth, the breath become fœtid, and the gums tender: after which, the friction may be employed less frequently, if these symptoms increase. On the contrary, if they do not appear in eight or ten days after the commencement of the use of the ointment, the quantity must be augmented.

A very slight degree of salivation is necessary to satisfy the practitioner that the Mercury is producing its full action on the habit; but this effect must be closely watched, for, in some persons, very small quantities of any mercurial will produce violent

salivation. Under all circumstances, beyond a certain degree, salivation must be checked. Many methods have been devised to effect this object. Thus, Plenck, an excellent physician and a well-known medical author, supposed that he could effect this by oxidizing the Mercury by trituration in water with gum Arabic: it has also been proposed, for this purpose, to exhibit the Mercury in the form of an amalgam with tin; but, if Mercury act upon the habit, no form of preparation that has any activity can produce its full effect without exciting some degree of salivation. It is not the salivation that is the evil, but the excess of it. The symptoms that indicate its excess are much swelling of the tongue and the inside of the cheeks, swelling and ulcerations of the tonsils, the formation of sloughing ulcers, fever, great restlessness, and a copious discharge of saliva. The means that have been suggested to check profuse salivation are various. Some of them, however, are not to be recommended, and frequently fail. Sulphur has been prescribed; but the experience of those who have had the best opportunities of judging have not satisfied them that it possesses any efficacy in diminishing mercurial action. Nitre, camphor, cinchona bark, preparations of iron, have also been employed, to little purpose, in profuse salivation. A more effectual method of checking salivation is the administration of purgatives and opium: the former produce their beneficial effect by inducing a greater action in the intestinal system of glands, and thereby lessening the determination of blood to the salivary organs; the latter by diminishing the general irritability of the habit. But the most decided method of checking profuse salivation is the free exposure of the patient to a cool dry air. Mr. John Pearson, who first recommended this method of managing salivation, remarks that he was induced to try it from observing its excellent effects in that often fatal mercurial Erethismus which sometimes occurs when mercurials appear to act as poisons upon the system. "The good effects of the practice," he adds, "justified my expectations; for I observed that the breathing of a cool dry air was no less beneficial than pleasant to a person affected with ulcerated cheeks and gums; the animal spirits were likewise recruited; and the health so much improved, in the course of a week or ten days, that the patient was generally capable of returning to the use of his medicine again*." Besides these effects of this practice, I may add, that the abstraction also of the mind from the state of the salivary glands, by taking the patient from the monotony of his chamber and carrying him into the country, greatly aids the checking of profuse salivation, which is often kept up by excessive attention to the discharge, and from the constant attempts

* Pearson's Observations on the Effects of various Articles of the Materia Medica in Lues Venerea, p. 135.

to eject it. The flow of saliva into the mouth is augmented, indeed, even in a state of health, by thinking of it; and this appears to depend on an increased determination of blood to the part, in the same manner as in blushing; in which the flow of blood is the result of a mental stimulus on a particular set of nerves. If this explanation of the obstinacy of profuse salivation in some cases be correct, it should be an object, in attempting to check it, to divert, as much as possible, the attention of the patient from his own feelings. In checking salivation, however, by free exposure to cool dry air, much caution is necessary that the action of the salivary glands be not too suddenly checked. "I have seen," says Mr. Pearson, "not only pains, but even general convulsions, produced from the same cause." This is, in fact, merely an example of that *metastasis* or translation of disease which occurs when some inflammations are suddenly checked. When it happens, the patient should he put into the hot bath, and the Mercurials again introduced as quickly as possible into the habit, until the salivation be restored in a moderate degree. With regard to local means of checking salivation, whatever can change the action of the part, as brandy and water, a solution of Sulphate of Copper, or of Nitrate of Silver, or the liquid Chloride of Soda, will be found beneficial. As counter-irritants to divert the determination of blood from the salivary glands, blisters prove useful. They should be applied over the affected glands.

In long-continued mercurial courses, the high state of morbid irritation is sometimes followed by an exhaustion which, too frequently, proceeds rapidly to a fatal termination. On the first appearance of such a state, the use of the medicine must be instantly suspended, and the patients exposed freely to a cool atmosphere, with a liberal allowance of mild but nutritive diet. I have been in the habit of ordering the sulphate of quinia, combined with sulphuric acid, in small doses, from one to two grains every second hour, for two or three days; and have always found it followed by the best effects.

Mercurials should be introduced into the system gradually, and in the weakest form at first. Thus, if the preparation selected be the ointment, the weak ointment should be first employed, until three or four drachms are used in each rubbing: the strong is then to be resorted to in an equivalent proportion: and if, after some time, the habit appear to resist the influence of the remedy in this form, it must be internally administered: if no effect be produced, Calomel may be rubbed on the inside of the gums and the cheeks; and if the habit still resist, fumigations of the grey precipitated oxide employed. Some physicians have recommended, in such cases, that the subsulphate, a preparation scarcely ever used except as an errhine, should be given in doses of four or five grains to excite vo-

miting. This practice is founded on correct physiological principles; for vomiting greatly favours that state of habit which is the result of the absorption of mercurial preparations into the circulating mass; but the remedy is too active for internal use.

During a mercurial course, although the efficacy of the remedy depends on its exciting power, yet the excitement should be moderate. The salivation should never exceed, at the utmost, two pints in twenty-four hours; the temperature of the air in which the patient lives should not be above 75°, nor below 65° of Fahr.; and the cutaneous function regularly cherished by flannel worn next the skin. The diet should be confined to milk, broths plainly cooked, mild animal food, and water or whey for drink.

In concluding these remarks on the physiological effects of Mercury, it is necessary to notice a peculiar affection sometimes induced by it in persons of a peculiarly nervous or irritable state of habit, when strongly agitated by mental impressions, or exposed to sudden alternations of heat and cold. Under these circumstances, Mercury causes a vesicular eruption of that kind which is termed *Eczema*. This affection was first noticed by Mr. Benjamin Bell, and afterwards investigated by Mr. Alley of Dublin, Dr. Moriarty, Dr. Spens, Dr. Mc Mullin, Dr. Sylvester, Dr. Willan, Dr. Duncan, jun. Dr. Kellie, Mr. Pearson, and several others. It is generally preceded by fever, dry cough, and tightnesss across the præcordia, and, at the same time, a diffused redness, with crowded, extremely minute vesications; and the hairs, easily detaching themselves, fall from every part of the body. The eyes and palpebræ are completely denuded, and the eyes themselves assume an inflamed aspect that gives the countenance a singular expression. The head swells, and sometimes so much as to shut the eyes altogether. The eruption extends itself from the scrotum and thighs over the whole body; and the skin, in various places, comes off in large flakes. When it proves fatal, the event is to be ascribed to the extreme exhaustion that accompanies the attack. No causes have been assigned for this eruption: it is not confined to any particular season nor kind of weather: it attacks adults rather than the young: but no period of life is exempt from it. My own experience is at variance with the opinion that all temperaments are equally liable to this disease: on the contrary, the sanguine appear peculiarly susceptible to its attack. Sudden exposure to cold is not, of itself, sufficient to produce the disease; and I feel that I am authorized in referring it to that peculiar state of the habit termed the *hysterical**.

* A case, highly illustrative of this opinion, is detailed in Thomson's Atlas of Delineations of Cutaneous Disease, art. Eczema.

The points necessary to be attended to in the treatment of syphilitic diseases by Mercurials are—

1. The state of the disease.

2. The intention with which Mercurials are prescribed in syphilis.

3. The selection of the preparations best adapted for each case.

4. The rationale of the operation of Mercurials, and of some peculiar effects of Mercury in syphilis.

Although syphilis is a disease which is produced by *contagion*, the virus must not only come in contact with the body of the person, but it must be conveyed beyond the sphere of the cuticle before the disease can be communicated: that is, the virus must be applied either to an abraded surface, or to one in which there is some lesion capable of admitting inoculation to be effected. When the disease is propagated by sexual intercourse, the organs of generation are first affected; when it passes from an infant born with the disease to the nurse, the breast is first affected; when from a nurse to an infant, the lips and mouth of the child first suffer.

When the virus is simply applied to a secreting surface, an erythematic or superficial inflammation supervenes, and the natural secretion of the part is augmented. This is a very common circumstance in the urethra, and the disease produced by it is called gonorrhœa. When a true inoculation occurs, the first effect of the application of the syphilitic virus to the healthy body is local; but it is afterwards gradually conveyed into the system. It would be out of place here to trace the symptoms which follow from this introduction of the virus into the circulation: it is only when it occurs that the administration of Mercurials, so as to affect the whole system, is requisite; and it is, therefore, this state of the syphilitic disease that demands our attention. Let us, therefore, now inquire into the intentions which are to be answered in exhibiting Mercury in this stage of the disease. These may be regarded as two:—1. To excite a moderate salivation. 2. To raise the mercurial irritation in the system to such a degree that we shall be satisfied that the body is charged with the remedy.

As I have already stated, salivation was long regarded as absolutely necessary for the cure of every case of syphilis, on the supposition that the virus of the disease is evacuated by the salivary glands; and consequently that syphilis can only be cured by the augmentation of the salivary excretion to a very considerable degree. This is, nevertheless, an error; and the objections to salivation being carried to any great extent are manifold. In the first place, the quantity of a Mercurial necessary to cause a severe salivation excites a degree of fever quite unnecessary; and the irritability and debility which result from

it cannot be borne with safety by many habits ; as, for example, by the young below fifteen years of age, the old and naturally debilitated, and those prone to the formation of tubercles in the lungs. Salivation, also, in defiance of every means employed to check it, often advances so rapidly that the face swells, the tongue enlarges, and the fauces are so much inflamed and swelled that there is danger of suffocation. Violent diarrhœas occur from the saliva being swallowed, or by the Mercury stimulating the pancreas. Besides these formidable objections to profuse salivation, epileptic fits have been, not unfrequently, occasioned by it: they have been supposed to depend on the Mercury overstimulating the brain, or on a portion of it being reduced and lodged in the cavities of the brain. I will not presume to decide upon these hypotheses: any cases resembling epilepsy, which I have seen, arising from the stimulus of Mercury, have occurred in highly irritable habits; and I am disposed to think that it is the increase of susceptibility to impressions, which would not otherwise affect the nervous system, that brings on those fits which have been called epileptic. The last objection which may be urged against salivation is, that the ulcerations of the mouth, the caries and the loosening of the teeth, and the rheumatic affections excited by it, remain for a long time after it has ceased ; and the whole constitution appears to have received a shock from which it never recovers. On these accounts, *profuse* salivation is now seldom induced. When the disease has been of long standing and is very inveterate, salivation is requisite, to ascertain the full saturation of the habit with the medicine: it is also sometimes advisable, in order to check greater evils and remove obstacles which are almost too formidable to hold out any prospect of being removed by other means. Thus, persons addicted to intemperance and other depravities, and who have not sufficient control to alter their habits, are brought into a tractable state by being salivated ; for then they can be restrained to a proper diet and withheld from their irregularities.

I have already mentioned that the quantity of any mercurial preparation necessary to be introduced into the habit to excite salivation, depends altogether on the state of the patient and several adventitious circumstances, over which the physician can exercise no control. In some individuals the susceptibility of the habit for receiving the mercurial impression is so great, that small doses of the mildest preparations of the medicine will produce salivation. Dr. Crampton has recorded a case in which two grains of Calomel caused extensive ulceration of the throat and exfoliation of the lower jaw, which terminated in death. On the other hand, there are individuals of a state of habit so opposite to those just alluded to, that no quantity of any Mercurial, however introduced into the system, can excite salivation.

But these idiosyncracies are rare; yet they should be kept in remembrance during the administration of Mercurials.

Physicians had early remarked that the most urgent symptoms of syphilis often disappeared before the salivation commenced; and that the disease was cured where little or no evacuation from the salivary glands had taken place. Owing to these and other circumstances, some practitioners rejected the plan of salivation. Almenar, a Spanish physician, who wrote in 1460, was the first who attempted to keep down and moderate salivation by the administration of purgatives. He was followed by very few for nearly half a century; but at length this became the general practice, and continued so until 1718, when the custom of exciting profuse salivation was revived, and followed for upwards of half a century. It is now generally agreed that much salivation should be avoided, and the Mercurials pushed as far as they can be without exciting it. The fœtor of the breath, the gums becoming sore and spongy, are sufficient indications that the habit is charged with the Mercury, and that the Mercurial irritation necessary for the cure of the disease has been duly excited. The time which this method requires may be regarded as an objection; but this is a weak one. If, however, we consider that much time was formerly occupied in preparing the patient for salivation, and that the extension of the convalescence after its conclusion was great, both plans will be found to be nearly equal. The charge, that relapses are more frequent when salivation is not resorted to, is untenable, if due precaution be observed.

Upon the whole, it is obvious that practitioners formerly administered immoderate doses of Mercury, at too short intervals, and excited violent salivation without any great advantage. Neither were the practitioners of those times at all aware of the quantity of Mercury required to effect a radical cure; they were not aware of the period necessary for employing the remedy, "nor competent to distinguish," as Mr. Pearson remarks, "between the proper effects of the venereal poison and the pernicious consequences of an injudicious practice." Much evil attended the throwing in Mercury so as to induce salivation suddenly. The effects were often so severe that it was requisite to suspend the use of the remedy; and, when the evil was set aside, to begin again to use it with caution. It may not be altogether out of place to mention here, that sometimes salivation does not occur during the period in which the use of the Mercury is continued, but after its administration has been abandoned. If we can trust the authority of Swediaur, several months have elapsed before the action on the salivary glands has occurred. Salivation may also happen a second time, after a considerable interval, without the introduction of any more Mercury into the system. Mr. Bromfield, who had ample oppor-

tunity for observation in the Lock Hospital, has mentioned several instances of this kind; in one of which the interval was three months; in another, a periodical salivation occurred at intervals of six weeks for a whole year after the use of the Mercurials was abandoned. These, however, are uncommon cases. In fulfilling the second intention, that is, to excite a moderate Mercurial irritation in the habit, it is necessary to keep in view the conclusions to which we have arrived regarding salivation. In the milder forms of the disease, a very moderate mercurial action only is requisite to overcome the morbid state which the introduction of the virus into the system has produced; and every step beyond this point to which Mercury is carried must be considered as injurious to general health. Mercury acting upon a sound constitution must be regarded in the light of a poison: and there cannot be a stronger proof of this than the influence of a mercurial atmosphere on those workmen whose labours expose them to the operation of this poison; such, for instance, as miners in the quicksilver mines, gilders, barometer makers, and others. These workmen are frequently attacked with what is termed shaking palsy—a disease characterized by tremors of the arms, followed by convulsions of both upper and lower extremities, and which, when extended to the other parts of the body, render it impossible for the individuals affected either to walk or to raise food to their mouths, or even to speak or to chew; and which, if they be not removed from the atmosphere inducing the disease, terminates in stupor, delirium, and death. It is a curious fact, that those most liable to these tremors are not susceptible of salivation.

The difficulty of knowing how far salivation may be pushed is considerable. If the Mercurial be applied through the medium of the surface, even where there is ulceration of the tonsils, in the form of what is termed the excavating ulcer—that is, a hollowed-out state of the tonsil, as if a portion had been scooped out, with ash-coloured sloughs, and a red, tumid margin—as soon as the gums are affected, the quantity of the ointment should be diminished one half; but it must be continued in sufficient quantity to keep up this degree of tenderness for a sufficient length of time, not only to overcome the diseased action, but also the habit superinduced by the syphilitic virus: and the best guide in this respect is the healing and cicatrization of the ulcers, and the complete desquamation of the diseased cuticle when blotches occur. Sometimes, after the conclusion of a mercurial course, a state of throat not very dissimilar from that which I have described, although less severe, may supervene some irregularity or imprudent exposure to weather. This is often mistaken for a return of the disease, whereas it is truly an effect of the remedy; and consequently, a return to the use of mercurials should not take place: but if a longer time

has supervened between the leaving off the mercurials, and this sore throat is accompanied with a papular, or scaly copper-coloured eruption, we may then conclude that it is not the effect of the remedy, but a renewal of the disease. This is not the place for entering upon the consideration of all the details necessary to be considered in the treatment of syphilis: it is only with the remedy and its effects that we are occupied; and I may conclude this part of our inquiry by remarking that it is not the violence of the mercurial action induced, but the maintaining a moderate degree of it for a sufficient length of time, that is likely effectually to destroy the syphilitic action. With regard to the topical application of mercurial preparations, it must be remembered that corrosive sublimate, applied to a wound or ulcer, occasions dangerous symptoms: even where the skin is entire, it must be used with caution.

We have now to enquire what are the preferable modes of exhibiting mercurials, and what are the best preparations for fulfilling the above intentions in the treatment of syphilis?

All the preparations of Mercury, when properly administered, cure syphilis; but, nevertheless, among so many, and those receiving their activity from different sources, some must be preferable to others. The external applications are either the ointments, or fumigation, or lotions. Let us examine how far each of these is applicable to produce the excitement necessary for the cure of syphilis.

The great advantage attending the use of the ointments is the facility which they afford of introducing a large quantity of the remedy into the habit before profuse salivation is likely to be produced: but their use is not unattended by some inconveniences. For instance, peculiar states of the constitution, or idiosyncracy, may produce so much torpor or want of action in the cuticular absorbents, that much time may be expended in the application of the remedy, and little be taken into the system. The mode in which the friction is employed is of importance: but as this must be left to the patient, we have little or no control over it; so that the quantity absorbed cannot be ascertained from the quantity employed. Besides, owing to the extreme irritability of some persons, the friction produces eruptions upon the skin, which interrupt the free and continued employment of the remedy. The two blue ointments, which differ only as to strength, are most commonly employed. Ointments also with the protochloride, or the white precipitate, or the grey oxide, are sometimes used in the same manner; but none of them remove either the local symptoms of the disease, or affect the general system in so short a space of time as the strong mercurial ointment of the Pharmacopœias. The quantity of the ointments to be employed has been already mentioned. It is curious to look back into the practice of some of

our best old authors, when they mention this remedy. Thus, Sydenham, and the practitioners of his time, used an ointment composed of one part of Mercury and two of lard; and of this one ounce was rubbed in for three successive nights. The consequence was severe salivation, which was kept up by the internal use of turpeth mineral, or by Calomel, exhibited whenever the flow of the saliva flagged. The patient was kept during the whole time in bed, and the most rigid abstinence observed.

With respect to the time for using the ointments, the evening is chosen; and certainly, as far as regards the convenience of the individual, this is to be preferred: but if we consider that, after repose, the skin is more elastic and soft, and that the vigour of the absorbents must be in accordance with that of the general system, we should be disposed to prefer the morning for this operation. The friction must be assiduously employed until the whole of the ointment be absorbed; and, as I have already stated, the operation should be performed by the patient himself. It has been recommended, by some writers on Syphilis, that, when the patient is obliged to continue his occupations during a mercurial course, the ointment may be applied to the soles of the feet; so that the friction of exercise may cause its absorption. I have seen this practice followed; but the results were not such as authorize me to recommend it.

Owing to the tediousness and labour of preparing the common mercurial ointment, turpentine, sulphur, oil of eggs, saliva, and a variety of other matters, have been employed to facilitate the oxidizement of the Mercury. But ointments thus hastily prepared are found by experience to be less efficacious than the common blue ointments, properly and slowly manipulated. The grey oxide ointment of the Edinburgh College, being prepared with an oxide of very minute division, has been supposed to be well adapted for mercurial frictions: but, it does not, if I may be permitted to use an apt but homely expression, work so well as the common ointment. M. Simouin has proposed a method of preparing the blue ointment, which seems likely to answer the purpose, and is said to form an unexceptionable preparation. I have made the ointment in this manner, but have had no experience of its remedial efficacy. M. Semouin takes ℥viii of Mercury and ℥viii of lard: ℥iv of the latter are melted in a bottle, into which the mercury is introduced, and then briskly shaken until it have acquired the consistence of syrup; after which the mixture is rubbed up in a mortar with the rest of the lard. The whole process is finished in half an hour.

Ointments are also prepared with the red oxides; but they are too irritating for general application, although they are excellent topical dressings in syphilitic ulcers.

I have already referred to another method of introducing Mercurials into the system by friction, that of rubbing Calomel

on the internal surface of the cheeks and gums. It was suggested by Mr. Clare, and undoubtedly has its advantages. From three to four grains of Calomel, either in the form of powder, or combined with mucilage is to be rubbed upon the gums. If the saliva be swallowed during the operation, diarrhœa is apt to occur, which is an objection to this method of proceeding. It causes salivation; but not, as might, a priori, be supposed, from any topical stimulus communicated to the salivary glands and their excretories, but from being absorbed in the same manner as the blue ointment. We have also sufficient evidence that the protochloride is decomposed in this case; as gold worn in the pocket is whitened in the same manner as when the blue ointment is employed. It is certainly a cleaner mode of effecting the system than that by the blue ointment. It cures the disease, and even in a shorter time than the blue ointment; but it is apt to excite salivation too soon, and to carry it too far. In using mercurial frictions, it is better that the effect should not be sudden; as, in that case, the continuance of its influence on the habit is too evanescent, if a full charge of the remedy be not accumulated in the body.

The form of introducing Mercurials into the system by fumigation was suggested soon after the discovery of the powers of Mercurials as remedies for syphilis. Cinnabar was the preparation employed; and, as a relic of a prior practice, gums and aromatics were added to the Mercurial, and occasionally sulphur and arsenic. The fumigations were applied to the whole body; but, owing to the dangerous results that occasionally followed this mode of practice, it soon fell into disuse. In 1736, a person of the name of Charbonnier, whose operations were superintended by the faculty in Paris, revived the use of fumigations on a new plan: but many having fallen victims of his treatment, fumigations again fell into disuse, and were neglected until 1776, when they were again revived by M. Lalonette. He discarded the sulphurets and employed Calomel, and the oxides, using a fumigating machine invented by Nicolas de Blengy, in 1683, a little modified. The plan of this individual was fairly put to the test of experiment by the late Mr. John Pearson, in the Lock Hospital; and the conclusions he deduced from his trials were—"that where checking the disease suddenly is an object of great moment, where the body is covered with venereal ulcers, or where the eruptions are large and numerous, so that there scarcely remains a surface large enough to absorb the ointment, the application of the vapour of Mercury will always be attended with evident advantage." But he found it difficult to introduce a sufficient quantity of Mercury, by this means, into the animal system to prevent a relapse; and he therefore concludes his account of his experiments in these words:—"I consider it (fumigation) as a mode of treatment

by no means eligible in general practice." Mr. Bacot, in his excellent and highly instructive Essays on the Nature and Treatment of Syphilis*, mentions the work of Dr. Rapon at Paris, in which the advantages to be derived from fumigation are minutely and fairly stated. Mr. Abernethy, in my opinion, has proposed the simplest and best mode of fumigation. He places his patient in a vapour bath, in a complete suit of under garments, with a cloth covering the bath. Two drachms of the grey or protoxide of Mercury are then put upon a hot iron placed within the bath. The patient remains in it for fifteen or twenty minutes, in which time the whole body becomes covered with a white powder. He is then put to bed, in the same clothes, and lies in them until the next morning, when he is placed in the tepid bath. Mr. Abernethy regards this as the most gentlemanly way of curing syphilis; and says, that he has seen it produce salivation in forty-eight hours. In the few instances in which I have seen it employed, it has not acted so quickly as Mr. Abernethy mentions.

The last method of topically introducing Mercurials into the body is by means of lotions or baths. The perchloride or any of the preparations soluble in water are used for this purpose; and the body, or a portion of it, is immersed in the solution. Syphilis has been thus cured; but, owing to the dangerous excitement caused by these baths, when any portion of the surface is abraded, the practice is not to be recommended.

In treating of the comparative merits of those preparations of Mercury which may be taken into the stomach, I will first notice the protoxide, as contained in the common blue pill; and, when properly prepared, this is the best of this set of remedies, because it is the mildest of those which certainly mercurialize the habit. It seldom, unless improperly prepared, incommodes either the stomach or the intestines. But, when turpentine has been used to assist the oxidizement of the Mercury, or when the conserve of roses with which it is made contains sulphuric acid, the blue pill is apt to gripe and run off by the bowels. From the mildness of its operation, the blue pill is peculiarly well adapted for those whose habits have been previously debilitated, or who are naturally delicate. In some persons, however, owing to idiosyncracy, it proves too active, unless it is corrected either by opium or by the addition of a few grains of rhubarb, given in the morning, which, by supplying a little tone, renders the intestines less irritable, and consequently less susceptible of those irregular contractions which cause griping. During the administration of the blue pill, the use of acids should be avoided; and, if the stomach be in an acescent state, the superabundant acid should be neutralized and carried through

* Medical Gazette, vol. ii, iii.

the bowels, or the stomach should be emptied by means of an emetic, and alkalies afterwards exhibited to allay the irritability of the organ. In doses of from five to twelve grains, given every morning and evening, this pill soon displays its influence upon the habit: salivation can be as certainly produced by it as by any of the more acrid preparations; and, at the same time, its activity is more under control than that of any of these. When a dyspeptic state of the stomach accompanies syphilis, Hydrargyrum cum Creta is sometimes preferred to the blue pill: it may be given in doses of a scruple or half a drachm for an adult, every morning and evening. But the effect from this preparation is slow and uncertain. In cases of congential syphilis, however, it is the only preparation which can be used, as it may be given to young infants.

The grey oxides, although precipitated from active salts, yet are mild preparations of the metal in the first state of oxidizement; and that form of it prepared by precipitation from Calomel has been regarded by several distinguished practitioners as more certain, and yet milder, in its effects than the blue pill. They affirm, with truth, that it incommodes the stomach and bowels less than the blue pill; that from its more minute mechanical division, and consequently being more perfectly combined with oxygen, it acts with greater certainty than that preparation; and that it is more easily prepared, and less likely to be adulterated.

The peroxides, particularly the red oxide, per se, were formerly much employed as internal remedies in the cure of syphilis. From the difficulty, however, of preparing the red oxide, it fell into disuse, until the time of John Hunter, who considered it one of the best of the mercurial preparations. It is, however, very apt to induce griping, diarrhœa, and tenesmus; and, therefore, Mr. Hunter always combined it with opium and oil of cloves; but, in spite of these combinations, it cannot be given in doses exceeding half a grain, without greatly incommoding the bowels; and, therefore, it is now seldom employed: nor is this neglect undeserved, since it possesses no advantages over other preparations, which are less acrid and virulent in their operation. The red oxide, prepared by the decomposition of the nitrate, is even more objectionable than the red oxide per se: both preparations are now entirely confined to external use, as topical Excitants.

The *Chlorides* are very active preparations. The protochloride, or calomel, is a more efficient preparation than any of the oxides. In doses of four or five grains, however, it generally purges, demonstrating that, although insoluble in water, it is soluble in the gastric juice. This is more easily explained, since the experiments of Dr. Prout have demonstrated the presence of muriatic acid in the gastric secretion; and, conse-

quently, it is partially converted into the bichloride, or a state approaching to it, in the stomach. In doses smaller than those which excite purging, it is a preparation well adapted for the cure of syphilis, and is less apt to induce sudden salivation than any other; it is, therefore, preferred for those who are readily salivated, and where the bowels are not very irritable; and, even in those with irritable intestines, it is more gentle in its operation than the peroxide. It should be given, at first, in doses not exceeding a grain; and, if this run off by the bowels, or gripe, opium may be added to it. Combined with antimonials, it is a diaphoretic; with squill and foxglove, a diuretic; and it aids the force of the milder purgatives, whilst it moderates the acrimony of the more drastic. It is, therefore, peculiarly well adapted in those secondary cases of syphilis characterized by cutaneous eruptions; and when exhibited to infants in these cases, it produces much less disturbance of the abdominal viscera than would, a priori, be expected. The best form of administering calomel is that of pill, conjoined with small doses of opium: or, when pills cannot be swallowed, and the form of powder is objected to, it may be mixed with water, by means of mucilage of gum tragacanth, which, owing to its spongy, insoluble nature, is well adapted to suspend a heavy, insoluble powder in a moderate quantity of fluid. Whatever may be the chemical difference between the sublimed and the precipitated calomel, there is, undoubtedly, a considerable diversity of action between them. The precipitated calomel irritates the stomach and bowels more than the sublimed preparation; nor can it be used for so long a time, nor in such large quantities.

The Bichloride is the most active of all the Mercurial salts. It has been supposed that it was first used as a remedy in syphilis by Basil Valentine. Be this as it may, it was first introduced, for this purpose, into England by Richard Wiseman, early in the 17th century: but its employment was violently opposed at this period; and it was consequently neglected until Van Swieten recommended it as a preparation of singular efficacy against every form of syphilis. Mr. Pearson supposes that Swieten derived his knowledge of the efficacy and safety of this remedy from Dr. Sanchez, who resided many years at Petersburgh, where the remedy was used long before its introduction into Great Britain. Of three hundred persons cured by the corrosive sublimate, in 1754, all remained well in 1755, and two hundred more were added to the list: but the most striking results of its success are recorded by Dr. Locher, physician to the Venereal Hospital in Vienna, in which the bichloride had been able to effect a complete cure in 5000 cases. Many respectable authorities in this country might be brought forward in its favour: in France, M. De Horne, who made experiments to ascertain its efficacy, by order of the government,

expressed himself satisfied that the cures performed by it were real and permanent: and Dr. Cirillo, a Neapolitan physician, who used it externally as an ointment, affirmed that it is milder and less uncertain than any other Mercurial in general use. Besides rubbing in this ointment, Dr. Cirillo employed warm baths, once in three or four days; and he assures us that the mouth is seldom made sore, and that the medicine operates principally on the skin and the kidneys. In opposition to these statements in favour of the bichloride, we find that Mr. Bromfield, after employing it in the early part of his practice, asserts that it cannot be depended upon: an opinion that was supported by Mr. Gataker, and also by M. Louis, men of great professional eminence and high authority upon this subject. The latest writer of reputation who has decided against it, is the late Mr. John Pearson. He admits that it will sometimes succeed in curing the primary symptoms of syphilis, yet contends that it is a medicine which cannot be confided in where secondary symptoms have appeared. From its acrimony, it frequently gripes, causing spasmodic contractions when taken even in small doses; and occasionally has the power of producing cough, hæmoptœ, consumption, and similar diseases: and when it has apparently cured syphilis, the symptoms have frequently returned. It is, nevertheless, one of those preparations on which my experience has taught me to rely in cases of syphilitic eruptions; particularly those which assume the characters of psoriasis or of lepra. In these cases, I generally order the bichloride in solution in nitric acid, in the proportion of one grain to f℥i of the diluted acid, so that six minims contain the sixth part of a grain of the bichloride. I have generally given, at the same time, either the decoction of sarsaparilla or that of elm bark; and, by gradually increasing the dose to ten minims, or one-sixth of a grain of the salt, I have seldom failed in curing these eruptions. The remedy must be continued for some time after the eruption has disappeared, the doses being gradually diminished. I have never seen it produce salivation when thus administered. Mr. Pearson admits that the bichloride may prove beneficial at the commencement of a Mercurial course, "to bring the constitution under the influence of Mercury at an earlier period, or during the course of inunction, with the intention of increasing the action of simple Mercury. He also admits its efficacy, after a course of friction, to prevent a relapse."

The perchloride may be also used in the form of pills, in doses of from $\frac{1}{6}$ to $\frac{1}{8}$ of a grain, combined with opium. Dr. Dzendi, of Hallé, affirms that he cures syphilis radically by giving it in pills containing $\frac{1}{12}$ only of a grain, beginning with four a day, and gradually augmenting the dose, until thirty are taken in the same period of time. If they purge, he adds a

few drops of tincture of opium to each dose; if the gums become spongy, he washes them with an astringent lotion; and, during the whole course, the food is reduced one fourth. Dr. Dzendi, however, does not solely confide in these pills, but administers the decoction of sarsaparilla after they have been continued for some time. The bichloride has been given more frequently in solution in alcohol—a form of administering it which was first suggested by Van Swieten. His solution contained half a grain to the fluid ounce of alcohol; and of this solution a tablespoonful was given for a dose. It was generally conjoined with opium, or some mucilaginous liquid, to prevent gripings. The bichloride has also been occasionally exhibited in distilled water, with a portion of muriate of ammonia to facilitate its solution, and to increase its tendency to pass off by the kidneys and the skin. The proportion of the muriate of ammonia is double that of the bichloride, and each fluid ounce of the solution contains half a grain of the bichloride. As far as syphilis is concerned, the chief use of the bichloride is to make a sudden impression when any particular symptom is gaining ground rapidly: in these cases, if it produce griping and purging, it should not be persisted in. As an alterative, in affections of the throat in which there is some reason for thinking that the remains of a syphilitic taint are lurking in the habit, the bichloride dissolved in nitric acid and given in doses of $\frac{1}{10}$ of a grain, with a course of sarsaparilla or decoction of elm bark, has proved successful in my practice. I may mention that, in such cases, I have seen no benefit derived from the use of the remedy, if the patient be permitted to take his usual diet, and to use, even moderately, either wine, spirits, or porter. It seems essential for securing the efficacy of the medicine, that no other stimulant should interfere with its action on the habit; and if we admit the theory that the fever of syphilis is to be knocked down by setting up another in the habit, we can easily understand how its influence may be interrupted by the use of other stimulants, whether dietetical or remedial.

All the preparations of Mercury, when properly used, will cure syphilis; and therefore a practitioner may, to a certain degree, please his fancy in the selection; but still, where a guide is desired, the few that are requisite should be pointed out. Those for topical application may be reduced to the common ointment; the solution of the perchloride; the black wash, formed by triturating the protochloride with lime water; and the red oxide by nitric acid. As an external means of introducing Mercury into the habit, the common ointment may supersede every other preparation; and for internal exhibition, the blue pill and the grey oxide are adequate for every purpose.

In curing syphilis by Mercury, it is necessary to know that

many circumstances may interfere with the regular operation of the medicine. Thus, with respect to climate, the human system is in general more susceptible of the impression of medicinal agents in warm climates than in cold; a smaller quantity of Mercury, therefore, and a shorter period for its application, will suffice to cure the disease in a warm climate than in a cold. It was the custom in the time of Sydenham to send syphilitic patients to the south of France, as experience had demonstrated that a much larger quantity of any mercurial preparation can be thrown into the system without producing salivation in that climate. For the same reason Mercury is more advantageously used in summer than in winter.

Women are more easily brought under the Mercurial action than men; and, as it augments the discharge of the catamenia, the use of Mercurials should be suspended for some days previous to, and during, the continuance of this periodical evacuation. In pregnancy, also, Mercurials should be used with great caution. It is not so injurious during nursing. When infants are affected with congenital syphilis, whether the exhalation from the body of the mother, or the milk being impregnated with the remedy, communicate the Mercurial influence to the system of the child, I will not venture to determine; but it is certain that the disease in the child has frequently been cured through the system of the nurse.

The sanguine and choleric are more susceptible of the Mercurial impression than other individuals; and, therefore, in syphilitic affections which require, or seem likely to require, a protracted course of Mercurials, great caution is necessary not to bring the habit suddenly under the full influence of the remedy. Some idiosyncracies are occasionally met with which prevent the free use of Mercury in certain individuals; and as this sometimes occurs in reference to peculiar preparations and not to others, it is proper, when a person seems to suffer from the preparation in use, to try others before pronouncing that his system will not bear Mercury. When symptoms of either erythema or erythismus display themselves, the use of the remedy must be instantly suspended, and the irritability of the habit subdued by a free exposure to cool dry air, and by a removal into the country.

It now only remains to take a brief view of the various theories which have been advanced to explain the mode in which Mercury effects a cure in syphilis.

If we take a retrospective view of the various theories which have been advanced, we find that the mechanical physicians referred every thing to the physical properties of the medicine; whilst the chemists ascribed all either to the solubility of the Mercury in the animal mucus, and its action on albumen, or to its chemical union with the syphilitic virus neu-

tralizing it, and thus depriving it of its acrimony, in the same manner as that of an acid or an alkali is destroyed by the formation of a neutral salt. This last idea fell to the ground before the fact that syphilis cannot be communicated to a healthy person by inoculation with the blood of the infected person; and although Mercurials certainly enter the system through the circulation, yet, were the blood tainted by the virus of the disease, the quantity of Mercury admitted into it is too small to produce the effect of neutralization. Some writers, as Dr. White, Dr. Wolf, and others, have ascribed the sanative effects of Mercury in syphilis to its expelling the virus from the system by evacuant properties exerted on the salivary glands: but, as I have more than once stated, the excitement of salivation is not requisite for securing the powers of the remedy over the disease, and that it merely shews that the system is affected with the remedy. Mercury has also been supposed, by some writers, and those of high authority—as, for instance, Swediaur—merely to act by communicating oxygen to the habit, which, increasing the febrile state to a high degree, neutralizes or renders inert the syphilitic poison. There are certainly grounds for this opinion of the reduction of the Mercury, which post-mortem examinations have detected in various parts of the body; and, on the faith of this explanation being correct, oxygenating substances, as nitric acid, chlorate of potassa, and similar preparations, have been employed as substitutes for Mercury in the treatment of syphilis. But the results have not infused confidence in the accuracy of the theory; and it remains still to be proved whether the presence of oxygen can destroy the syphilitic virus in the living system.

The last and most probable opinion is, that Mercury produces a peculiar excitement or febrile action, sui generis, which overcomes or destroys that induced by the virus of syphilis. This is, indeed, assuming, in the first place, that such a diversity of action is induced: but the probability of the opinion is great, when we consider, what can scarcely be denied, that the syphilitic virus exerts its specific power over the habit, interrupting in particular the healthy functions of the glandular system, and altering in a striking degree the secretions. Now, it is well known that Mercury has a powerful influence over the glandular system; and this is rendered obvious by its effect upon the salivary glands: if, therefore, the action of Mercury be sufficient to suspend the morbid action of syphilis—and it is a law of the system that morbid actions can be suspended, for a time at least, by the influence of new actions superinduced—it is probable that that of the syphilitic poison may be overcome by that of the Mercury; and, as this can be withdrawn or subdued by the disuse of the remedy, the system is left to the influence of its ordinary and healthy functions. In presenting

this theory as the one to which I incline, the reasons that induce me to urge the necessity of dieting the patient during a mercurial course will be obvious. If stimulants be given at the same time as Mercury, they interfere with the power of the Mercury to overcome the diseased action. Perhaps I might extend this remark to almost all medicines.

I am willing to admit that the theory which I have adopted does not altogether remove the difficulty in explaining the influence of mercury in curing syphilis: it may be said merely to express a fact, not to develope its cause; but, in most circumstances, we can proceed no further*.

e. AMMONIA. L. E. D. Syn. *Volatile Alkali.*

This substance is a compound of nitrogen and hydrogen: it is formed in every case of putrefaction of animal and vegetable matter, and is very largely produced in foggy weather, probably owing to a partial decomposition of the aqueous fluid in the atmosphere, which, coming in contact with the nitrogen extricated from putrefying animal matter, unites with it and forms Ammonia. This theory of its formation may be questioned; but its presence, at these times, is rendered obvious to the senses by the strong odour of Ammonia, which is exhaled in places where animal decompositions are in progress, during the prevalence of fogs. Ammonia is found also ready formed in nature, in combination with a variety of substances, in the neighbourhood of volcanoes: it is a constituent in coal; and, in Africa, it has been found in some mineral waters. All cruciform plants yield Ammonia. For medicinal purposes, it is procured from the decomposition of the muriate of Ammonia by means of lime, which has a stronger affinity for the muriatic acid than the Ammonia, and consequently displaces it: the Ammonia is given off in the gaseous state; but, being very soluble in water, it is combined with that fluid and forms the officinal Liquor Ammoniæ.

Ammoniacal gas is transparent and colourless, invisible, elastic, and possesses all the mechanical properties of common air. It stimulates powerfully the eyes and the nose; has an acrid, caustic taste; and, by its effects on vegetable blues, and on litmus reddened by an acid, it proves its affinity to alkalies. Its specific gravity is 0.5931, and 100 cubic inches weigh 18 grains. It destroys animal life, and cannot support combustion. Water

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* The student may consult *Hoffman*, Diss. de Mercurio et medic. mercurialibus selectis ad expurgandos sine salivatione morbos corporis humani rebelles: 1700, 4to. *Stahl*, De Mercurii in corpus humanum agendi modo: Orford, 1738, 4to. *Duncan*, Obs. on the Operation and Use of Mercury, &c. Edin. 1772. *Mathias*, Researches on the Diseases produced by the Use of Mercury: London, 1820. *Pearson* (*J.*), On the Effects of different Substances in Lues Venerea: London, 1800.

takes up 500 times its bulk of this gas without any alteration of the properties of the gas; but, independent of water, Ammonia, under a pressure of a little more than six atmospheres, at a temperature of 50°, can be rendered fluid. When oxygen gas and gaseous Ammonia are mixed together and exploded, water is formed and azotic gas remains. Ammonia is a compound of

Hydrogen 17.64, + Nitrogen 82.36 = 100:

or

3 prop. of Hydrogen = 3, 1 prop. of Nitrogen = 14, equiv. 17.

During the absorption of ammoniacal gas by water, heat is evolved: when saturated, the gravity of the solution is 0.85; in which case 100 grains of water contain 35 grains of Ammonia, or 494 volumes of the condensed gas in 1 volume of water: but the solution of Ammonia ordered by the London College, which is of the specific gravity of 0.960, consists of only 10 parts of Ammonia and 90 parts of water in 100 parts. It is in this state that it is chiefly used as a medicine. The aqueous solution is colourless; has an acrid, very caustic taste, and powerful odour: it displays an alkaline reaction. It is a violent poison, whether the vapour be inhaled or the solution swallowed in a concentrated state: producing local inflammation, a rapid exhaustion of nervous energy, and death. It vesicates and corrodes the skin, when applied in its strongest solution.

2. *Carbonate of Ammonia.* — Ammonia combines readily with the acids; and, if muriate of Ammonia and carbonate of lime be mixed in the proportions directed in the London Pharmacopœia, and exposed to a gradually raised red heat, a subcarbonate of Ammonia is formed, which operates on the animal body as an Excitant in the same manner as the Ammonia. Carbonate of Ammonia possesses the sensible properties of pure Ammonia, which it exhales; so that turmeric paper, held over it, is tinged brown. It is soluble in cold water without decomposition; but hot water decomposes it with effervescence. When kept in an open bottle, the superabundant Ammonia escapes, and the salt becomes neutral and inodorous. In its perfect state, it consists of Ammonia 28.81, + Carbonic acid 55.93, + water 15.26, = 100: or Carbonic acid 3 prop. (22×3) = 66, Ammonia 2 prop. (17×2) = 34, water 2 prop. (9×2) = 18, making the equivalent = 118. It is decomposed by the acids, the other pure alkalies, lime-water, muriate of lime, magnesia, alum, bitartrate and supersulphate of potassa, hydrochloride of mercury, the salts of lead, and the sulphates of iron and of zinc. These substances, therefore, should not be ordered in combination with it in prescriptions.

As this salt is usually found in the shops, it is nearly inodorous: this, according to Mr. Phillips, is owing to the escape of the carbonate of Ammonia in the state of gas; for he supposes this salt to be a compound of carbonate of Ammonia and bicarbonate of Ammonia with water.

With regard to the effects of Ammonia on the animal œconomy, I have already stated that it rapidly destroys life. It is probable that this may arise from spasm of the glottis and consequent suffocation, as there is scarcely time sufficient for inflammation to produce its effects. In its diluted state, but stronger than ordered by the Pharmacopœia, it excites powerfully the living solid, inflaming the part to which it is applied, and causing vesication and suppuration: largely diluted, it produces a primary exciting effect on the nerves of the stomach when it is taken into that viscus, which is rapidly propagated over the system; but its effects are transitory; and thence it is regarded as a diffusible Excitant. Its use is indicated in low states of the habit in which there is a deficiency of nervous power, and in torpid states of the system, as it is said to rouse the powers of the nerves without quickening, in an equal ratio, the sanguiferous system.

In a practical point of view, Ammonia is employed as an Excitant in many diseases. It is peculiarly indicated in the latter stages of typhus, when petechia display themselves, and tremors and subsultus tendinum occur: it is given in combination with aromatic confection and other cordials; but it must not be given in sufficient quantity to exhaust the excitability. Although it would be highly improper to order it in the early stages of pneumonia, or at any period of that disease when active inflammation is present, yet, in the latter stages of it, when the bronchial tubes are loaded with phlegm which cannot be expectorated, Ammonia, in the gaseous state, largely diluted with common air and inhaled into the lungs, or the solution, diluted with water and taken into the stomach, promotes expectoration, and is the best mode of relieving the oppressed state of the respiration. In long-continued paralysis, which does not depend on local affection of the head, it may be used with advantage. Nevertheless, in some diseases of the head, when there is no febrile nor inflammatory symptoms present, and the vital powers require to be sustained, Ammonia and its carbonate may be advantageously prescribed. Under such circumstances, it is given in mania, in doses of from five to eight grains. In states of asphyxia and syncope, the stimulus of Ammonia is highly useful; but, in asphyxia, some caution is requisite. In dyspepsia connected with hypochondriasm, it not only proves a useful stimulus to the stomach and nervous system, but it combines with the acid which usually, in this disease, superabounds in the stomach, existing partly in the gaseous state, and thus operates, by its chemical properties, in relieving the disease. In all spasmodic affections, Ammonia is perhaps one of the best stimulants that can be employed. In convulsive affections, such as asthma, hooping cough, and similar diseases, it has been regarded as exerting some specific influence; but it is to its stimulant power that its beneficial effects are to be ascribed; the spasms, in these dis-

eases, depending altogether on that increased irritability of the system which accompanies debility. In hysteria, the diffusible character of the stimulus of Ammonia renders it a medicine well adapted for such cases during the paroxysm; but it can be of very little service in the intervals, although it is often prescribed. It is not easy to explain the manner in which Ammonia operates when it is taken into the stomach for warding off the effects of the bites of poisonous snakes, unless we admit that the virus introduced into the wound acts as an immediate and direct sedative to the nervous system, and that the Ammonia, by sustaining the nervous energy, enables the system to withstand the influence of the poison until it expends its power. Triguerra* has recommended it in hydrophobia; but experience has not strengthened his recommendation. It may operate somewhat in the same manner in relieving syphilis, for which it was not many years since regarded as a specific superior to mercury; but experience, which tends more and more to confirm the influence of mercurials, when properly employed in this virulent disease, has done nothing to confirm our confidence in Ammonia, which is, therefore, now seldom used in syphilis.

Ammonia may be given, in its state of Liquor Ammoniæ, in combination with muriate of lime and any of the salts of baryta; but it is incompatible with acidulous salts and metallic salts, except tartarized iron. It may be administered in any bland mucilage or emulsion, or in bitter infusions, or in milk, in doses of from ten minims to half a drachm.

The subcarbonate should never be ordered in the solid form, as it is apt to prove emetic. The dose is from five grains to a scruple, dissolved in any mucilaginous or bitter infusion.

The London College order a solution of the subcarbonate, in the proportion of four ounces to a pint of distilled water. It may be given in doses of thirty minims to a drachm in any bland liquid.

MENTAL EXCITANTS.

There can be no doubt that all our agreeable feelings are more or less causes of nervous excitement, and, like many of the material Excitants which have been described, their excess is followed by collapse, and may even extinguish life altogether. In taking this view of the subject, it might be supposed that many more mental emotions than *Joy* and *Impetuosity* should be enumerated as Excitants: but as material agents are regarded either as Excitants or Tonics, according to the degree of the rapidity and the intensity of their effects, so mental emotions,

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* Sage, Anal. Chim. des trois regnes, t. i, p. 283.

which increase action, may be arranged in the one or the other of these classes.

a. Joy.—Many simple pleasurable feelings—namely, satisfaction, hope, and confidence, operate as direct stimulants to the nerves, and thence to the sanguiferous and muscular systems; but the increase of action which they induce is moderate in degree, and may be continued for a considerable length of time, not only without producing exhaustion, but with the utmost benefit to the system; diffusing equably the circulating fluid; aiding absorption, secretion, and excretion; and so favouring assimilation as to increase the healthy action and the natural vigour of every important organ. These emotions, therefore, in the strictest meaning of the term, may be regarded rather as Tonics than as Excitants. *Joy*, on the other hand, produces effects closely resembling those which follow a powerful material Excitant; the action of the heart and arteries is suddenly augmented to such a degree that palpitation sometimes ensues; whilst, as might be expected, the animal heat and the perspiration are considerably increased; more blood is consequently sent through the capillaries; the face glows, the eyes sparkle, and are even sometimes suffused with tears; whilst the breathing becomes fuller and quicker than usual. The mental functions of the brain are not less excited than those of the body; the imagination takes a more excursive range; the most pleasurable of the past scenes of life are again pictured in the mind, the future teems with only gay and delightful anticipations; every task seems easy, every labour light, and schemes of undertakings the most momentous and difficult, appear already accomplished, and crowned with the most brilliant success. But, besides these illusive impressions, the excitement of Joy quickens the senses, the eyes are turned with celerity towards every object, which is instantly and clearly perceived; the ear is alive to every sound; the taste and the touch are acutely sensitive; and every bodily action is more prompt and energetic.

It is not my intention to offer even a conjecture respecting the metaphysical nature of this powerful Excitant; it is sufficient for us to know that Joy operates as an Excitant, and to trace its therapeutical influence.

The states of the habit in which Joy is most likely to display, very obviously, its exciting influence, are those of diminished action in diseases, particularly of a chronic character, in which languor and debility exist; such as Melancholia, Hypochondriasis, Dyspepsia, and Chlorosis. It is not easy to say in what manner it can be applied as a therapeutical Excitant, except in the communication of good news to the afflicted; but could it be administered with a proper regard to time and quantity, it is well adapted for aiding in relieving the morbid conditions of the body just referred to, and likely to be productive of highly beneficial

effects: many cases, were it necessary, might be detailed in proof of the accuracy of this assertion*.

But as Joy, like every direct Excitant to the nervous and irritable fibre, exhausts the principles on which the functions of the vital solids depend, so, as I have already hinted, excessive Joy is an injurious agent, and may cause temporary delirium and epilepsy†. This is particularly the case where Joy acts on persons suffering under grief or any other depressing passion; for, in such a state, the irritability being, as it were, accumulated in the body, the susceptibility of impression is greatly augmented; and, consequently, for the same reason as the application of much heat to a frost-bitten limb is followed by gangrene and the death of the part, sudden transitions from grief to extreme Joy are at all times hazardous, and often prove mortal. The influence of this Mental Excitant, in these cases, is like the blaze of an electric corruscation: the instant it has passed, the extent of its depredations are exposed; whilst it illuminates, it consumes its victim. Besides the instances described by classical writers‡, several well-authenticated cases of this kind, more fitted for our consultation, are collected in Haller's Physiology (vol. v, p. 581). The necessity, therefore, of caution in the employment of so powerful an Excitant scarcely requires to be mentioned.

b. Impetuosity—under which term I rank *enthusiasm*, *anger*, and other violent affections, reacts upon the brain and nervous system nearly in the same manner, and with equal energy, as extreme Joy. It is, however, a voluntary act, although it often occurs without deliberation—I may almost say without consciousness. It is placed in the table of Excitants rather to afford an opportunity of pointing out to the student and the inexperienced practitioner the necessity of guarding the debilitated from indulging in it, than to point out its use as a remedial agent. The suddenness and fatal force of its impression are well illustrated by the following case, which came within my own observation. 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 sunk into his chair and instantly expired. It is easy to conceive that, in such a state of eager excitement, the effects are likely to be more strikingly obvious upon the thoracic viscera

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* Lory de Melancholia, t. i, p. 57. Trellianus, lib. xi, p. 17.

† Van Swieten, Comment. t iii, p. 414. Boerhaave, de morbis nervorum, lib. ix, cap. 12.

‡ Livy, lib. xxii. Valerius Maximus, lib. ix, cap. 12.

than any other set of organs; even in a state of health, it causes an unusual glow of warmth in the præcordia, the pulse beats quick, and a peculiar sensation is felt, which is not erroneously referred to the heart. When impetuosity rises to anger, the muscular system is preternaturally excited; the face is flushed; the breathing irregular and convulsed, and thence apoplexy sometimes follows: or epilepsy, hæmorrhagies, hepatic diseases, or insanity, may result. It is, nevertheless, true that palsy has been suddenly cured by a fit of anger*.

THERAPEUTICAL EMPLOYMENT OF EXCITANTS.

On this part of our subject I shall be very brief; as many of the remarks which would necessarily have been brought forward now, have already formed part of the details in the descriptions of the particular Excitants.

The great number of substances which operate as Excitants leaves the practitioner ample opportunity for selecting that one which is most likely to answer the indication to be fulfilled: but, before doing so, it is necessary that several circumstances should be taken into consideration, and especially whether the impression is to be confined to the digestive organs, or extended to the circulating, or to the cerebral and rachidien systems.

The substances chiefly useful for the first-mentioned purpose are those which contain volatile oil in combination with tannin, extractive and the bitter principle; namely, some of the roots and barks which have been described. These have been found most beneficial in debility of the digestive organs, particularly in that sickness which frequently arises from chronic weakness of the stomach; and in all cases of deficient action of that organ; but they ought rarely to be employed alone, except in spasmodic pains: and even when the dyspeptic affection is grafted upon an hypochondriacal condition of the habit, combined volatile oil only should be employed. Besides those diseased states of the stomach already mentioned, Excitants have been found serviceable in cardialgia and flatulency; their administration is also clearly indicated in various affections of the intestinal canal; namely, colic when no inflammatory action is present: and externally, as counterirritants, when it is present, and is of a chronic or subacute character: in flatulent colic and flatulent cholera, the warmest carminatives may be had recourse to, even under the utmost violence of the pain. In the state of collapse, in spasmodic cholera, the judicious employment of the most powerful Excitants, externally under the form of the hot air bath, and internally under the forms of dif-

* Acta Hafniensis.

fusible stimulants, have been much used; but, hitherto, with little decided advantage. What has been stated under the head of Mercury, Caloric, and Iodine, prevents the necessity of extending our remarks on these articles.

When we reflect that one effect of Excitants is to stimulate the stomach to increased action, it may appear inconsistent to prescribe remedies of this class in cases of insatiable voracity; but their utility is undoubted, and they have been employed from the time of Galen, who recommended brandy and water, in small but frequently repeated doses in diseased appetite.

During the paroxysm in atonic gout, especially when the stomach is affected, powerful Excitants, ginger, capsicum, ammonia, and the most pungent aromatics, are indicated. In atony, also, of the intestinal canal, producing obstinate constipation, when ordinary purgatives are of little avail, the addition of Excitants, by rousing the nervous energy, is productive of the best effects.

In the administration of Excitants of any kind in gastric and intestinal diseases, it is important to ascertain the exact condition of the stomach, as well as that of the whole mucous membrane of the intestinal canal. Before prescribing Excitants, we must be satisfied that there exists no ulcerations, nor scirrhous nor cancerous tendency in any portion of the canal. It is necessary also to determine whether vomitings or gripings, which may seem to demand their employment, be not symptomatic of cerebral engorgements, nor irritations of the encephalon or of the spinal marrow: at the same time, the condition of the liver and the neighbouring organs, the pancreas and the spleen, must be carefully investigated.

It is scarcely necessary to caution against the general employment of Excitants in febrile states of the habit 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 Excitants are called for, or are admissible: 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. But much discrimination is requisite in determining the exact period when Excitants are demanded, even in this stage of fever; and there is less risk in permitting the prostration of strength to proceed for a short time, than in urging the administration of Excitants on the first indications of the approach of collapse: even under the circumstances which demand the employment of wine in typhus, much caution is requisite in its administration. 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 which it appears to bestow is

likely to be succeeded by a greater degree of debility, and consequently that the utmost danger may result from persevering in the use of Excitants. When petechiæ appear, or when there is protracted diarrhœa followed by sudden collapse, wine and other Excitants are not only admissible, but are the only remedies upon which we can 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 pain in the head, and a rapid, small, thrilling pulse.

The topical influence of Excitants has been found beneficial in that debility of the organs of the glottis which reduces the voice to a whisper. In affections of the chest, also, accompanied with spasm, as in the latter stages of hooping cough, their utility is undoubted. 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.

Excitants are not only contraindicated, 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, the administration of Excitants 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; and certainly this class of medicines is equally improper in inflammatory states of the coats of either of the arteries or the veins; or in palpitations indicating inflammatory action either in the pericardium or in the heart. In bronchitis and similar affections of the chest, although, during the continuance of the inflammatory action, when the cough is dry and the expectoration difficult, Excitants would be productive of the greatest mischief, yet in the advanced stages of pulmonary affections, particularly in peripneumony, their administration is demanded not only to aid expectoration, but to stimulate the capillaries so as to relieve the engorged state of the pulmonary tissues. On the same principles also, they 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 matters are effused into the air-tubes, 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 Excitants.

In the neuroses, Excitants are clearly indicated; for example, in hysteria, epilepsy, chorea, catalepsy, tetanus, neuralgia, and, under some circumstances, in hypochondriacal and maniacal affections. In this general statement, however, many exceptions

are included: the state of the brain and the spinal marrow must be clearly ascertained; morbid dissections having demonstrated that many of those affections which are frequently regarded as altogether nervous, have been connected with and are dependent upon abscess, ulcerations, tumors, or depositions of blood in the substance of the brain, or collections of fluid in the ventricles; sometimes on similar affection of the spinal marrow or its tunics. Wherever these are suspected, there can be only one opinion respecting the impropriety of the administration of Excitants.

In many instances of paralysis, especially those of the lower extremities, constituting paraplegia, experience has fully demonstrated the utility of strychnia and other Excitants; but at the same time many circumstances may exist which contraindicate their employment, and nothing is more necessary than a sound judgment and a cautious diagnosis in such cases. Indeed, in all cases of palsy, a more indiscriminate employment of Excitants has been indulged in than a correct knowledge of the pathology of the disease warrants. External Excitants, however, are less exceptionable; but the result of their employment, not excepting electricity, has too often been disappointment.

From the state of the nervous centres closely resembling those which produce paralysis, the skin often loses its natural qualities, becomes pale or discoloured, soft and scaly, or covered with crusts. In this condition, Excitants 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, and the disposition to which is undoubtedly increased by exciting medicines; while darting pains, restlessness, and wakefulness, supervene and increase all the sufferings of the patient.

In many painful affections, in which it is necessary to exhaust the sensibility of nerves, the topical application of Excitants has been found beneficial; as, for example, in toothache from caries, which is relieved by the introduction of any acrid substance, as camphor or volatile oil, into the hollow of the tooth. On similar principles, the use of local Excitants is indicated in other affections in which pain is a predominant symptom; for example, whitlow, paronychia, in which lotions of alcohol have been found useful; the various species of erythema, and in some of those of herpes. In malignant sore throat, capsicum and some other Excitants form the bases of the most useful gargles.

From the details which have been delivered respecting the influence of the substances arranged in this class of medicines, the importance of Excitants, in a therapeutical point of view, is undoubted; but the very nature of many substances belonging

to the class renders them more liable to be abused than those in any of the other classes. Many Excitants are employed as condiments; some of them as our daily beverage; and enough has been said with respect to the general predilection of all nations for diffusible Excitants, particularly wine and ardent spirits, to demonstrate the caution which is requisite in their employment as remedial agents. It is of the utmost importance that the student and the inexperienced practitioner should clearly understand the distinction between Excitants and Tonics, or those medicines which simply increase action and those which are capable of producing a permanent increase of power. It is true that the stimulus which Excitants afford to the nervous system, in a debilitated state of the body, give 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 improved condition of the habit, is soon followed by the directly opposite state, that of exhaustion; indubitably proving that action is not strength. The combination, however, of Excitants and Tonics aids greatly the power of the latter; calling forth, as it were, the strength which the tonics render permanent*.

SECTION III.

SEDATIVES.—MEDICAMENTA SEDANTIA†.

SEDATIVES are substances which directly depress the energy of the nervous system, diminishing motion in animal bodies without inducing previous excitement. Regarded in a remedial point of view, they are powers intended to diminish preternaturally increased action in animal bodies. This increased action may display itself chiefly in the circulating system, and only in the nervous system as it is connected with the sanguiferous; or it may appear in the muscular system, and may affect the sanguiferous only in a secondary and transitory manner. Whatever may be the cause of this increased action, whether irritating matters introduced into the body, or some state of its own œconomy, the substances which directly lessen this preternatural action may be considered as Sedatives; and this they effect by

* Besides the substances described in the class of Excitants, the following are also employed on the Continent, and elsewhere: Legusticum *levisticum*, Apium *graveolens*, Scandix *cerefolium* and S. *odorata*, Sisymbrium *nasturtium*, Tropæolum *majus*, Anthemis *cotula*, Matricaria *parthenium*, Epidendrum *vanilla*, Maranta *galanga*, Illicium *anisatum*, Dictamnus *albus*, Ambergris, Acetic Ether, Phosphorus.

† From the Latin word *sedo*, to calm.

depressing the nervous power, and by diminishing the energy of the brain and that of the spinal marrow.

The immediate influence of the administration of a Sedative is experienced first upon the nervous system, and secondly through it upon the muscular: if the dose be large, the individual who has taken it loses his power of volition, becomes vertiginous and staggers; the nerves of sensation cease to respond to ordinary impressions, the person becomes unconscious, syncope supervenes, and, in a few seconds, life ceases.

In general, writers on the Materia Medica have confounded Sedatives with Narcotics; from which, however, they are perfectly distinct*. Let us examine in what this distinction consists.

The administration of narcotics is frequently followed by sedative or depressing effects; but, in every instance, this is the result of a previous excitement, which is more or less obvious in proportion to the extent of the dose. In small and moderate doses, narcotics augment the force and increase the frequency of the pulse, promote the secretions, and bestow a temporary higher degree of both mental and bodily vigour; and, if the narcotic be administered at proper intervals, this excitant effect is maintained. In a short time afterwards, however, the transitory nature of this state of excitement is conspicuous; and one of depression or collapse follows, in which general languor, dulness of sensibility, and sleep, ensue. When the dose is large, the period of the excitement is so short, that the symptoms of diminished sensibility and motion appear as if they were induced without any previous increased action. This seems to throw difficulties in the way of separating Sedatives from Narcotics; but as it can be demonstrated that, even in small doses, no excitement follows the administration of *Sedatives*, there is no doubt that their operation is perfectly distinct from that of Narcotics. To illustrate this point by an example, let us suppose that a few drops of a powerful sedative, hydrocyanic acid, for example, are taken into the stomach: no quickening of the arterial action is perceived; on the contrary, the force and the frequency of the pulse are diminished, and there is a feeling of depression which is too decided to be overlooked: it is, indeed, evident, that this acid possesses a quality directly the opposite of that of an excitant; it produces a prompt but decisive effect on the nervous system, not only directly diminishing its sensibility, but, if the dose be sufficiently large, also paralysing the whole powers of the nervous centres. This directly depressing power is common to all sedatives: their effects are an immediate diminution of the powers of life, prostration of strength, stupor, and numbness, lowness of the animal spirits, yawning, sleepiness, vertigo, and, indeed, a complete paralysis of the natural

* Billing, First Principles of Medicine, p. 44.

powers of the habit: yet, in the midst of all, the muscular energy is scarcely diminished, and some of the automatic actions proceed, for a short time, when every symptom of sensibility to impression is utterly destroyed.

The admirable experiments of Mr. Brodie upon sedative poisons explains well the manner in which they act upon the brain through the medium of the nerves, the functions of which are consequently more or less impaired; but it is upon the nerves of sensation chiefly that direct sedatives operate; and, therefore, as the motor nerves are but little affected, the organs of respiration continue their functions; and the powers of the heart also being unimpaired, that organ continues to act, circulating venous blood for some time, as long as respiration can be supported. Thence, in Mr. Brodie's experiments, by maintaining artificial respiration, so as to carry off the superfluous carbon from the blood, it sometimes happened that the animals recovered. It is easy to demonstrate that the action of the heart and the peristaltic movement of the intestines continue after the sensitive life of the animal is destroyed.

When Sedatives taken into the body do not destroy life, their influence is lessened after a certain time; and, sooner or later, according to circumstances, it altogether terminates; the impression, however, may be renewed by a reapplication of the means; but it becomes weaker after each repetition until it almost ceases to act, unless the dose be greatly augmented. It is difficult to explain this fact.

If these statements be correct—and that they are so is undoubted—one inference only can be drawn from them:—namely, that sedatives act directly on the nerves of sensation, producing a peculiar effect on those parts of the system which are suplied with these nerves; and that this effect is most probably not the result of a stimulus rapidly exhausting the excitability, but of a direct impression of a peculiar kind on the nerves, which immediately exhausts them of their susceptibility of receiving impressions from external objects. From the ideas which, at a very early period of life, we obtain of the effect of stimulants as connected with mechanical impressions, it is much less difficult for us to admit the hypothesis, that, in every instance of diminished action from the influence of medicines, there must exist a previous state of excitement, than that something is either abstracted from the nervous energy, or that some alteration takes place in the nerves themselves, which diminishes their power of receiving impressions. No examination of the nerves in animals killed by sedative poisons has demonstrated any change in these organs; and we are necessarily unable to affirm, from appearances, that any thing is either abstracted from them, or that their condition is in any degree altered: yet it is evident that some change has taken place, and that there has been a complete

exhaustion of that quality, their excitability, which renders the nerves susceptible of impressions: and we may, however, presume to affirm that the sedative effect is immediate, not secondary. Sedatives, therefore, diminish or destroy excitability; and this in a degree according to the extent of the dose in which they are given; and, as the secondary effect of their direct influence on the nervous system, they lessen, both in point of strength and frequency, the action of the heart and arteries on the pulse, or extinguish it altogether.

Notwithstanding the powerful action of Sedatives, their effects in small doses are, in a certain degree, confined to the part to which they are applied: in larger, but still moderate doses, their influence is extended over the system; and it is only in comparatively large doses that they display their poisonous properties, so rapidly destructive of life. In this respect, Sedatives differ from many of the other classes of medicines; their effects being regulated more by the extent of the dose than by the condition of the body.

1. *Effects of Sedatives on the Digestive Organs.*—When a sedative substance is introduced into the stomach, in a moderate dose, no particular sensation is experienced; and the certainty that it has operated upon the organ is rendered obvious rather by the effect upon the digestive function which follows, than by any thing which can be referred to the state of the stomach itself. When this organ is morbidly irritable, this diseased state is more or less maintained by the imperfect secretion of the gastric juice reacting upon its nerves, already too susceptible of even ordinary impressions: the influence of a direct sedative, therefore, when admitted into the organ, produces an immediate effect upon the gastric nerves, not only rendering them less susceptible of impression, but, by removing the irritation which is present, favouring the formation of a more healthy, because more slowly secreted, gastric juice, and thus also removing one exciting cause of the diseased condition of the organ. That such a local influence may be exerted upon certain sets of nerves, without being sensibly felt by the general system, is undoubted.

If the dose of the Sedative be a little increased, the effect is then extended to the brain, and manifested by slight vertigo, insensibility for a few seconds, sinking of the pulse, failing of the limbs, which the patient most commonly refers to the thighs, general lassitude of the frame, and torpor of the mind. If the dose be large, but not sufficient to operate as a poison, a sensation of weight and dull pain, felt in the forehead and in the bottom of the orbits, is superadded. It has been contended that the last-mentioned symptom indicates the existence of excitement previous to the state of collapse which I have described; but this opinion is not tenable, as it is well known that coma may proceed from inanition, as well as from congestion in the brain,

and that the administration of stimulants may be requisite for the relief of symptoms closely resembling those which are cured by venæsection and depleting remedies. This fact, which I had observed and acted upon many years ago, was first made known to the profession by my friend, Dr. Marshall Hall*; and Dr. Abercromby†, nearly about the same time; and afterwards by Dr. Gooch‡: and it is now generally acknowledged to be founded upon correct observation.

2. *On the Circulating and Respiratory Organs.*—When the influence of Sedatives extends beyond the stomach, or the surface to which they are applied, it is frequently displayed on the heart and arteries, by the diminished action of these parts: but this is by no means commensurate with the impression made upon the nervous system. When death occurs, the arteries and the left ventricle of the heart are found empty, the right is gorged with black blood. Schubarth asserts that the heart loses its contractility; but my own experience, and observations drawn from experiments upon the lower animals, incline me to accord with Coullon§, that the heart, the intestines, and the voluntary muscles, retain their contractility in poisoning by powerful Sedatives.

The effects of Sedatives on the respiratory organs depends much on the manner of employing them, whether they be applied directly to the lungs in a gaseous form, or operate through the medium of the stomach. If pure carburetted hydrogen gas be breathed, an immediate sensation of numbness in the respiratory muscles, and an overpowering oppression of the chest, are felt; in a few seconds the person becomes insensible to external objects; he feels "sinking into annihilation‖;" and, if he continue breathing the gas, he dies with a complete destruction of muscular irritability. On examining the lungs, no signs of increased action can be perceived; the organs appear as if their functions had been instantaneously arrested; the blood is fluid and dark coloured; and things remain as one may suppose them to have been at the moment when the cessation of action occurred.

3. *On the Secerning System.*—Little is known respecting the influence of this class of medicines on the secerning system, except on the secreting surface of the stomach. In some instances, salivation has occasionally followed the employment of hydrocyanic acid¶; and, in other instances, the secretion of urine has been greatly augmented. The latter effect seems to depend on the same circumstances which augment the urinary

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* Researches on the Effects of Loss of Blood, page 119.
† Account of some Diseases peculiar to Women.
‡ Researches on Diseases of the Brain and Spinal Cord.
§ Recherches, &c. p. 146. ‖ Researches on Nitric Oxide Gas, p. 467.
¶ Lond. Med. and Surg. Journ. Feb. 1823, p. 128.

discharge, when fear and some other mental sedatives influence the habit.

4. *On the Nervous System.*—From what has already been stated, there can be no doubt that it is on the nerves that sedatives exert their influence. This is further proved by the fact, that, when hydrocyanic acid is applied to one limb only of a frog, this member becomes paralyzed, whilst the other limbs remain unaffected. Robiquet, also, while making some experiments on the tension of the vapour of this acid, after having exposed his fingers to it for some time, felt a numbness in them, "which lasted several days*," without experiencing any effect from the acid on his system. In cases of poisoning by Sedatives, however, nothing, either in the brain, the spinal marrow, or the nerves, affords any information of the nature of the impression, except that it is not that of excitement: indeed, this conclusion might have been anticipated from their effects—exhaustion of excitability, and death—without one preceding trace of increased action when administered in large doses†. Whatever may be the nature of the impression, it is evident that it is different from that of any exciting power, whether the sedative be of a corporeal or a mental nature.

The foregoing considerations, although they afford little which is satisfactory for enabling us to form any accurate conclusion as to the manner in which this class of medicines influence the animal organs, yet they confirm the truth of the proposition, that there are powers which destroy excitability and life without previous excitement, or, at least, without any signs of it being discoverable.

Sedatives, from the nature of their effects, may be arranged under two distinct heads: *Direct Sedatives*, or those which operate immediately on the nerves: and *Indirect Sedatives*, or those which operate through the medium of the vascular system.

TABLE OF SEDATIVES.

A. DIRECT SEDATIVES.

* *Organic Products.*

a.—CYANOGEN—

Combined with Hydrogen, in
Hydrocyanic Acid.
Laurel Water.
Volatile oil of Bitter Almonds.

Combined with Potassium, in
Cyanide of Potassium.

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* Journ. Complement. v. xxviii, p. 33. † Christison on Poisons, 1st. edit. p. 561.

b.—EMPYREUMATIC VOLATILE OIL—in Tobacco smoke.

c.—NICOTINA—contained in the leaves of Nicotiana *Tabacum*. 5. 1. Solaneæ.

* * *Inorganic Substances.*

d.—SULPHUR—

Combined mith Hydrogen, in Sulphuretted Hydrogen Gas. Hydrosulphuret of Ammonia

e.—CARBON—

Combined with Hydrogen, in Carburetted Hydrogen Gas.

B. INDIRECT SEDATIVES.

f.—CARBON—

Combined with Oxygen, in Carbonic Acid Gas.

g.—BLOOD-LETTING.

ORGANIC VEGETABLE PRODUCTS WHICH OPERATE AS SEDATIVES.

CYANOGEN*.—This substance forms the active constituent of several powerful sedative medicines. It is obtained, in the gaseous state, from Bicyanide of Mercury, by the aid of heat. The mercury is disengaged from the Cyanogen, and volatilized in a metallic state, whilst the Cyanogen is procured in the gaseous form, and may be collected in jars, over mercury. To procure it in this manner, the bicyanide should be perfectly dry. Cyanogen gas is dense, colourless, and has a penetrating odour. It burns with a violet-coloured flame, is soluble in water, ether, and alcohol. Its aqueous solution reddens Tincture of Litmus, and precipitates the salts of Iron blue. It exerts a deleterious influence on animal life by operating as a direct sedative.

1. *Cyanogen with Hydrogen.*

Cyanogen, in combination with Hydrogen, forms an acid which possesses very peculiar properties on the living animal system.

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* From κυανος, blue, and γενναω, I engender.

*a. Hydrocyanic Acid**.—This acid is formed in several processes, in which both animal and vegetable matters that do not naturally contain it are employed. It is found prepared by the hand of Nature in the leaves of the Cherry Laurel and those of the Peach, in the blossoms and seeds of the Peach, the Apricot, the Bitter Almond, the Cherry Laurel, the Cluster Cherry, and of several other plants. The essential oil and the distilled water of these vegetable substances yield hydrocyanic acid; but it has been doubted whether the acid be ready formed in these substances, or whether it be not the result of the operation for procuring it, by a new combination of its ultimate constituents, carbon, nitrogen, and hydrogen.

Hydrocyanic acid is artificially prepared for medicinal use; but in this state it is diluted with water, and so far it differs from the real acid. There are, therefore, two descriptions of hydrocyanic acid, the strong and the medicinal. Various processes have been proposed for procuring both of them. Vauquelin's process is the best for the strong acid; that of Scheele, modified, for the medicinal preparation. To procure the strong acid, the dry bicyanide, broken into small particles, is put into a tube about eighteen inches long, and less than half an inch in diameter. One end of this tube is connected with a flask, in which sulphuretted hydrogen gas is to be evolved and passed through the tube until the whole of the bicyanide become black. The flask is to be then removed, and one end of the tube closed with a little plaster of Paris, whilst the other is to be attached to a small flask placed in ice. As soon as the plaster is set, the tube is to be gently heated to drive off the hydrocyanic acid, which is to be received in the cooled receiver. In this process, the bicyanide, which consists of 2 prop. of Cyanogen = 52; and 1 prop. of Mercury = 200, is decomposed by the sulphuretted hydrogen, which is composed of 2 prop. of Hydrogen = 2; and 2 of Sulphur = 32. On passing it over the bicyanide, the two proportions of hydrogen combine with the two of cyanogen of the bicyanide, and form hydrocyanic acid, whilst the sulphur combines with the mercury, and forms a bisulphuret of mercury.

The hydrocyanic acid, thus prepared, is a colourless, limpid fluid, with a penetrating odour, which causes severe headache, nausea, and fainting, when it is incautiously snuffed up the nostrils. This odour is generally compared to that of the peach blossom or the bitter almond; but, if the acid be totally free from the volatile oil of those vegetable substances which contain hydrocyanic acid, it certainly differs from that of the peach blossom. This acid evaporates so rapidly that a drop of it con-

* The names Cyanogen and Hydrocyanic acid were imposed by Gay-Lussac; the former implies a *producer of blue*, being a compound of two Greek words, κυανός and γενναω; and, therefore, as this is acidified by hydrogen, he called the acid Hydrocyanic.

geals by the cold caused by the evaporation of a part of it; it combines with water and alcohol in all proportions, and faintly reddens litmus; has a specific gravity of 0.7508; it boils at 80, and freezes at 5°; its vapour is inflammable, burning with a blue flame; and, when mixed with oxygen gas, it detonates, leaving *carbonic acid*, *nitrogen gas*, and *water*. This strong acid is so susceptible of decomposition, that it sometimes spoils within an hour after it is made. It is converted, by spontaneous decomposition, into ammonia, and a black compound of carbon and nitrogen. It is not used in medicine.

The medicinal acid is procured in several ways. One very simple method, that of M. Proust, is to pass a stream of sulphuretted hydrogen gas through a solution of bicyanide of mercury until no more sulphuret of mercury is precipitated, or until the filtered fluid remains colourless and transparent, when mixed with a solution of sulphuretted hydrogen. It is then to be decanted and agitated with carbonate of lead, to remove any excess of sulphuretted hydrogen, and afterwards filtered. In this process the bicyanide is decomposed; the cyanogen, which is set free, unites with the hydrogen of the sulphuretted hydrogen gas, forming hydrocyanic acid, whilst the sulphur combines with the mercury, and forms a sulphuret of that metal, which precipitates, and is thus easily separated. An acid of any given strength may be thus prepared.

The Dublin College orders hydrocyanic acid to be prepared by mixing one ounce of cyanuret of mercury with seven fluid drachms of muriatic acid, diluted with eight fluid ounces of water. Of this mixture, eight fluid ounces are to be distilled into a cool receiver: these are hydrocyanic acid, whilst a solution of corrosive sublimate remains in the retort. The chief recommendation of this process is its economy: but, if too much muriatic acid be employed, the result will be a very small proportion only of hydrocyanic acid, a chloride of ammonia and mercury, and formic acid. Another mode of preparing the medicinal acid is that of Scheele, modified. One part of Prussian blue, and half the quantity, by weight, of red oxide of mercury, are reduced to fine powder and boiled in a glass vessel, with twenty parts of distilled water, agitating the mixture during the whole time with a wooden spathula. This mixture is then allowed to remain a short time at rest, after which the whole is filtered, and the deposite washed on the filter with boiling distilled water. The filtered fluids are next to be put into a flask with ℥iss of fine pophyrized iron filings, and f℥iss of strong sulphuric acid, and, after agitation, this mixture is allowed to remain at rest for an hour, after which the supernatant fluid is to be distilled in a retort until $\frac{1}{6}$ of the whole passes over. This is diluted hydrocyanic acid, which only requires to be purified from any sulphuric acid that may have come over, by means

of barytic water and redistillation over a little pure chalk*. In this process, the Prussian blue is decomposed by the peroxide of mercury, and a solution of bicyanide of mercury is formed: this is next decomposed by the hydrogen gas evolved from the action of the iron filings and the sulphuric acid on the water, uniting with the cyanogen of the bicyanide, and forming hydrocyanic acid. It differs from the strong acid only in strength. Its specific gravity should be 0.995. The last process, perhaps the best, is to mix together twenty-two grains of cyanide of potassium, fifty of crystallized tartaric acid, two fluid drachms of alcohol, and six of distilled water: and, after occasional agitation for ten minutes, to decant the supernatant fluid. In this process the cyanide is converted into a Hydrocyanate by a partial decomposition of the water in which it is dissolved, and a double exchange taking place, the results are bitartrate of potassa, which is precipitated by the alcohol, and diluted Hydrocyanic Acid containing a definite quantity of alcohol. As it is of consequence to have a medicinal acid of a uniform strength, Dr. Ure has proposed a test for ascertaining this point. He agitates peroxide of mercury, reduced to a fine powder, in the acid to be tried, until no more be dissolved. On dividing the weight of the peroxide used by four, the quotient expresses the quantity of real acid contained in the diluted acid. The oxide should be added to the cold acid in small quantities at a time, avoiding an excess, which is known by the solution not changing the infusion of red cabbage to green. Processes to procure this acid have been also proposed by Vauquelin, Gay-Lussac, Robiquet, Pessinau, Frantwan, and others.

According to Gay-Lussac, the composition of pure hydrocyanic acid, in numbers, is—Carbon 54.39, + Nitrogen 51.71, + Hydrogen 3.90 = 100; or 1 prop. of Cyanogen = 26, + 1 prop. of Hydrogen = 1, making the equivalent of the acid 27. (H + 2 Cn.). Hydrocyanic acid is decomposed by chlorine and the oxides of antimony. It is precipitated from its solutions by nitrate of silver and sulphate of copper, but not by the salts of iron, nor the alkaline sulphurets and hydrosulphurets. If it be not preserved in well-stopped bottles, it becomes weak by the volatilization of the acid; it also, sometimes, undergoes decomposition, and deposites brown flakes, in which state it is unfit for medicinal use.

Such is hydrocyanic acid in its strong and its diluted state. Before examining its therapeutical properties, let us examine its compounds. The first of these is—

b. Laurel Water.—This is the distilled water of the leaves of a species of cherry, the Prunus *Laurocerasus* of Linnæus, a

* M. Schrader affirms that the acid rectified on magnesia, chalk, or any saline matter, soon spoils. (Bull des Scien. Med. iv, p. 184.)

native of the coast of the Black Sea, although it is now very common in Europe, into which it was brought about the end of the sixteenth century. It belongs to the natural order Amygdaleæ*. The volatile oil residing in the leaves and kernels of the fruit is combined with hydrocyanic acid. The flowers, as well as the leaves, have the odour and taste of the bitter almond and the kernel of the peach, and communicate both readily to boiling milk, cream, diluted alcohol, and other substances; in which forms they are employed as condiments. In the distilled water, the grateful odour of the peach kernel can be readily distinguished from the peculiar odour of the hydrocyanic acid. According to Schubarth, it contains 0.25 per cent. of hydrocyanic acid; but, although tests readily detect the acid, yet I am inclined to think that its proportion is overrated.

The leaves and kernels of other species of cherries — namely, the cluster cherry, Prunus *Padus*, an indigenous species†, the black or bird cherry, Prunus *Avium;* the *sloe*, Prunus *spinosa;* the *Bullace*, Prunus *institita*, and even the leaves and kernels of the common cherry, Prunus *Cerasus*, yield a similar distilled water; but, in these, both the oil and the hydrocyanic acid are in smaller quantity than in that of the P. *lauro-cerasus*.

c. Oil of Bitter Almonds.—The seed yielding the largest quantity of combined hydrocyanic acid is the bitter almond; the kernel of the fruit of the variety *amara* of the Amygdalus *communis*, a tree which is a native of Barbary and Syria, but is now cultivated in Europe‡. The sweet and the bitter almond are produced on trees so closely resembling one another, that they are regarded as varieties of the same species; and it is asserted that the sweet almond tree yields bitter almonds when neglected, the bitter almond tree sweet almonds when it is cultivated with care§. When the marc, which remains after bitter almonds have been subjected to the press, is distilled in water, a pale yellow volatile oil is obtained, acrid and bitter to the taste, and exhaling the odour of the peach blossom. It is heavier than water; and is distinguished from other volatile oils by the promptitude with which it absorbs oxygen, and the formation of crystals, which are benzoic acid||.

The poisonous influence of the oil of bitter almonds was known so early as the time of Dioscorides, who states that it was employed for killing wolves; but it was not known, until a German chemist, Bohm, ascertained the fact, that this influence

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* Woodville's Medical Botany, third edition, p. 513, pl. 185. Richard, Hist. Nat. Med. t. ii, p. 446.

† The Kirschwasser of the Germans is obtained from the cherry.

‡ Woodville's Med. Bot. 3rd edit. p. 507, pl. 183.

§ Murray's Apparatus Medicaminum, vol. iii, p. 257.

|| Ann. de Chimie et de Phys. t. xliv, p. 378.

depends greatly on the presence of hydrocyanic acid. The fact that this oil contains hydrocyanic acid is easily proved by digesting it with peroxide of mercury, which is converted into the bicyanide. Vogel thinks, and probably correctly, that the volatile oil is poisonous; for when the Hydrocyanic Acid is separated from it by distillation, the oil is still poisonous: but Robiquet has quaintly remarked, that probably the oil tried by Vogel was not completely freed from the acid. When this oil is distilled, the portion which comes over first has less of the peach-blossom odour, but more of that of Hydrocyanic Acid than the oil itself; whilst the residue in the retort, which has acquired a high red colour, scarcely smells of Hydrocyanic Acid, although it retains much of the odour of the peach blossom. From these experiments, the oil of bitter almonds appears to consist of two distinct substances: the one an azotized portion, which, being highly volatile, passes first over during the distillation, and is highly impregnated with Hydrocyanic Acid; the other, a portion which passes over last, and crystallizes on exposure to the air. These crystals acquire acid properties when exposed to the air: they are soluble in boiling water; they crystallize on cooling; are fusible, volatile, unite with alkalies, are not poisonous; and, in fact, present no analogy with the oil from which they are procured.

Robiquet supposes that the volatile oil of bitter almonds does not exist naturally in the almond, which he contends possesses a peculiar principle that appears to him to be the sole cause of its bitterness, and one of the constituent elements of the volatile oil, for the formation of which the presence of water is essential. According to the experiments of MM. Henry and Plisson, the constituents of the oil of bitter almonds are of carbon 74.40, + oxygen 11.79, + nitrogen 5.97 parts. The water with which the oil is distilled retains a portion of the Hydrocyanic Acid and the odour of the oil: consequently it possesses powerful sedative properties.

The powerful and baneful effects of bitter almonds, eaten in large quantities, were observed at a very early period. Besides influencing men, the volatile oil acts powerfully on quadrupeds, causing convulsions*. The most remarkable instance of poisoning by laurel water on record is that of Dr. Price, the Alchemist, who, in 1782, poisoned himself with laurel water a few days before the time appointed for repeating his experiments of converting mercury into gold†. In the cases of poisoning by this distilled water, it was remarked by Cullen, as a

* Bibliotheque Germanique, t. i, p. 102. Ann. Cliniques de Montpellier, t. i, p. 297. Journ. de Pharm. t. ii, p. 344.

† For an account of the earliest proof of the deleterious effects of laurel water, see Phil. Trans. vol. xxxvii, p. 84.

curious fact, that, however violent its operation, no traces of inflammation were ever detected after death: but it was not until after hydrocyanic acid was ascertained by Bohm to be the active principle in laurel water, that the cause of this was fully understood.

Hydrocyanic acid, in its anhydrous state, is so powerful a poison, that a single drop of it introduced into the stomach of a dog, or injected into the jugular vein, or even applied to the eye, will destroy the animal as instantaneously as the most powerful shock of an electrical battery, or the stroke of lightning. This rapidity of action is incompatible with the idea that it must be taken into the circulation before it can exert its sedative influence. It exerts its influence directly on the nervous sensibility, which it completely extinguishes; and in smaller animals this is effected by vapour, even when it is largely diluted with atmospherical air. The usual symptoms in cases of poisoning by the weak or medicinal acid are stupor and numbness, with a sense of weight at the top of the head; yawning, irresistible drowsiness, vertigo, and dimness of sight; the pulse, which is at first not affected, quickly flags, and becomes slow and vibrating; but, before this takes place, vomiting and hiccup sometimes occur, the extremities are paralyzed, and the pupils remain dilated, and every function seems destroyed, except respiration, which is rarely either accelerated or difficult. Its effects on the human body have too often been witnessed. The vapour of the medicinal acid causes vertigo. In a case mentioned by Hufeland, a strong and healthy man, who was seized as a thief by the police, whilst in the act of being conveyed to prison, took a small phial from his pocket, broke off the neck of it, and swallowed the contents. He staggered a few paces, then fell on his knees, and instantly expired without a struggle*. It affects all animals indiscriminately, from the worm up to man: all are killed by large doses of it, and all die nearly in the same manner: vegetables also suffer in an equal degree. An instantaneous cessation of vitality takes place; yet, in animals the eyes are open, and appear animated as if alive†. Although the sensibility is thus so completely destroyed that nothing can again arouse it into activity, yet, if in this state the body be opened, the action of the heart is seen proceeding, and the most beautiful demonstration is afforded of the movements of the intestinal canal; demonstrating, as Majendie has happily expressed himself, "that an animal may be dead with regard to its external functions, although still enjoying life through its nutritive faculties."

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* Journ. de Med. et de Chirurg. part Jan. 1815. Both Schull and Scharinger are supposed to have fallen victims to its power.

† When the strong acid, however, is employed, the extreme coldness caused by the evaporation, renders the cornea, when it is applied to it, opaque.

Hydrocyanic acid, therefore, whether in a free state or combined with volatile oil, as in that of the bitter almond and in laurel water, is a most powerful sedative poison.

The post-mortem examination of the body exhibits the blood congested in the right ventricle of the heart and the veins. The blood appears to be more than usually fluid, and sometimes exhales an odour of hydrocyanic acid. The venous turgescence extends to the brain and spinal marrow. The same appearances are found when the poison is the essential oil of bitter almonds or is laurel-water.

With respect to the period of time in which this acid produces its fatal effects, I have seen it destroy a dog before it could be put upon the ground from the knee of the person who held him during the administration of the poison. In some experiments made by Mr. Macaulay, of Leicester, one dog, to which four drachms of the diluted acid were given, died in eight seconds; another, with four drachms, in seven seconds; and another, with four drachms and a half, in three seconds. In these cases, it is scarcely requisite to say that absorption could not have taken place. It would, however, be uncandid not to mention the experiments of Dr. Krimer, of Aix-la-Chapelle, which are intended to prove that, notwithstanding the rapidity with which Hydrocyanic Acid destroys life, it may, nevertheless, be taken into the circulation. He found that it does not act when it is applied directly to the medullary matter of nerves; nor when it is applied externally to the brain and spinal marrow. He even states that he has ascertained that, when applied to the tongue, it does not kill until it is evaporated by the heat of the organ, and is absorbed into the pulmonary circulation, when it kills by first diminishing the action of the heart and then that of the spinal marrow. He says that when the arteries and veins of a part are tied, and the nerves left entire, and the acid is introduced into a wound, it does not act, but it takes effect the moment the ligatures are removed from the blood-vessels; and that death also occurs when the nerves are divided, if no ligatures be used. When the gastric vessels are tied, although the nerves remain entire, Hydrocyanic Acid, when swallowed, does not produce its usual effects: but it operates immediately when it is placed on the tongue; and in thirty-six minutes it can be detected in the blood by reagents; which is also the case when it is inhaled without the vapours coming in contact with the nerves of the tongue. These experiments of Dr. Krimer are, prima facie, apparently confirmed by those of Mr. Brodie with oil of bitter almonds. A single drop applied to the tongue of a cat caused violent convulsions, and the animal then lay on one side, motionless, insensible, and breathing in a hurried manner, until she died, which occurred in five minutes. On opening the thorax, the heart was found

pulsating eighty beats in a minute, and circulating dark blood. The same effects resulted from injecting two drops of the oil, in half an ounce of water, into the rectum of the animal; so that the first experiment affords no support to Dr. Krimer's theory. Notwithstanding, therefore, the apparent conclusiveness of Dr. Krimer's experiments, the justness of the conclusions may be doubted. I cannot conceive how it is possible that the acid can be taken into the lungs without acting on the nerves. On these accounts, and from witnessing the instantaneous effects of this poison when given in large doses, I see no reason for altering my opinion respecting the manner in which it acts on the animal œconomy.

The same reasoning refers to oil of bitter almonds, and cherry laurel water. Some experiments have lately been made with it by M. Jorg and others, at Leipsig. They took it in doses, progressively increased, from five to twenty-five minims, and finally to a hundred and twelve minims! The symptoms were those of concentrated action on the brain, sense of weight on the head, sleepiness, torpor of the intellectual functions, lassitude, feebleness, retardation of the pulse, and headache. This last symptom was preceded by a dull, pungent pain in the region of the optic nerves. It likewise brought on a slight attack resembling bronchitis. M. Jorg refers these symptoms to the turgescence or plethora of the vessels of the brain; but they may arise from paralysis of that organ.

2. *Cyanogen with a Metallic Base.*

d. Cyanide of Potassium.—This substance does not hold a place in any of the British Pharmacopœias; but, as it possesses the same sedative properties as free hydrocyanic acid; as it is always the same, and is not liable to spontaneous decomposition; it might be advantageously employed instead of hydrocyanic acid as a remedial agent—an idea suggested by MM. Villermé and Robiquet*. It is prepared by exposing the ferro-cyanate of potassa to a red heat, for some time, or until decomposition takes place: by lixiviating the residue, filtering and evaporating the solution of the hydrocyanate of potassa, the Cyanide of Potassium remains in cubic crystals. One grain placed on the tongue of a large Guinea pig, killed it in three minutes†. When dissolved in water, it becomes a hydrocyanate; a portion of the water being decomposed sufficient to yield oxygen for converting the potassium into potassa, and hydrogen to form the cyano-

* Bull. de la Soc. Med. d'emulation, Juillet 1823, p. 411.
† Journ. Physiol. &c. par M. Majendie, tome iii, p. 230.

gen into hydrocyanic acid. 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.

Dr. Buttigny and Dr. Lombard, of Geneva, have successfully employed this preparation, both in the state of solution and in the form of ointment, externally, in neuralgic affections: the solution containing from one to four grains of the cyanide in each fluid ounce of water; and the ointment from two to four grains in every ounce of lard. Both are beneficial; but Dr. Lombard thinks that the solution acts more promptly than the ointment. This cyanide has been found to relieve also the pains in chronic rheumatism. It is, however, according to Dr. Lombard, contraindicated when the nervous affection is complicated with a state of active inflammation.

In whatever form hydrocyanic acid or its compounds may be administered, much caution is requisite in regulating the dose according to the strength of the patient, and watching its effects: it is, therefore, important to know in what manner the symptoms of an overdose are to be counteracted. There is no time for freeing the stomach of its contents; and, therefore, we must immediately consider what will decompose the acid remaining in the stomach, and, at the same time, overcome the general effect of the poison on the nervous system. With this object in view, the use of the ammoniated iron has been snggested by myself, and that of the sulphate has been recommended by M. Virey; but both are said to be inferior to chlorine, which was first proposed by M. Simeon, whose opinions have been fully confirmed by a series of experiments upon dogs by MM. Peresy and Novat; and some in my own laboratory by my assistant, Mr. Barnes. The chlorine so completely neutralizes the action of the hydrocyanic acid, that, in one instance, when respiration had been suspended for twenty-five seconds, the animal who was apparently dead, was rapidly revived by the chlorine, and in a short time recovered its usual vivacity. When the hydrocyanic acid has been swallowed, the chlorine may be given in the ordinary aqueous solution recently prepared: when the poisonous effects have resulted from inhaling the vapour of the acid, the chlorine may be administered in the gaseous form, largely diluted with atmospherical air*.

If chlorine cannot be instantly procured, cold water should be dashed upon the face and back, as recommended by M. Herbst; and brandy, ammonia, and other excitants, freely administered.

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* It is, nevertheless, stated by Coullon and M. Calles that the actionof the Cyanuret of Chlorine on living animals is the same as that of Hydrocyanic Acid. Dict. Mat. Med. Univ.

Therapeutical Employment of Hydrocyanic Acid and its Compounds.

From the nature of the influence exerted by hydrocyanic acid and its compounds on the animal œconomy, it must be evident that the diseases in which it is likely to prove useful are those depending on an increased irritability of the nervous system and those connected with a state of excessive sensibility.

In no kind of idiopathic fever, either intermittent or continued, has hydrocyanic acid been employed; nor does my experience enable me to accord with the panegyrics which several writers have passed upon it as a remedy in hectic. In some of the Phlegmasiæ, it is said to prove beneficial, particularly in phrenitis and pleurisy. In the former, I have never seen it employed; but, as the inflammation of the membranes of the brain morbidly augments the general sensibility, manifested by the impatience of light and sound, it is likely to prove a useful addition to other remedies in this disease. It was first prescribed in pleurisy by the professors of the University of Padua and Pavia: but, notwithstanding the praises bestowed upon it, Hydrocyanic acid is greatly inferior, as a remedy in inflammatory affections, to those medicines which directly influence the circulation. As far as the cough is concerned, it may prove beneficial; but, beyond that, it has no pretensions to be regarded as a remedy in this disease. In eruptive diseases, except as an external application, Hydrocyanic acid holds forth no prospect of benefit. In the state of combination in which it is found in the bitter almond, it was employed as an external sedative so early as the time of Celsus, in a painful pustular disease which he describes as peculiar to infants. His formula is the following:—"lapides, quem pyriten vocant, partes octo, cum quinquaginta Amaris nucibus miscetur, adjiciunturque Olei cyathi tres*." I have ordered the simple acid in the proportion of f℥ii to six fluid ounces of bitter almond emulsion, as a lotion in Erythema nodosum: but candour obliges me to say that, in this affection, I do not think it more useful than the mixture of alcohol and water, which is more generally employed. In another very painful cutaneous disease, however, impetigo, it performs everything that can be desired from a topical application. I have generally ordered it, in combination with acetate of lead, in the proportion of f℥ii of the hydrocyanic acid, sixteen grains of the acetate of lead, half a fluid ounce of alcohol, and f℥viii of *distilled* water. This lotion not only soothes the irritability of the diseased surface, but also disposes it to renew its healthy action; and although Mr. Plumb has stated, as a caution against the external use of this acid, that, in two cases, of both legs, in which the eruption extended from the

* Celsus de Medicina, lib. v, § 15.

ankle to the knee, where it was employed, a considerable intermission of the pulse took place, yet I must say that, in upwards of fifty cases in which I have ordered it, no inconvenience has arisen; on the contrary, it has been productive of the greatest comfort to the patients. In *prurigo*, *inveterate psoriasis*, and several other skin diseases attended with severe itching and tingling, it has rarely failed in affording comfort to the patient.

In active hæmorrhagic affections, experience authorizes me to place confidence in this acid. In cases of this description, I have augmented the dose from m. iii to m. xii, or until the pulse began to give indications of the influence of the medicine; and, in a very few instances, where there was not some formidable organic disease, have my expectations been disappointed. In phthisis, the powers of hydrocyanic acid have been greatly overrated. Given in small doses, and frequently repeated, it certainly diminishes the hardness and the frequency of the cough, and lessens the general hectic tendency: but I am of opinion that so much is not to be expected from it as from some of the narcotics. As a palliative, nevertheless, it is not without its value: it moderates the cough, and often favours sleep, without increasing those sweats which are too frequently augmented when opium is employed. In the last stage of the disease, it hastens the termination of the case, by adding to the debility which already exists: indeed, it is in the early stages only of this intractable disease that hydrocyanic acid can be regarded as likely to prove beneficial, even as a palliative. Its employment in laurel water is of no recent date; as most of the old works on Consumption enumerate laurel water amongst the means to be employed for soothing the cough. If M. Jorg's conclusions respecting the action of this water were admitted, its use would certainly be contraindicated in the early stage of phthisis, as well as in every inflammatory affection of the lungs: but this is contrary to general experience. I have found it almost specific in that affection of the trachea which has been named Phthisis trachealis; and which, if the inflammation of the mucous membrane be allowed to run on to ulceration, is as fatal as consumption of the lungs.

In chronic catarrh, I have seen sufficient proofs of its efficacy; and although my opportunities of prescribing it in dysentery have been very limited, yet they have been satisfactory. I have generally ordered it, at the same time with full doses of calomel, to the extent of four minims for a dose, in the bitter almond emulsion. On the principle of allaying irritation, and thereby favouring a slower, and consequently more healthy, gastric secretion, I was induced to try the influence of the hydrocyanic acid in dyspepsia; since then, the benefit resulting from its employment in this disease has been laid before the profession by my colleague Dr. Elliotson. In dyspepsia, the simplest mode of administering it is the best: I therefore usu-

ally order it to be taken dropped in water, from three to five minims for a dose, with the addition of f3i of the tincture of calumba. In pyrosis, it affords relief on the same principle, by allaying the irritability of the stomach, and permitting the secretion of a more healthy gastric juice.

It is in the spasmi that the powers of hydrocyanic acid are most conspicuous. M. Jorg admits its influence in lessening nervous sensibility; but he, nevertheless, regards it as contra-indicated in spasmodic affections where the cause is excitement of the brain, or turgescence of its vessels: but I conceive that, if it prove useful in any class of diseases, either in its free or combined state, it is likely to be so in the spasmi. In tetanus, chorea, and epilepsia, I have had no experience of its influence; but in asthma, even when the pulse is small, irregular, and often not easily distinguishable, I have seen it act almost as a charm, in removing the oppressed breathing, and restoring the free play of the respiratory organs. In hooping cough, I regard it as the sheet anchor of the practitioner; and do not think I am stretching my praise of it too far in affirming, that few cases of this disease would prove fatal, were the hydrocyanic acid early resorted to and judiciously administered. After emptying the stomach with an emetic, and purging briskly, the use of the acid should be begun, and the prescription never altered, except to increase the dose. When thus treated, the disease seldom continues more than a month or five weeks, particularly if the little patients be confined to a graduated temperature, and their diet be solely milk and vegetable.

Such are the chief diseases in which hydrocyanic acid, operating as a sedative, has been found beneficial. I am of opinion that advantage would be derived from employing the cyanide of potassium, both on account of its being easily preserved and retaining its strength, which never varies when it is properly prepared, and also from its cheapness. It has been proposed to employ the essential oil of bitter almonds, instead of the free hydrocyanic acid; on the plea that the strength of the medicine can be more certainly determined; that it is less likely to suffer change from air, light, variations of temperature, and age. Twelve drops of the volatile oil of the bitter almond may be regarded as equivalent to m. iv of the ordinary medicinal acid. One objection, however, to its use is the powerful effect which it has on individuals of a peculiar idiosyncracy; namely, that of producing a rash resembling nettle-rash. In some people, eating a single bitter almond will produce nettle-rash, vomiting, and vertigo; and it is probable that this depends on something in the fruit, independent of the hydrocyanic acid; as instances are met with in which the sweet almond causes the same inconveniences, nevertheless no hydrocyanic acid has ever been found in it. Although the oil of bitter almonds may be used internally in the

same manner as the hydrocyanic acid, yet, it requires more care as an external application. I once ordered it as an ointment, largely diluted with spermaceti ointment; but the effects were such as to prevent me from again prescribing it: and Coullon has recorded the case of a child who was killed by the leaves of the Prunus laurocerasus applied to a sore on the neck.

b. TOBACCO.

1. *Empyreumatic Oil of Tobacco.*—This oil is produced in the ordinary process of smoking, which is a kind of destructive distillation.

The experiments of Mr. Brodie have rendered it probable that there are two active principles in tobacco; one, the volatile oil of which I am treating, that operates directly on the brain, nervous system, and the general sensibility of the habit; the other, a saline substance, Nicotina, which appears to act chiefly on the motor nerves, confining the sphere of its influence particularly to the heart, which it paralyzes and thereby causes death. In whatever manner this oil is procured, it is extremely virulent in its influence upon the animal œconomy, so that instantaneous fatal effects follow its introduction into a wound.

When dried tobacco leaves are infused in boiling water, and exhibited as an enema, the sedative effects are probably due to the Nicotina, which is combined with some acid in the tobacco that renders it soluble. The energetic nature of this sedative is such, that, when swallowed in doses of a grain, the action of the heart ceases even before that of the diaphragm — an effect directly the opposite of that which results from the administration of hydrocyanic acid. It is the presence of the oil, however, which renders the smoke so powerfully sedative.

2. *Nicotina.*—This substance is regarded as the active principle of tobacco in its natural state. It may be procured by a process suggested by Vauquelin*. It is a nearly colourless fluid, has an acrid taste, and the peculiar odour which distinguishes tobacco, and, like it, causes violent sneezing when snuffed up the nostrils. It is soluble both in water and in alcohol, and approaches, in its chemical properties, to the volatile oils. It is precipitated from its solutions by tincture of gall-nuts, which also throws it down in the infusion of tobacco leaves.

When a person unaccustomed to smoking takes a pipe for the first time, he soon becomes sick and vomits, the force of the circulation is reduced, great muscular debility, vertigo, insensibility, and cold sweats, supervene; and a considerable period elapses before he regains his former healthful feelings. The same symptoms follow the application of infusion of tobacco to the scalp, or in the form of cataplasm to the pit of the stomach;

* Ann. de Chimie, tome lxxiv.

or still more severely if the infusion or the smoke be thrown into the rectum*.

This sedative influence of Tobacco is taken advantage of for the relief of several diseased conditions of the body; and, reflecting on its violent action on the nervous system, it is not extraordinary that it is little employed. The infusion, in the proportion of ʒi of the dried plant to a pint of boiling water, is frequently employed in cases of incarcerated hernia: great muscular debility and relaxation soon follow, and the gut is often then readily replaced. The aid thus afforded, however, to the taxis is sometimes attended with a degree of hazard; and, from the irregularity of the action of the remedy, and the occasional frightful extent of its influence, it should not be resorted to whilst there is the least chance of any other means proving useful. It has, also, been remarked, that those who have used the tobacco clyster, before the operation for hernia, do not recover so well as those on whom it has not been tried. The Tobacco enema has also been used for destroying ascarides, and at the same time expelling them from the rectum; but it is too hazardous a remedy to be employed for this purpose. The infusion has also been applied topically in cases of scabies and in other cutaneous affections; but the most serious consequences have resulted from this practice†. The sedative influence of Tobacco has been taken advantage of in other diseases: smoking it relieves toothache, and abates the severity of the paroxysm of spasmodic asthma; and Dr. Fowler has recommended the internal administration of the infusion in dropsy. It has also been used in colic, tetanus, epilepsy, and dysentery: but, under all circumstances, Tobacco must be employed with the utmost caution.

When Tobacco produces its deleterious effects, like hydrocyanic acid, it operates too instantaneously on the nervous system to admit of the employment either of the stomach pump or of emetics; we must, therefore, have recourse to some chemical reagent to render it inert; and at the same time we must rouse the depressed powers of the system. The best substance for fulfilling the first indication is the infusion of nut-galls, or of any other astringent; the effect of the tannin being a precipitation of the Nicotina, in which state it ceases to be active. To fulfil the other indication and support the vis vitæ, brandy, ammonia, and other stimulants, must be resorted to; and, bearing in recollection the effects of artificial respiration, in the experiments of Mr. Brodie, there is every reason for supposing that this method of maintaining the function of the lungs might prove

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* Barbier, Mat. Med. t. iii, p. 456.

† Ephem. Cur. Nat. Dec. 2. Ann. 4, p. 467. Apparatus Med. vol. i, p. 681. Journ. de Med. de Leroux, &c. xv, p. 289.

beneficial, if an admixture of oxygen gas with common air were used. I feel the force of an objection that may be raised in this case: it may be stated that artificial respiration is useful only when the lungs and heart do not share in the shock given to the sensitive part of the frame, as in cases of poisoning by hydrocyanic acid; whereas, when tobacco is employed, the motor nerves are those principally affected; but, at the same time, I know that by stimulating the heart and pulmonary system, this set of nerves may be again roused into activity: it is my opinion that the impression of sedatives on the motor nerves, although almost as rapidly induced as that on the nerves of sensation, yet is more transitory, and consequently more easily relieved*.

d. SULPHUR WITH HYDROGEN.

Pure sulphur exerts no depressing influence on the animal œconomy; but some of its combinations are powerful sedatives: two only of these require to be noticed.

1. *Sulphuretted Hydrogen Gas.*—This gas, in combination with aqueous vapour, is exhaled from sulphurous springs and baths. It may be artificially prepared by acting upon protosulphuret of iron† with sulphuric or muriatic acid, diluted with three or four parts of water; or more pure, by heating one part of sulphuret of antimony, in a retort, with four or five times its weight of strong muriatic acid. In both instances sulphuretted hydrogen is formed, and escapes as gas, while the metal is changed into a protoxide and unites with the acid employed. It is probable that the oxygen and the hydrogen evolved are obtained from the decomposition of a portion of the water.

Sulphuretted hydrogen gas thus procured is colourless and elastic, like common air; it has a fœtid odour and taste, resembling that of putrefying eggs: its specific gravity is 1.1805; 100 cubic inches weigh 36.6074 grains. It is rapidly absorbed by water: 100 cubic inches of water taking up 253 of sulphuretted hydrogen gas, and the solution reddens litmus. It cannot be breathed with safety unless largely diluted. It does not support combustion; but, when set on fire, it burns with a bluish-red flame, and deposites much sulphur. It explodes when one measure of it is mixed with one and a half of oxygen gas, and fired; water and sulphurous acid being formed. It is evidently sulphur, acidified in a peculiar manner by hydrogen, and held in solution in hydrogen gas. It consists of Sulphur 34.454 or 1

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* *G. Neander*, Tabacologia, Lugduni-Batav. 1662. *Stahl*, de Tabaci effectibus, &c. Erfodiæ, 4to. 1732. *Fowler* On the Diuretic Effects of Tobacco, &c. Lond. 1785. Journ. de Pharm. 1815. *Pointe, J. P.* Obs. sur les Maladies auxquelles sont sujets les Ouvriers, &c. Paris, 1818.

† Protosulphuret of iron is readily procured by exposing to a low red heat a mixture of two parts of iron filings and one and a fourth part of sulphur in a Florence flask, or a common earthen crucible fitted with a cover.

equiv. = 16 + Hydrogen 2.1534 or 1 equiv. = 1, making the equivalent 17. It is readily decomposed by chlorine, which, uniting with the hydrogen, forms muriatic acid, and sulphur is deposited: with sulphurous acid, a mutual decomposition takes place, water is formed and sulphur deposited; with iodine, its hydrogen is attracted to form hydriodic acid, whilst sulphur is deposited.

This gas is extremely deleterious to animal life, even when much diluted. MM. Thenard and Dupuytren ascertained that an atmosphere of common air, holding 1-800th of it*, will quickly kill a middle-sized dog: and Professor Chaussier ascertained that it proves fatal even when merely applied to the skin or the mucous membrane in a concentrated state; a rabbit, whose skin only was exposed to it, died in ten minutes; and a horse, into whose anus ten quarts were injected, died in one minute†. Workmen employed to empty privies and drains often suffer from this gas, becoming suddenly weak and insensible; and, if the gas be concentrated, they fall down and suddenly expire‡. If the gas be much diluted, either coma or delirium, followed by tetanic convulsions, succeeded by a cold clammy skin, feeble, irregular pulse, and frothing at the mouth, takes place. Post-mortem dissections of persons killed by it, exhibit a black, thin state of the blood; the loss of the contractility of the muscles: and a putrescent odour of the whole viscera; and white lead, thrust under the skin, is immediately blackened.

In cases of asphyxia by this gas, water should be dashed on the chest, and artificial respiration employed: if the person revive, ammonia and other stimulants should then be administered.

I am not aware that this gas, either in the gaseous form, or in solution in water, has ever been used as a therapeutical agent, although its employment in phthisis has been suggested: but the great caution requisite to prevent its dangerous effects will always operate as an obstacle to its general employment. I have noticed it here chiefly to afford an opportunity of mentioning the following fact. Much of the depression which occurs in those diseases which are termed nervous, and in febrile affections of a low kind, seems to depend upon the extrication of large quantities of this gas in the intestinal canal, indicated by the offensive odour of the fæces, closely resembling that of the gas, and also by the blackening of slips of paper rubbed with carbonate of lead, when held over the vessels containing

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* Orfila's Toxicologie Générale, t. ii, p. 479.

† Sedilott's Journ. de Med. t. xv, p. 28, 34.

‡ No drains or pits of necessaries should be entered until the presence of this noxious gas be determined, by first letting down into them a piece of paper rubbed with white lead. If this become black, there is risk in descending into these places.

the fæces. Solution of chlorine, or the chloride of soda, should be administered in these cases.

2. *Hydro-sulphuret of Ammonia.* E. D.—This combination of sulphuretted hydrogen and ammonia is readily prepared by passing a stream of sulphuretted hydrogen gas through a solution of pure ammonia. It may be procured in a dry state by the direct union of its constituent gases: if they be passed into a glass globe kept cool by ice, the hydrosulphuret is deposited in crystals on the sides of the globe. It is of a green colour; has a very fœtid odour, and an acrid pungent taste. It attracts, powerfully, the oxygen of the atmosphere, and thus undergoes decomposition; consequently it ought to be preserved in small bottles, well stopped, and kept full. It is decomposed by acids. When the ammonia is not neutralized, it renders turbid the sulphate of magnesia in solution. It consists of 50 parts of sulphuretted hydrogen, and 50 of ammonia, or of 1 equiv. of Sulph. Hydrogen = 17, + 1 of ammonia = 17, making the equivalent 34.

As a Sedative, it lessens the action of the heart and the arterial system by acting directly on the nervous energy; and, even in moderate doses, it causes nausea, vomiting, drowsiness, and vertigo. Mr. Cruikshanks proposed its use in diabetes mellitus, with the view of diminishing the morbid action of the digestive organs.

The dose is m. v in a tumbler of water three or four times a day, increased until vertigo occur.

e. CARBON WITH HYDROGEN.

Carburetted Hydrogen Gas.—Carbon, like sulphur, acquires sedative properties by combination. The gas now under consideration is abundantly exhaled from the surface of stagnant pools; and it forms the greatest part of that gas which escapes from the crevices in coal mines, and is well known to miners under the name of *fire damp.*

Carburetted hydrogen gas possesses all the physical properties of common air; it is colourless, and has neither taste nor odour. Water absorbs about $\frac{1}{60}$ of its volume. Its specific gravity is nearly $\frac{1}{2}$ of that of common air, or 0.5554; and it is highly elastic. 100 cubic inches of it weigh rather more than 17 grains. It is a compound of 1 prop. of Carbon = 6, + 2 of Hydrogen = 2; making the equivalent 8. It is unable to support combustion or respiration, but is inflammable, burning with a clear, yellow flame. When mixed with certain proportions of atmospherical air, or with oxygen, and ignited, it explodes violently, producing carbonic acid and water; and it is this ad-

mixture which explodes and produces such fatal consequences to miners.

Except sulphuretted hydrogen, this is the most deleterious sedative to animal life; producing, when taken into the lungs, even in a diluted state, almost instantaneous death; and so complete a destruction of nervous energy, that animals thus destroyed cannot be recovered under any circumstances. When a person inspires it, even combined with three times its bulk of oxygen, he becomes sick; his lips turn livid; his pulse instantly sinks; and, on the third inspiration, the irritability of the lungs is destroyed. In cases where death does not ensue, from the large dilution of the gas, the consequences of breathing it are felt for twenty-four hours. Notwithstanding these effects, miners, accustomed to it, breathe it in a diluted state with impunity—a fact which demonstrates how soon the habit gets accustomed to deleterious atmospheres.

This gas has been employed for medicinal purposes, as a Sedative, diluted with 20 or 30 times its bulk of common air. In this state of dilution, it cannot be respired for more than a few minutes at a time, as it causes nausea, dizziness, and symptoms of great depression. It has been employed in phthisis; and, could it be used with sufficient caution, it is more likely to prove useful, as a remedial agent, than any of the other gases. Its obvious effects are those already stated; it also diminishes pain: when employed, it should be at first diluted with thirty times its weight of atmospherical air, and the quantity of common air gradually reduced to twenty times the bulk of the carburetted hydrogen.

INDIRECT SEDATIVES.

These are comparatively few in number; and, although their influence is felt upon the nervous system, yet it is more immediately experienced by the circulating medium, operating either by altering its properties so as to unfit it for affording a due stimulus to the brain and nervous centres, or diminishing its quantity so as to cause a similar state of the brain from defect of excitement, or, as it were, from inanition. The first of the Indirect Sedatives requisite to be noticed is

f. CARBONIC ACID GAS.

This gas is formed in many common operations; in burning fuel; calcining limestone; and fermenting liquors: it is ex-

haled in the dark by plants, and expired from the lungs of animals; it also accumulates in wells that have been long out of use, and in old ill-ventilated cellars. It is easily procured for medicinal use by acting upon marble (carbonate of lime) by means of muriatic acid, diluted with two or three times its weight of water. Thus procured, Carbonic Acid Gas is colourless and transparent, having a peculiar odour, and all the physical properties of common air. 100 cubic inches of it weigh 46.597 grains, when the barometer stands at thirty inches; thence its specific gravity is 1.527: it may be condensed into a liquid. It cannot support respiration or combustion. It renders lime-water turbid; but, in a saturated solution in water, it dissolves carbonate of lime. Water absorbs it, and receives from it an agreeable, acidulous taste; and the solution reddens litmus. It combines with salifiable bases and forms carbonates. It is from the extrication of this gas in fermented liquors that they derive their briskness. It has also a curious property of passing by endosmose through animal membranes and displacing oxygen.

Carbonic acid is a compound of 1 prop. of Carbon = 6, + 2 prop. of Oxygen (8×2) = 16, making the equivalent 22; or 100 cubic inches consist of 34.454 grains of Oxygen and 12.923 grains of Carbon, or equal measures of oxygen and of the vapour of carbon.

Carbonic Acid, when dissolved in water and taken into the stomach, appears to act as a tonic upon the nerves of the viscus, raising the spirits and increasing the appetite; but, in the state of gas, it is an undoubted Sedative. A question, however, has been raised, whether this gas is positively or negatively Sedative? That the latter opinion is correct has been inferred from the fact that, when the body is immersed in carbonic acid gas, if atmospherical air be freely admitted to the lungs, all the sedative symptoms produced by the gas—namely, weight in the head, vertigo, dimness of sight, singing in the ears, &c.—occur: but, nevertheless, the sedative effect caused by breathing Carbonic Acid Gas is partly negative. As soon as it is attempted to be inspired, the glottis contracts, and none of the gas enters the air-tubes of the lungs; but death ensues in the same manner as in drowning or in strangulation. This occurs even when the gas is mixed with nearly an equal bulk of atmospherical air; and the operation is more speedy than that of any other mode of suffocation. But, although Carbonic Acid Gas does not enter the cavity of the lungs, and causes death by shutting out the agent by which the lungs decarbonize the blood returned to them in the course of the circulation, yet it must be admitted that it causes a condition of the heart which leads to the supposition that it acts also on the irritability of the nervous sys-

tem, destroying it in the same manner as sedative poisons*. Carbonic Acid exerts also a sedative influence when applied to ulcers. Dr. Priestly, having excited pain in a blistered part by immersing it in oxygen, relieved the pain instantly by plunging the hand into a jar of Carbonic Acid Gas. If cancer has proceeded to a state of open ulceration, a stream of Carbonic Acid Gas, which has passed through water, and is directed on the part by means of a flexible tube, sometimes affords considerable relief to the pain†; and it is the extrication of this gas, in the fermentation of those vegetable matters that enter into fermenting poultices, which affords the relief obtained from them.

These sedative effects of the local application of Carbonic Acid Gas led to the employment of it as a remedy in phthisis, malignant fevers, and other diseases. But, although it appears to lessen the expectoration and to improve some of the symptoms, yet, as may be readily supposed, no cures have been effected by it. The carbonic acid, in this case, is respired largely diluted with common air‡.

g. BLOOD-LETTING.

The blood is a primary fluid, and its quantity is greater than that of any other in the body: it is the pabulum of the solids, the source of every secretion, and, with the exception of the epidermis, the enamel of the teeth, the body of the crystalline lens, and a few other parts which are known as exsanguineous, it is generally diffused through the system. It first passes through a series of gradually diminishing tubes, the *arteries*, propelled by the action of the heart; and it is again returned to that viscus through another series of gradually enlarging tubes, or *veins*. In man, its average proportion to the weight of the body, in a healthy adult subject, is as *one* to *five*: when the relative proportion is greater than this, an unnatural or diseased state of the habit, *plethora*, exists: when the relative proportion is smaller, the body becomes emaciated: when it is suddenly abstracted, a series of phenomena occur which display a diminished degree of vitality; and, if the quantity exceed a certain proportion of the whole, death immediately ensues. The abstraction of a certain proportion, therefore,

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* Mem. sur les eaux min. de Naples, 8vo. Paris, 1804. In its concentrated state, carbonic acid gas destroys plants as well as animals.

† Ingenhouz, Miscellanea, &c. 1795.

‡ Percival's Medical Essays, vol. i, p. 309. Warrington, 1789. *Johnson*, Experimental Researches, &c. 8vo. Philadel. 1797. *Mechry*, de Aeris fixi usu, &c. Gotting. 1796.

produces a sedative effect on the habit. According to the manner in which the blood is abstracted, blood-letting is regarded as general or local.

General Blood-letting is effected either by venæsection—that is, a mechanical division of the coats of a *vein*, in which the current of the blood towards the heart has been previously obstructed by a ligature—or by arteriotomy, the mechanical division of the coats of an artery. The influence of either of these operations on the general œconomy is determined by the quantity of blood abstracted; but the effect varies in different individuals, according to the strength and the constitution of the patient; and, in the same person, according to the period of life, the state of health, and the *manner* in which the abstraction is accomplished.

Before passing to the consideration of blood-letting as a sedative, it is proper, but almost superfluous, to state, that blood supplies the *materials* of the solids originally, and is afterwards their nutriment or pabulum; and from it all the *secretions* are derived. But, what is more necessary for us to know, it is the agent which excites the heart to action and maintains the temperature of the body.

The action of the heart commences in the second or third week after conception, and continues to the last moment of existence; and its structure is admirably adapted for this perpetual and equable motion. The contraction and relaxation of the ventricles and auricles can be distinguished by distinct sounds, on placing the ear on the chest of a healthy person, between the cartilages of the fourth and seventh ribs, or under the lower part of the sternum. The action of the ventricles is a dull sound; that of the auricles a clearer sound, similar to the noise of a valve, or somewhat like the licking of a dog. This action of the heart communicates an impulse to the arteries, which is manifested to the finger in all those arterial branches which do not exceed one sixth of an inch in the diameter of their canal, and constitutes the pulse, every beat of which indicates the *systole* or contraction of the heart. The diversity of the pulse at various periods of life, in different sexes, and as modified by climate, has been well ascertained. It is altered by watchfulness, sleep, exercise, the depressing and exciting passions, meals, the discharge of the seminal fluid, and disease; and it is this index of velocity, force, tension, and general state of the mobility of the heart, which, in most instances, enables us to decide as to the propriety of abstracting blood. The celerity of the blood in health varies, not only in different persons, but in the same individual in different parts of the body; the velocity being greatest in the arterial trunks, in the ratio of diminished friction, and less in the branches. During health, in an adult, there are from 68 to 75 pulsations in a minute, depending on contractions of the heart closely connected with its irritability; and that this

is attributable to the nerves is very evident, from the influence of the passions over it, and its sympathy with the stomach, displayed in various diseases. It thus appears that the blood passes through every part of the system; and, in doing so, it undergoes some important change; as it differs in its characters in the veins and in the arteries. But these circumstances only refer to the blood, in a healthy state of the body, circulating in due quantity.

During life, the blood vessels are always in a certain degree of tension, by which the tone of the system is maintained: blood-letting diminishes this tension, and is followed by relaxation and debility; consequently this operation produces a sedative effect on the frame. On opening a vein in the arm, the first effect is diminished tension, not only of the blood vessels, but of the whole system; the secretions are less copious, from part of the supply of blood being cut off; and perspiration becomes more free. As the blood continues to flow, the patient begins to feel slight dizziness; singing in the ears; a loss of consciousness; and, in proportion to this, the breathing is more or less affected, being generally suspended until the painful sensation produced causes deep and repeated sighs, after which it is again suspended; the pulse becomes slow and weak, the face pale and bedewed with perspiration; and sickness follows. These symptoms evidently indicate that the brain is the organ the function of which is first impaired, and this appears to be the result of the defect of stimulus; the respiration suffers as an immediate consequence; and the enfeebled action of the heart is not only the effect of a deficient quantity of blood, but of its defective arterialization in passing through the lungs. On recovering from such a state, there is not unfrequently transitory delirium, yawning, a return of consciousness, irregular sighing, deep-drawn breathings, and gradual development of the pulse.

The *mode* of performing the blood-letting very much regulates the effect: little is produced when a large quantity of blood is abstracted slowly and gradually through a small orifice, and the patient is in the horizontal position: syncope follows its sudden abstraction through a large incision, and especially if the patient be seated or in the upright position. This depends on the tension of the whole system, which, on the sudden abstraction of the blood, is more rapidly removed than will allow the vessels to adapt themselves to their contents; and on this account it seldom occurs in local or topical bleeding, the abstraction of the blood being slow and confined to the part on which it is performed. In ordinary venæsection, also, the abstraction being less rapid than in arteriotomy, and the momentum of the blood greater in the arteries than in the veins, the production of syncope is less rapid. These effects of the different modes of blood-letting are important to be recollected, in a practical point of view,

in the employment of blood-letting as a sedative. Arteriotomy is now rarely performed, except in cases of apoplexy or phrenitis, when a sudden and very powerful effect is requisite; as syncope can always be obtained by venæsection, if the orifice be sufficiently large and the patient be placed upright. If the blood-letting be carried beyond a certain point, instead of the symptoms which I have been describing as indicating recovery from syncope, the countenance becomes pale and sunk, the breathing becomes stertorous, and terrible gasping follows; the pulse sinks until it is imperceptible; the animal heat fails, and cannot be restored to the extremities by any external warmth; there is constant restlessness and jactitation; every thing indicates an exhausted state of the energies of the brain; and the patient sinks, gasps, and expires. When the abstraction of blood is within more moderate bounds, the effect produced is the result, in some degree, of the mere mechanical influence of diminished tension; for the momentum of a moving body being in the direct ratio of its weight, this is diminished; and the moving power remaining the same, the velocity of the body being in the indirect ratio of its bulk, the velocity is increased: thence the mechanical result of a general abstraction of blood is to diminish the force, but to augment the velocity of the blood. As the pulse is thus rendered feebler, so it is softer; and this diminished tension being extended, the whole system becomes languid, and the action of the heart weaker. Some effect is also produced on the blood itself. Considered as a mechanical mixture, the serum is increased in quantity and the crassamentum diminished: the coagulability is augmented, but the coagulum is less firm. Whether in its chemical constitution any change is effected by the production of syncope has not yet been clearly ascertained.

Many other circumstances, besides the mode of abstracting blood, demand attention as modifying the result of the operation:—these are age, temperament, sex, mode of life, climate, and the quantity abstracted.

1. With regard to *age*—in infancy the laxity of the solids, and the relative proportion of the serum or watery part of the blood to the crassamentum or clot, which consists of fibrin and colouring matter, are more considerable than in adult age: blood-letting, by increasing this greater proportion of serum, proves hurtful; and a state of syncope in infants is always one of great danger. The first effects of exhaustion in young subjects is an increased degree of irritability, which leads to stupor, and generally terminates in convulsions: the pulse is quickened, the pupil of the eye dilates, and symptoms present themselves closely resembling those which precede the effusion of water in the ventricles. I have seen this occur, more than once, in children in whom symptoms resembling those of inflammation of the

brain, accompanying irritation of teething, have displayed themselves; and leeches or cupping has been resorted to; but, instead of affording relief, a state of evident defective stimulus supervened; and, in one case, snoring, stertor, and other appearances of apoplexy, having followed the bleeding, more leeches were applied, and the infant died. This state is detected readily by attention to the state of the breathing, which seems to be performed almost wholly by the diaphragm; and is always accompanied with the evolution of much flatus. It is best obviated by white wine whey, opium and ammonia, administered warm, in small quantities, and frequently repeated. In youth, and in the vigorous and robust, on the contrary, reaction takes place, and is especially marked after repeated venæsections: the most favourable age for bearing blood-letting is from eighteen to forty-five. In old people the reaction is extremely feeble; and, during the flow of the blood, exhaustion often steals on so insidiously and imperceptibly, that, when nothing injurious is anticipated, syncope appears; no reaction can be induced, or it is defective, and gives way to a state of positive sinking. The risk in such a case is extreme.

2. With respect to *temperament*—those possessed of a sanguine temperament bear blood-letting worst. In these, therefore, it must be used with more caution than in the phlegmatic or the melancholic. But the capacity of supporting the loss of blood is not always to be ascertained by its effects in producing syncope; nor is this always to be regarded as the translation of reaction into exhaustion; the syncope often proceeding from a peculiar idiosyncracy. One person of a strong and vigorous habit will faint on losing the smallest quantity of blood; another of a weak and puny habit will bear large abstractions of it without feeling even the approach of syncope.

3. Men, owing to the nature of their organization, and their higher degree of tone, bear, in general, blood-letting better than women. Some circumstances connected with sex, also—for instance, the presence of menstruation—have usually rendered practitioners cautious of abstracting blood: but, if the patient be labouring under acute inflammation, or any state of disease which requires blood-letting, it is not to be omitted on this account.

4. The *mode* of life, also, modifies the effects of blood-letting. The inhabitants of the country, engaged in agricultural occupations, and much in the open air, bear the loss of blood better than those of the town; those of active, better than those of sedentary habits: the sportsman than the studious man, the labourer than the man of science. It has been often supposed that the luxurious and self-indulgent are more able to bear bleeding than the moderate and the temperate: but this is not the case; for, although luxurious indulgence favours plethora, yet

it is accompanied with a laxness and debility of habit, which are soon exhausted by the abstraction of blood.

5. With respect to *climate*, venæsection is better borne in temperate than in either hot or cold climates. In warm climates, although inflammatory states of the habit, with topical inflammation, frequently occur, yet these are always accompanied with increased irritation, and sooner followed by a state of collapse than inflammatory affections occurring in temperate climates; thence the lancet is to be used with caution. Under the influence of pure inflammation, the sedative effects of general blood-letting is less felt than even in health; this state, as has been well remarked by Dr. Marshall Hall, in his valuable Treatise on the Morbid and Curative Effects of Blood-letting, being "a sort of concentrated and permanent stimulus, exciting and maintaining the powers of the system," and "whilst it exists, constituting a stimulus and a protective power against the influence and effects of loss of blood" (p. 203). Now, as this state more frequently occurs in temperate than in warm climates, the loss of blood is better borne in the former. In cold climates, the rapid reduction of the animal temperature, produced by blood-letting, is one reason for employing it with caution: indeed, this is not confined to blood-letting, but the rule extends to the employment of all Sedatives.

6. But the most important circumstance to be attended to, as modifying the effects of the abstraction of the blood, is the *quantity* which can be lost by the patient. From what has been already said, it must be obvious that the degree of sedative effect produced must be in the direct ratio of the quantity abstracted. Fashion has too much regulated this; and, at one time, we find practitioners bleeding with a small orifice, and in moderate quantity, on all occasions; at another, abstracting the most hazardous quantities of the vital fluid, with the largest orifice: consequently, in the most sudden manner, and with a degree of indiscriminate rashness, which to the eye of judgment is truly frightful. Both extremes are improper. The due quantity must be regulated by the constitution of the patient and the nature of the disease. It has been ably argued, in the work to which I have already alluded, "that the power and susceptibility of the system, in regard to the effects of the loss of blood, may generally be determined by placing the patient in the erect posture, perhaps with the eyes turned towards the ceiling, and taking the blood from a moderate-sized orifice, until the first or slightest appearance of syncope be induced; the quantity of blood which thus flows denotes that power or that susceptibility respectively." It is also argued that this first appearance of syncope manifests the quantity to be taken, the power of the system for supporting the loss of blood being exactly in proportion to the necessity for blood-letting. But, from

what has been previously said, although this rule may hold good in many instances, yet there are exceptions to it; and mischief might result if too close an adherence to the general rule were observed. I have witnessed cases of decided inflammation, in which syncope occurred after three or four ounces of blood were taken; yet, on repeating the operation in a few hours afterwards, from twenty to thirty ounces were abstracted without the least evident approach of syncope. On the other hand, we are always to wait for the approach of syncope; for, although the inflammatory state of a disease renders the system, otherwise incapable of bearing the loss of much blood, able to sustain it, yet this protecting influence is not always marked by the non-appearance of syncope. In the lectures of Mr. Lawrence (published in the Lancet, No. 325), is the case of a young female of slender habit, in whom depletion was tried to its full extent, and eight-and-forty ounces of blood taken away without fainting being produced. "The blood," says Mr. Lawrence, "still ran out in a vigorous stream into the vessel, without touching the surface of the arm, to the very last. In the end I stopped it because the quantity did seem to me to be so very great. Now," continues he, "that single venæsection cured her; she was well from that time; all the symptoms were removed; she had no further symptom whatever indicating inflammation of the chest." Upon this case we may remark, that we are to discriminate as to the quantity of blood taken, without, in every instance, waiting for indications of syncope; as this is not invariably necessary in order to secure the beneficial sedative influence of blood-letting. It is not improbable that, if the blood had been permitted to flow in this case until the tendency to syncope displayed itself, the transition from reaction to sinking would have been sudden; and, although the patient had rallied for a little time, yet the effect might have been fatal. It is the last drop of blood abstracted, which either relieves the diseased state or hurries on the fatal issue: the reaction may be moderate and salutary, or a state of sinking and sudden death may follow, if we proceed till a tendency to syncope occur, and the bleeding has been carried to a considerable extent before this state present itself. If, during the flowing of the blood, the pulse become fuller and stronger, the power of bearing the depletion, and the necessity for it, are both indicated: if the pulse become small and feeble, the bleeding must be stopped.

It is not easy to reconcile the accounts of the large abstractions of blood often taken by the older physicians with what the habits of the present race of men will bear. In acute rheumatism, Sydenham, who practised in London, used to order forty ounces of blood to be abstracted—a degree of depletion which could not now be ventured upon in this disease. The inactive habits of more civilized men, the higher cultivation of intellect,

the less necessity there exists for the aid of mere brute force in the works of the artisan, and the general use of spirituous liquors instead of beer, may, in some degree, account for this change of constitution. Another practice has also been discontinued by well-informed physicians, which was formerly prevalent; that is, the repetition of venæsection as long as the appearance of a buffy coat in the blood presents itself. This custom arose from the erroneous idea of the nature of this coat: we now know that it depends on the slow coagulation of the blood, which occurs from the change produced by the inflammatory action on the vital fluid; the red globules sink to the bottom before the fibrin has become sufficiently solid to entangle them in it, and thus the latter coheres more firmly and assumes its natural pale colour. But the nature of the change which gives rise to this is unknown. The buffy coat will appear in the last bleeding, which may occasion a fatal syncope; it often arises from the mode of bleeding, and consequently is not to be relied upon. Such are the general views which ought to guide us in the use of this powerful sedative, when employed with a view of producing a decided effect on the habit.

Local blood-letting is useful as an auxiliary to general blood-letting; it is better fitted to relieve in some cases of irritation in which general blood-letting would prove hurtful, and in cases of local inflammatory action. In chronic inflammation affecting the cavities of the body, local is more appropriate than general blood-letting, and this is true also respecting other partial affections. Blood may be locally abstracted either by *cupping* or by *leeches*.

Cupping is of very ancient date, and is performed by some of the rudest nations. A horn was perhaps the most ancient cupping instrument, and suction by the mouth of the operator the mode of exhaustion. This was indeed one of the two kinds described by Celsus*. The other was performed by a copper cup, in which linen was burnt to produce the vacuum, in the same manner as the French still use tow in their cupping glasses. The principle of the cupping glass is to produce a determination of blood to the scarified part, by removing from it the pressure of the atmosphere: much, therefore, depends on the exhaustion of the cup; if it be not sufficient, the determination is inadequate to produce a free flow of blood into the cup; if it be too great, the edges of the cup operate as a ligature on the surrounding vessels, and check the flow towards the divided vessels.

When the quantity of blood to be taken from any part is considerable, and especially if it be requisite to abstract it quickly, so as to produce an immediate effect, then cupping is preferable to the application of leeches. From the manner in which the blood is taken by cupping, syncope rarely occurs,

* De Re Medicina, lib. xi.

unless from fear; consequently this method of abstracting blood is ill calculated to produce a sedative effect upon the habit; although, in cases where the lancet has been previously employed, a degree of sinking occasionally occurs which is alarming. This, however, is less likely to happen than when leeches are employed; as, from the nature of the incisions made by the scarificator, the bleeding is more under control than it is from the orifices produced by the bites of leeches.

We have no exact account of the time when leeches were first employed. Themison used them, and we find directions for using them in a work of Hieronymus of Nigrisol*. They may be applied to any part of the skin, if it be cleaned, and freed from hairs. The rings of which the body of the leech is composed seem to be semi-cartilaginous, and capable of expansion to nearly three times their natural magnitude; thence the quantity of blood which a leech can draw is greatly disproportioned to its natural size. Mr. Kennedy has stated, on the authority of experiment, that it is equivalent to the weight of the animal: M. M. Tandon affirms that a small lively leech will take twice its weight, a middle-sized one one-half its weight, and a large one its weight: Derheim says six times its weight. This, however, is no criterion of what is obtained; for the blood continues to flow after the leech falls off; and, by applying a poultice or warm water to the orifices, or a cupping glass over the place, a considerable quantity may be afterwards abstracted. It is a curious and still unexplained fact, that the blood taken into the body of a leech remains for two or three months uncoagulated and free from putridity: the only change it suffers is that of becoming deeper in colour, and a little thicker in consistency. When the animal is gorged with blood, it drops off; and this usually occurs in ten or fifteen minutes: but occasionally it will remain affixed for a considerable time, as if from indolence; but they are easily roused from this state by sprinkling them with a few drops of cold water. The ancients, when they wished to abstract a large quantity of blood with few leeches, snipped off their tails when they were in the act of sucking: the blood flows drop by drop from the artificial opening, and the leech continues to suck. The same effect is produced by an incision made by a lancet near the tail of the animal when it is sucking†.

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* Progymnasmata seu de Hirudinum appositione internæ parti uteri.

† It is curious that the circumstance of the leech dropping off when it is gorged, and yet thus continuing to suck if the blood be allowed to flow from it by a puncture, or cutting off the tail during the act of sucking, has never suggested the question —what causes the leech to drop off when it is gorged?—The usual reply which I have received to this question is that the leech has had enough; or that it drops off from the uneasiness of distension. This, however, is not the case: it drops because it falls into a state of asphyxia, from want of respiration; and I found this opinion upon the fol-

There are some circumstances connected with the application of leeches that require to be noticed. An erysipelatous inflammation sometimes follows their application, which has been referred to a peculiar irritable state of the skin of the patient; but which has been ascertained by M. Derheim to proceed from the sudden separation of the leech by force, causing the teeth to separate from the animal and remain in the wound. The leech should, therefore, always be permitted to drop off spontaneously: and when it drops off it should be thrown into water slightly salted, till it disgorges the blood; after which it should be thrown into clean water.

Various means have been suggested to facilitate the application of leeches; the best and the simplest is to make the part clean and dry, and also to dry the leeches in a clean cloth; or, if this fail, to scratch the surface of the skin with the point of a lancet, and to apply the leech on the spot moistened with blood. If the skin be much inflamed and hot, a little tepid water should be poured into the water containing the leeches, before they are taken out of it to be applied; and this should also be done if it be requisite to apply them within the mouth, on the verge of the anus, or within the vagina. If the patient be taking sulphur internally, or externally applying it, leeches will not bite; neither will they bite if tobacco-smoke, or vinegar in vapour, or sulphur, or any fœtid odour, be diffused through the apartment of the patient.

When leeches are applied to soft parts, for instance, to the abdomen, a large quantity of blood is sometimes obtained; particularly when a poultice is laid over the bites, and the patient is kept warm in bed: to prevent, therefore, injurious symptoms of exhaustion from such a circumstance, the poultice should be frequently examined. This is more likely to occur in children than in adults; and in children it not unfrequently happens that the bleeding cannot be stopped by any means except by encircling the orifice with a ligature. On this account,

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lowing grounds. The respiratory organs of the leech are a number of vesicles in immediate contact with the lateral longitudinal vessels, small twigs of which communicate with these vesicles, so as to submit the blood to the action of the air. Now, although the leech can live for some days in oil and in the exhausted receiver of an air-pump, yet, from an experiment made by Dr. Edwards, it is evident that the leech respires and consumes the oxygenous portion of the air; the inference from which is, that the animal, by filling these vesicles with air, can exist for some days without a fresh supply: but it by no means follows that they can exist if these vesicles be entirely emptied. My opinion, therefore, is, that the animal continues capable of exerting the function of sucking as long as these vesicles contain a sufficiency of air for the respiration to be carried on; but, as the body becomes greatly distended with blood, the cavities of these vesicles are obliterated; no respiration can consequently take place; and as, in all animals that breathe by lungs, asphyxia occurs as soon as air ceases to be received into them, and the muscular energy depending on volition being no longer exerted, the leech drops off. When the tail is punctured or is cut off during sucking, no asphyxia occurs, because the vesicles are not compressed, and therefore the leech continues to suck.

leeches should never be applied late at night on children; for, as the application of leeches in infancy must be regarded as a species of general Blood-letting, the precise number which will regulate not only the quantity, but be equivalent to rapidity in the detraction of the blood, should be determined; and the bites should be instantly closed on observing that the system is brought under the influence of loss of blood. Instances have occurred in which death has followed the application of leeches to children; and sometimes to adults.

By whatever means blood is abstracted, if the quantity be more than the constitution can bear to lose, morbid effects result. Thus, the *delirium* which frequently occurs has in some instances continued, and has worn out the patient. The first or second bleeding may be well borne; but a repetition of it may produce sudden dissolution; the pulse falls, becomes a mere flutter, and the person rarely survives more than a few hours. And this may happen whether leeches or the lancet be employed. Effusion into the ventricles is not an unfrequent consequence of an extreme degree of vascular exhaustion. Sometimes, when reaction occurs, it is feeble, and continues so, causing fainting on the slightest exertion, and sometimes terminating in sinking to a hazardous degree. In other cases the reaction produces symptoms resembling those of inflammation of the meninges of the brain; hard beating pulse, particularly in the carotids; throbbing in the head; palpitation of the heart, and pulsation of the aorta; and, in children, lead us to suspect hydrocephalus, when nothing but exhaustion demands attention. Instead of Blood-letting, light cordials, a mild but nutritious diet, rest and quietude, should be enjoined.

Practical Employment of Sedatives.

All the Sedatives which we have examined, with the exception of blood-letting, are powerful poisons: nevertheless, when they are properly administered, and their effects carefully watched, they are possessed of powers that cannot be obtained from any other medicines. They are chiefly indicated in diseases of increased sensibility and irritability. As the remedial effects of most of the substances described have been already mentioned, I will confine my remarks chiefly to blood-letting.

In intermittent fevers, Sedatives are not indicated, unless we except blood-letting, which was employed as the sole means of cure in these diseases by the older physicians. The practice partly arose from the mistaken notion that a morbific matter existed in the blood and required to be evacuated—an opinion now justly exploded. Whatever may be the sources of agues, whether from the influence of simple aqueous vapour applied to the surface, whether from the decomposition of water and

the lowering influence of hydrogen acting on the body through the nervous system, or from the effluvia arising from marshes, known by the name of Miasmata, they are connected with irritability and debility; and, therefore, whatever tends to increase these states of the habit must favour the existence of the disease. If this opinion be correct, it must be obvious that the abstraction of blood is not to be indiscriminately employed in intermittents: indeed, when it has been resorted to, it has frequently rendered them more obstinate than usual. It has also tended to induce other diseases in those labouring under ague; such, for instance, as dropsy; and that state of plethora which indicates a greatly diminished vigour of body. Circumstances, however, may occur not only to permit, but to demand, the use of the lancet in intermittents. Thus, in spring, the disease is frequently modified by the inflammatory diathesis—a disposition of body which always prevails at that season, and requires blood-letting in the commencement of the attack. But, even under this state, the age, constitution, habits, and the situation of the patient, must be considered; for if a man, labouring under a vernal ague, and displaying that diathesis which authorizes blood-letting, live in a damp situation, he is much less able to bear the loss of blood than one living in a dry situation; and therefore this sedative remedy must be employed with caution.

The type of the intermittent, also, influences the propriety of blood-letting. Quotidians are more likely to require it than tertians, and these than quartans: but sometimes the condition of the air and the character of the prevailing epidemic forbid its employment, although it be apparently indicated. If the disease occur after long-continued rains, it not unfrequently assumes something of the typhoid type, and then blood-letting proves hurtful. If the intermittent, whatever be its type, have run on for a considerable time, the habit cannot fail to have suffered; and, consequently, the duration of the disease must also be taken into account, in determining the propriety of blood-letting. When it is proper, it is requisite to enquire in what stage of the disease it is likely to prove most beneficial. It has been employed both during the paroxysm and during the interval. Whilst the cold or the sweating stage is present, it should never be resorted to; for in the first the vital powers are depressed, and in the second they are exhausted. If, therefore, it be used during the paroxysm, it must be whilst the hot stage is present: but even then caution is requisite, as the over abstraction of blood at this time may induce a dangerous collapse.

In the interval it is seldom that symptoms occur which authorize the use of blood-letting. The symptoms indicating the loss of blood are those of great excitement; a full, hard

pulse; violent headache, throbbing at the temples, and flushing of the face, continuing more or less during the whole interval. Those indicating it in the hot stage of the paroxysm are a quick, hard pulse, intense headache, suffusion of the eyes, delirium, and great thirst. With respect to the quantity to be taken away, this must be determined by the power of the system, indicated by tendency to, or freedom from, syncope when the patient is bled in the erect posture. As a general rule, however, blood-letting should be very sparingly employed in agues. The use of other Sedatives is still more exceptionable. In making this remark, however, it is necessary to state that the bitter almond emulsion, which owes its properties to hydrocyanic acid, has been used successfully in intermittents, even in cases where the bark failed; and Dr. Brown Langrish used to cure agues with the distilled water of the Prunus *laurocerasus*.

If that pure inflammatory fever designated Synocha by Dr. Cullen exist, there can be no question as to the propriety of abstracting blood: but, as continued fevers are generally of a typhoid character, many circumstances ought to be enquired into before blood-letting be employed; and the sum of medical opinion is against it. Not only the constitution of the patient, but the state of the atmosphere must be taken into account; for, as inflammatory fevers sink into typhus, so this fever sometimes suddenly changes its character and displays an inflammatory type. Thus, in the British army in the Peninsula, typhus, in the hospital at Bilboa, while the atmosphere remained sultry and relaxing, assumed characters directly the reverse of those indicating venæsection: but as soon as the weather changed, and frost set in, the change of type, says Dr. Hennen, "pressed on our consideration the propriety of blood-letting. This was rendered obvious by the fact that spontaneous hæmorrhages, which formerly sunk the patient's strength, were now accompanied with obvious relief." In synochus, blood-letting is indicated in the early stage of the disease, and may be repeated according to the manner in which it is borne; but if the disease have run on for a few days, an irremediable degree of exhaustion is likely to follow blood-letting. As a general rule, the continued fevers of warm climates require the use of the lancet less than those of temperate climates; and those of cold climates more. In large towns, fevers require less the use of blood-letting than in the country; in damp situations than in dry; and in crowded hospitals than in private practice.

The nature of the exciting causes will also affect the consequences of blood-letting in continued fever. If inflammatory symptoms occur, topical blood-letting may be employed; and it should be laid down as an axiom, that recourse should never be had to general blood-letting unless symptoms strongly in-

dicate the phlogistic diathesis. When the exciting cause of the fever is cold, the vascular action is generally considerable, it lasts longer, and the attack seems more to require bleeding than in the severer forms of continued fever. Epidemics differ, not only in their nature, but in their consequences; and therefore require different treatment: in some, every circumstance would seem to point out the propriety of blood-letting; yet it will prove injurious; and sometimes, when the propriety of the measure is less obvious, it is better borne and is productive of benefit.

In pure inflammatory fever, blood-letting, as a Sedative, may be employed at any period of the disease: in typhus, the commencement is the most proper period; but in mixed fevers it is difficult to fix the proper time, as the limits of the inflammatory portion of the disease and its opposite state are difficult to be determined. As a general rule, however, the nearer to the commencement of the disease the bleeding takes place, the better, and the safer; the more precarious, and the greater the risk, the longer the attack has continued. In mixed fevers, the symptoms denoting the propriety of blood-letting are a frequent, full, hard pulse, increased thirst, a high temperature of the body, determination of blood to the head, and delirium of the phrenitic kind: it is also indicated if any determination to the lungs exist, manifested by cough or difficulty of breathing; and to the abdomen by pain and tension: but, even when these symptoms are present, it may admit of a question how far the use of the lancet is advisable in this fever. In fixing the quantity to be drawn, much discrimination is requisite: it must ever be borne in mind, that fever is an affection of the whole vascular and nervous systems, and, even when symptoms of high excitement display themselves, that still the disease differs from pure inflammation, and that syncope is more readily produced by blood-letting in this state than in pure inflammation. In inflammation, there is much less susceptibility of the nervous system, and larger abstractions of blood are borne in it with impunity; but, in the reaction of fever, stout men frequently faint on being bled even to a very moderate amount: nevertheless, when local inflammation is superinduced, the same individual will bear a larger quantity to be taken without fainting. There is, in fact, in this form of fever, a strict alliance between the degree of tolerance of loss of blood and the exigencies of the cure.

In the Phlegmasiæ, blood-letting constitutes the most important curative agent. Still, however, the abstraction of blood is to be resorted to with caution; for it is a well-known fact, that the moment the protecting influence of inflammation ceases, or is withdrawn, further blood-letting is in the highest degree dangerous. When the inflammation is extreme in violence or

diffusion, the whole nervous system becomes severely affected; nevertheless, from the protecting influence of inflammation, general blood-letting is indicated, and it is well borne; but, after a certain time, the abstraction of blood exhausts the powers of the system, and sinking supervenes. Syncope does not at once subdue the reaction in severe inflammation; but it is subdued by repeated or excessive syncope: and in this respect inflammation of an active kind differs from fever, in which syncope at once subdues all the action. A much larger quantity of blood may be also drawn with impunity in inflammation than in fever; but we must, at the same time, remember that the remote effects of excessive blood-letting are apt to supervene the moment the inflammatory action is subdued. No mistake is so dangerous as to bleed after the symptoms of inflammation have subsided, with the view of preventing a recurrence of them.

In erysipelatous inflammation, the propriety of employing blood-letting as a general Sedative depends on the type of the attending fever. If it be of the inflammatory kind, moderate blood-letting is indicated. Topical bleeding, however, which was formerly deprecated, has of late years been found to be highly serviceable. If the attending fever be of the typhoid kind, it is unnecessary to say that blood-letting would be injurious.

In ophthalmia, general blood-letting is not frequently required; topical bleeding with leeches, if early resorted to, being sufficient to subdue the inflammation: but, when this is deep-seated, with swelling, intense pain, and intolerance of light, when the pulse is full and hard, not only venæsection, but arteriotomy, so as to induce repeated syncope, will be found necessary. If local bleeding only be indicated, and the inflammation have run on for some days, cupping, as it abstracts the blood more rapidly than leeches, is to be preferred. Scarification of the inflamed vessels, however, is better than either. When the pain is acute, I have seen much relief obtained from the topical application of the hydrocyanic acid, very largely diluted.

In Cynanche Trachealis, Croup, blood-letting, carried at once to syncope, in the very commencement of the disease, often arrests its progress. Some practitioners draw the blood from the jugular vein, others prefer cupping; but the principle is the same; by a sudden abstraction of blood, to produce a powerful *sedative* effect on the arterial system, and thus subdue the local inflammation.

The term *Pneumonia* is generic of all the inflammatory attacks of the thoracic viscera; and, in these, the general abstraction of blood is more or less demanded. In inflammation of the substance of the lungs, the blood-letting should be prompt, copious, and repeated: but it should be confined to the early stages of the disease. The extent of the quantity of blood to

be lost can neither be foreseen nor indeed ordered by the physician, who, in every case, should witness the operation and regulate the quantity by its effects: as an average quantity, in an adult, less than from thirty to thirty-five ounces will seldom prove serviceable. In that state of pulmonary inflammation, which has been termed bastard peripneumony, Peripneumonia *notha*, blood-letting is generally regarded as hurtful: it frequently occurs in broken-down habits; and in those addicted to the abuse of spirituous liquors. Some discrimination is requisite to recognize the disease in the commencement: it differs from pneumonia in the character of the cough, which is short, with copious expectoration, and little or no fever. As it proceeds, the cough increases in violence, the breathing becomes more difficult, the expectoration less, whilst the face assumes a livid hue, the air tubes of the lungs are choaked up with a frothy mucus, and suffocation ensues. It is evident that, in such a condition of the lungs, blood-letting, or Sedatives of any description, would prove hurtful; on the contrary, stimulant expectorants are indicated. Pneumonia, attacking old people, is very apt to sink into this state; and the same result may follow the incautious and undue abstraction of blood in pneumonia.

In both pneumonia and in inflammation of the serous membrane of the chest, if the pain be considerable, there can be no doubt of the necessity of copious blood-letting; but the absence of pain does not denote the contrary. At one time the medical world was divided in opinion whether the blood should be taken from the pained side or the opposite: the Emperor Charles IX was appealed to; but, before he delivered his judgment, he was bled for pleurisy and died; and his death was ascribed to the blood having been drawn from the wrong side. The controversy ran still higher; and ended, as all such disputes usually do, without either party being convinced; and both remaining a mark for the finger of derision in future ages:—Sanin ? creta an carbone notandi ?

In pneumonic inflammation, also, we are to be guided in determining the propriety of venæsection by the period of the disease. It was formerly an opinion that, after four days, peripneumony could not terminate in resolution; but more correct observation has exposed this error: nevertheless, venæsection cannot be too early employed; and a quantity of blood, sufficient to bring on a slight tendency to syncope when the patient is in the erect posture, if taken within the first twelve hours, will often prevent the necessity of further blood-letting. The abstraction of blood, however, is not to be confined to any period; it is to be regulated solely by the symptoms: but we must always bear in mind that there is more to be apprehended from the disease than from the lancet. In the second stage, however, when there is dulness on percussion, and the character of the sound

of the respiration indicates hepatization of the lungs, blood-letting loses that character for efficacy which it justly possesses in the early stages of the disease. The average quantity of blood to be taken at once is about thirty or thirty-five ounces: I have seen this quantity abstracted every eight hours, until 140 ounces were lost within forty-eight hours,with decided advantage. Much depends on the rapid abstraction of the blood: in this species of inflammation, therefore, more than in any other, a large orifice, with the erect posture, is never to be dispensed with. Such are the advantages of this sedative agent in Pneumonia: it is proper to look at the bad effects likely to follow its abuse. The first bad effect of excessive blood-letting in this disease, is interruption of expectoration, inducing effusion into the lungs, and causing either suffocation or hydrothorax. In the present day, such an effect is not likely to occur; the habit of following a full bleeding with a large dose of calomel and opium superseding the necessity of its frequent repetition. As the principle upon which we must proceed in Pneumonia is applicable to all the other Phlegmasiæ, I have ventured to enter a little more into its practical treatment than would otherwise have been requisite.

The use of the unrespirable gases in the phlegmasiæ has been, perhaps, too little attended to: in many respects they might prove useful, from the facility with which they can be applied to the seat of the inflammation, either when that is external, or confined to the pulmonary system of vessels.

In active Hæmorrhages, Sedatives are indicated, and, of course, blood-letting. During the flowing of the Hæmorrhage, although blood-letting be often resorted to, it is not always necessary, as the Hæmorrhage will cease as soon as the quantity of blood lost brings down the plethoric state which induced it: thence it is generally more useful to bleed in the interval, so as to anticipate the attack; and, at this time, the bleeding should be carried to syncope. If, during the hæmorrhagic flow, blood-letting be at all advisable, the same rule should govern the mode of abstracting the blood: during the state of syncope, the Hæmorrhage stops; and this is the method which Nature adopts to check these discharges. In passive Hæmorrhages, blood-letting is contraindicated: this is also true of all other Sedatives.

In Phthisis, blood-letting has been much employed. In the inflammatory stage of the disease, blood-letting is our principal remedial agent. It must be early employed; the object being to diminish vascular action: but, in this deplorable malady, the symptoms are not always so obvious as to lead to decisive measures; the inflammatory action steals on insidiously; and the disease, when it is only expected, has already established itself in the frame. Still, if suppuration have not taken place, the lancet may prove useful; but the utmost discrimination is requi-

site in directing its employment. In the second stage of the disease, when tubercles are in a suppurating state, much relief has been afforded by small and frequently repeated venæsections: the quantity taken at a time should not exceed a few ounces; seldom more than three. Phthisical patients, even after hectic shews itself, bear such bleeding well; and instances are recorded in which they have been bled two hundred times in a few months. What advantages are derived, except transitory ease to the feelings of the patient, it would be difficult to conceive; the same termination takes place as awaits all those who are subjects of this relentless disease. Carburetted hydrogen gas, mixed with common air, in the proportion of $\frac{1}{20}$ to $\frac{1}{30}$ in 100 of air, has been found to afford immediate relief in the hectic of phthisis; diminishing the sense of uneasiness, promoting sleep, and abating the frequency of expectoration: but the strength fails.

I have seen no case of Dysentery in which it has been necessary to bleed to any considerable extent: in this affection, some of the other sedatives, especially the hydrocyanic acid, are generally more likely to prove beneficial than the lancet.

Spasmodic and convulsive diseases depend on increased irritability; and, consequently, whatever favours debility is to be avoided. They are sometimes, however, complicated with an inflammatory diathesis; in which case, blood-letting is not to be neglected. When there is a determination to particular parts, although the phlogistic diathesis be not present, cupping and leeches may be proper.

In Apoplexy, the lancet is resorted to during the attack; and also in the interval, to prevent the recurrence of the attack, from the idea of congestion or effusion of blood within the cranium: but this is not always the case; and Apoplexy may proceed from causes depressing the powers of life, without the presence of actual plethora. When a state of plethora really exists, with an evident determination to the head, blood-letting cannot be dispensed with: but when the disease occurs in advanced life, in debilitated habits, and without such determination, Excitants are more likely to prove useful than Sedatives. But, even in old age, and in weak people, if determination to the head be evident, topical blood-letting will be useful.

In Mania, the general use of the lancet has produced much mischief. It is true, that Mania is accompanied with the most violent excitement: but in no case is this state so rapidly followed by collapse. How far the employment of other sedatives may be safely proceeded with in these cases is still a question for experience to decide.

SECTION IV.

REFRIGERANTS.—MEDICAMENTA REFRIGERANTIA.

Syn.—*Medicamenta temperantia.*

THAT there exist substances which diminish the morbid heat of the body, is a well-established truth. The expression, cooling medicines, is not devoid of meaning, but implies a fact which has been acted upon, in prescribing for diseases, from the earliest periods of the history of the medical profession. But although this refrigerant power has been acknowledged to exist in many substances, yet no very satisfactory explanation of the phenomenon which follows their administration has yet been offered. It would be a waste of time to mention the absurd hypotheses that have been advanced on this subject up to the time of Dr. Cullen, whose reasoning on the operation of Refrigerants is too obscure and hypothetical to merit attention, and is at complete variance with the usual soundness of his remarks. The latest theory is that of Dr. John Murray, who has endeavoured to explain the operation of Refrigerants on chemical principles. He sets out by considering, as an established fact, that animal heat depends on the consumption of oxygen in the lungs, and that this is greatly influenced by the nature of the food and other ingesta; that, when these consist of substances which contain a small proportion of oxygen, the consumption by the lungs is increased, and consequently the animal temperature is augmented; but, when the ingesta contain much oxygen, especially in a loose state of combination, then an opposite effect takes place in the lungs. This hypothesis, although it is apparently supported by a fact observed by Mr. Spalding—namely, that he consumed the oxygen of the air in his diving bell in a much shorter space of time if he used an animal diet or drank spirituous liquors than when his nutriment was solely farinaceous matter—yet is not so; as the consumption of oxygen would be necessarily greater from the increased impetus of the blood, when these stimulants were taken.

Dr. Murray founds his theory on the presumption of the truth of that of Dr. Crawford, that the arteries in the lungs absorb the caloric liberated there, in the process of respiration, and, owing to their great capacity for caloric, they instantly render it latent, in which state it remains until the subsequent conversion of the arterial into venous blood, when the heat is liberated equally through the system. Beautiful as this theory is, the difference of capacity of arterial and venous blood is certainly insufficient to account for the heat of the body; and subsequent enquiries have enabled us to explain the augmentation of animal temperature on different principles. Yet there are

many facts which may be regarded as demonstrating the truth of Dr. Crawford's opinions. The size of the lungs and the quantity of blood which passes through them are in proportion to the temperature of the animals. Thus, the capacity of the lungs is greatest in birds, which have the highest temperature among animals; and the temperature, in the same animal, is always reduced when any circumstance lessens the free action of the lungs and prevents the consumption of oxygen. In hybernating animals, the temperature diminishes as respiration is suspended; and it rises with the return and the progress of respiration. M. Le Gallois, also, ascertained by experiment that, when less oxygen is consumed than in natural breathing, the temperature of the body always falls, and this exactly in the ratio of the quantity of oxygen consumed. It would be presumptuous in me to deny the accuracy of these experiments: but they can be explained on other principles. Thus, if we admit that nervous energy is the cause of animal heat, we can readily explain why the heat should be in the ratio of the size of the lungs, by supposing that, the nervous energy being greater in these animals, the secretions must proceed more actively than in the colder-blooded animals. The facts, also, which tend to prove that the temperature of parts, and consequently that of the entire body, is regulated by the nervous energy, are as numerous and as satisfactory as those which support the doctrine of Crawford. Sir E. Home ascertained that, by dividing the nerves going to the growing antler of a stag, the temperature fell immediately several degrees; and although after a few days it again rose to a degree higher than in the other antler, yet, this may have depended upon circumstances of which we have not been made aware; and it does not invalidate the influence of the nervous energy, or the fact that the temperature of a part is greatly regulated by the state of the nerves. In paralysis, the heat of the limb falls; yet, in many cases the paralysis is confined to the sensibility of the limb, and the state of the local circulation is not commensurate with the reduced temperature. From these facts, it appears that our ideas are still imperfect respecting the source of animal temperature. The most important experiments on the subject are those of Mr. Brodie. He found that the action of the heart can be maintained by artificial respiration after the brain is removed, and that, although the blood undergoes its ordinary changes, yet that animals thus treated cool rapidly. I cannot help remarking, that these experiments prove that no consolidation of oxygen occurs during respiration: for this would necessarily evolve heat: on the contrary, however, "when the inspired air is colder than the natural temperature of the animal, the effect of respiration is not to generate, but to diminish animal heat." When the functions of the brain are suspended, the power of generat-

ing animal heat is also suspended; although, during this period, by means of artificial respiration, the same quantity of oxygen is consumed, and the same quantity of carbonic acid formed, as in natural respiration under ordinary circumstances. We cannot, therefore, refer animal heat solely to the chemical changes going on in the lungs.

The experiments by which Mr. Brodie established these facts were made on rabbits, in which the functions of the brain were suspended by dividing the spinal marrow. "It may perhaps be urged," says that ingenious physiologist, "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 this 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 undergoes 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*." In the experiments of Mr. Brodie, the blood in the aorta and pulmonary veins was not more florid, and that in the vena cava and the pulmonary artery was not less dark-coloured, than under ordinary circumstances. These conclusions of Mr. Brodie are further verified by the fact that, when the axillary plexus of nerves on one side is crushed, as was observed in an accident which came under the care of Mr. Earle, the paralyzed limb of that side is of a lower temperature than the opposite limb: and, in general, paralyzed limbs are more easily affected by external heat and cold than sound limbs; whilst increased nervous action is always accompanied by increase of temperature.

From a consideration of the foregoing facts, we may affirm, that animal heat is a vital process, depending on the integrity of the nervous system. It is true that the stimulus of arterial blood is necessary for the excitement of the brain and nerves, and consequently for the proper development of animal heat: respiration, therefore, is essential, in the production of animal temperature, for producing that change in the blood without which the brain would lose its energy, and the heat of the system be necessarily greatly lowered. Under the present opinion, that carbon is converted into carbonic acid in the lungs,

* Phil. Trans. 1811.

and that heat must necessarily be evolved by the act of the oxygen combining with the carbon, we must still admit that something is due to this, and adopt so far Dr. Crawford's theory ; but that animal heat is rather to be ascribed to vital energy than to chemical phenomena, cannot be denied. This opinion received great support from some experiments of Dulong, who, in 1823, repeated those of Lavosier, with the view of ascertaining whether the quantity of caloric developed by the oxygen which disappears in respiration, be equivalent to the quantity given out by the body. He found that, in carnivorous animals, it is equal to 49 and 55 parts in the 100 of the heat generated by the whole body during the same interval of time ; and, in phytivorous animals, to betwixt 65 and 75 parts; and that the whole quantity of caloric and water together is equivalent to 69 and 80 parts only : thence that the animal heat is greater than can be accounted for by the fixing of oxygen in the formation of carbonic acid during respiration*.

In according with the conclusions drawn by Mr. Brodie from his experiments, it is only justice to mention the opinion of M. Gallois, that, owing to the nature of artificial respiration, the temperature may fall, and the animal actually be killed by cold, even though every part remain uninjured. The air introduced in artificial respiration does not rush into the pulmonary cells, as into a vacuum, but is propelled into them forcibly ; the consequence of which is the formation of a large quantity of frothy mucus, which both prevents the air coming in contact with the sides of the air cells, and by its evaporation tends to cool the body. A more forcible argument on the same side is found in the facts, that acephalous fœtuses maintain their temperature during the few days that they live ; and that vegetables, which have no nervous system, preserve a certain degree of temperature, and resist the influence of external cold. Such are the contending opinions that obstruct our efforts to arrive at truth : the most probable state of the case is, that both opinions are to a certain extent true ; that animal heat is influenced by the state of the nervous system, and in part also by chemical changes occurring in the lungs. It is also probable that, during the processes of nutrition, secretion, and other chemical phenomena proceeding in the minute arterial branches, caloric is constantly disengaged†.

Such being the sources of animal heat, the theory of Dr. John Murray can be regarded only in the light of an ingenious hypothesis. In what manner, then, it may be asked, do refrigerants operate ? It is, under all circumstances, more easy to destroy than to build up. The weak parts of the opinion of

* Ann. de Chim. et Phys. t. xxvi.

† See a paper by Dr. Williams, Edin. Med. Chir. Trans. vol. iii

Dr. Murray are obvious; but it is difficult to form a less objectionable theory. We may, however, endeavour to approach to something like an explanation of the mode in which refrigerants operate.

If we reflect upon the action of those substances that produce a refrigerant effect when applied to the surface of the body —namely, diluted acids, salts in a state of solution, and cold water or ice—we may form some idea of the manner in which they operate when taken into the stomach. The term *cold*, is the common method of expressing the fact of the abstraction of caloric: by whatever means this is effected, the capillaries of the surface have their activity immediately diminished; and, as these form a part of the whole vascular structure of the body, their action cannot be materially lessened without that of the whole body being also influenced; thence the vigour of the heart and arteries is materially diminished by the abstraction of caloric from the capillary branches of the system. The consequence of this is immediately felt on the respiration; the blood does not undergo its necessary change; black blood is conveyed to the brain; and, impeding its functions, a state approaching that of paralysis of the nervous system ensues; so that torpor of all the functions depending on the energy of the brain must necessarily follow. Now, let us suppose that something analogous to this effect on the surface takes place when the same kind of substance is introduced into the stomach; and recollecting the sympathy existing between the stomach and the skin, we may readily admit the possibility of the same general influence over the whole system being equally experienced in the one case as in the other. This opinion receives some support from the fact, that neutral salts—for example, nitre—produces its most powerful effect as a general refrigerant when it is swallowed at the moment of its solution; for, when taken after it has been some time dissolved, it operates as an excitant. The sensation of cold, therefore, which nitre, during solution, causes in the stomach, may be regarded as equivalent to the partial abstraction of stimulus; and this being extended to the heart and arterial system, produces a reduction of action, which is followed by a sensation of cold over the whole body. We thus advance one step towards an explanation of the action of refrigerants.

1. *Effects of Refrigerants upon the Digestive Organs.*—In the healthy state of the stomach, little impression is made upon it by medicines of this class; but, when it is in a more irritable condition, refrigerants, particularly the vegetable acids, allay the sensations of heat, nausea, thirst, and general uneasiness, which irritation produces in it. In a more extensive state of disease, however, when ulceration or cancer exists, Refrigerants tend rather to increase than to allay the sufferings of the patient.

2.—*upon the Circulating and Respiratory Organs.*—Most of the substances employed as Refrigerants are taken into the circulation. In the healthy condition of the habit, they cause no evident change in the action of the vessels, neither diminishing nor augmenting the force nor the frequency of the action of the heart, nor that of the larger blood vessels, nor even of the capillaries. But, in a state of excitement, they moderate arterial action, and relax the tension of the pulse; and their effect upon the capillaries is especially manifested by the diminished temperature which follows their administration. This refrigerant influence is so decided, that those labouring under fever display an instinctive desire for acidulated fluids, which keeps pace with the degree of the temperature of the body.

In the same manner, Refrigerants do not sensibly affect the respiratory function in health; but, in the febrile state of the habit, the influence which they exert on the circulation is necessarily communicated to the lungs. In the diseased state of these organs, many Refrigerants, particularly the vegetable acids, augment cough and oppress the breathing, if administered before the inflammatory action is lowered and the morbid susceptibility of the mucous membrane is diminished.

3.—*upon the Secerning System.*—The action of Refrigerants upon the secreting organs seems to be confined to the kidneys: the quantity of urine is greatly augmented; but this seems to be altogether independent of the refrigerant effect of the substances belonging to this class of medicinal agents.

4.—*upon the Nervous System.*—Although little effect be produced on the nerves by the introduction of Refrigerants into the habit, in the healthy condition of the body, yet, in affections of the spinal cord, the whole of the organic tissues are rendered more susceptible of impression by the administration of the vegetable acids. I once witnessed a remarkable illustration of this fact in a person who was labouring under subacute inflammation of the spinal theca. Whenever he swallowed an ordinary effervescing draught, he immediately suffered from a sensation of pricking over the surface, the skin became so sensitive as scarcely to admit of being touched, and the whole habit was restless and uneasy. This effect might be ascribed to idiosyncracy, were it confined to particular individuals, which is not the case.

Notwithstanding these effects of Refrigerants upon particular organs, they operate generally as atonics; and the cooling effect which they produce, although first exerted solely upon the nerves of sensation, yet, is soon extended to the whole of the system. Refrigerants may be regarded, therefore, as operating either on the organic functions or on the sensibility of the body.

TABLE OF REFRIGERANTS.

A. REFRIGERANTS OPERATING ON THE ORGANIC FUNCTIONS.

* *Organic Products.*

a.—VEGETABLE ACIDS.

Oxygen combined with Compound Radicals, forming

Acetic Acid;
Oxalic Acid;
Citric Acid;
Tartaric Acid;
Malic Acid.

** *Inorganic Substances.*

b.—NITRATE OF POTASSA.
c.—BIBORATE OF SODA.

B. REFRIGERANTS OPERATING ON THE SENSIBILITY.

d.—COOL AIR.
e.—ICE—COLD WATER.
f.—EVAPORATING LOTIONS.

REFRIGERANTS WHICH OPERATE ON THE ORGANIC FUNCTIONS.

* *Organic Products.*

a. VEGETABLE ACIDS.

1. *Acetic Acid.*—This acid is found in the sap of all plants, either in a free or in a combined state. It approaches nearer than any other of the vegetable acids to the state of the primary vegetable products; namely, gum, fecula, sugar, and ligneous matter, all of which, by a small modification of their components, form acetic acid. This analogy, more or less complete, as De Candolle has well remarked, tends on the one hand to explain the facility of its formation, and perhaps, on the other, to demonstrate that acidification is a phenomenon different from

that of oxygenation as manifested in the formation of the mineral acids*.

Acetic acid is prepared for medicinal use by submitting vegetable matter to destructive distillation, or by subjecting it to fermentation. In the former process, it is procured by distilling wood in large cast-iron cylinders. It comes over mixed with *tar* and volatile oil; in which state it is combined with chalk to form an acetate, which is afterwards decomposed by sulphate of soda, and thus converted into acetate of soda, which is again decomposed by sulphuric acid, and acetic acid and sulphate of soda procured. The acid in this state is termed pyroligneous acid; it possesses all the properties of pure acetic acid.

Common vinegar is prepared by fermentation from wine, or infusion of malt, or sugar and water, or any substance containing much saccharine matter. In this state, it is more or less coloured, and contains mucilage and gluten: that sold in the shops contains also a small proportion of sulphuric acid, the law permitting the maker to mix with it a thousandth of its weight of that acid. To free vinegar from impurities, it is distilled in glass vessels: the first eighth part which comes over is rejected; the six parts which follow constitute the *distilled vinegar* of the Pharmacopœias. This is a colourless, limpid, volatile, slightly pungent fluid, having a refreshing odour, and containing five per cent. of acetic acid. Sixteen parts of pure pyroligneous acid, of a gravity of 1.046, mixed with eighty-four of water, form an acid of a similar strength and quality. Distilled vinegar is sometimes adulterated with sulphuric or with muriatic acid: the presence of the first is detected by muriate of baryta; that of the second by nitrate of silver. It may also contain salts of copper, tin, or lead: the copper is detected by ferrocyanate of potassa or by ammonia; the tin by nitro-muriate of gold; and the lead by sulphuretted hydrogen.

The pure anhydrous acetic acid, contained in common and in distilled vinegar, consists of

		Berzelius.	Prout†.	Gay-Lussac.
4 equiv. of Carbon	$(6 \times 4) = 24$, or	46.83	47.05	50.224
3 ——— Hydrogen	$(1 \times 3) = 3$,	6.35	6.87	5.629
3 ——— Oxygen	$(8 \times 3) = 24$,	46.82	47.08	44.147
	Equiv. 51	100.00	100.00	100.00

The quantity of water contained in any specimen is denoted

* Physiologie Végétale, par A. P. De Candolle, t. i, p. 312.

† Dr. Prout states that the oxygen and hydrogen of this acid are in the exact proportions to form water. Phil Trans. 1827, p. 355.

by the specific gravity of the fluid; that of the distilled vinegar of the Pharmacopœias is 1.0036.

For administration as a Refrigerant beverage, vinegar or distilled vinegar is farther diluted with water or any vegetable demulcent fluid; but, owing to the more agreeable qualities of the other vegetable acids, it is seldom administered. When taken, properly diluted, in a febrile state of the habit, the pulse becomes slower, the animal temperature is lowered, and the secretions are improved. It is used topically as a gargle in sore throats. In hæmorrhages, the cold feeling which it produces on the skin is sympathetically extended to the rest of the habit. I have been much in the habit of ordering it in the hectic fever of phthisis, with seeming advantage, in doses of a fluid drachm diluted with some demulcent, three or four times a day. It should be recollected that, if opium be prescribed in conjunction with it, the activity of the narcotic is greatly augmented by such a combination. When largely diluted, its external application as a refrigerant lotion is applicable to every case in which the skin is preternaturally hot, if no peculiar idiosyncracy forbid its employment.

2. *Oxalic Acid.*—This acid was formerly much employed as a Refrigerant, in the state of the binoxalate, obtained by simple expression from the leaves of the Oxalis *Acetosella*, an elegant little plant belonging to the natural order Oxalideæ, found in woods and moist shady places, flowering in April and May*. It is contained also in the expressed juice of the common sorrel, Rumex *Acetosa*, a plant belonging to the natural order Polygoneæ†. But the facility of artificially preparing the binoxalate has set aside altogether the use of these plants, except for the purpose of making whey, by boiling the leaves of the wood-sorrel with milk, and straining the decoction.

The Oxalic Acid, the base of the binoxalate, is in various states of combination in the rhizomes and bulbs of Tormentil, Fennel, Valerian, Florentine Iris, Ginger, Turmeric, and Squill; in the barks of Simarouba, Cascarilla, and Canella *alba;* and in combination with potassa, in the state of the binoxalate, in various parts of the plant, in Oxalis *Acetosella*, Rumex *Acetosa*, Rheum *palmatum;* and with soda in Salsola *Soda*. It is generally procured by acting upon sugar, starch, gum, and many other vegetable substances, with nitric acid: a part of the acid is decomposed and converted into oxygen and deutoxide of nitrogen; whilst the sugar is also decomposed, and carbonic acid, water, and oxalic acid are formed. It is probable that the sugar, which is a compound of carbon, hy-

* Woodville's Med. Bot. third ed. p. 563, pl. 201. Richard, Hist. Nat. Med. t. ii, p. 721.

† Woodville's Medical Botany, third edition, p. 230. Richard, Hist. Nat. Med. t. ii, p. 504.

drogen, and oxygen, is deprived of all its hydrogen and part of its carbon by the oxygen derived from the decomposed nitric acid.

One hundred parts of sugar yield sixty of oxalic acid.

The crystals, purified by repeated solution and crystallization, are slender, white, semitransparent, flattened, four-sided prisms, terminated by dihedral summits. They impress an agreeable, acid taste on the tongue, and communicate a sensible acidity to 2633 parts of water. They slightly effloresce in dry air, dissolve in eleven times their weight of cold water, and without any limit in boiling water. They contain forty-eight per cent. of water of crystallization, which can be expelled by heat, and the acid sublimed without decomposing it. It is distinguished by forming with salts of lime a white precipitate, which is insoluble in an excess of the acid. Independent of the water of crystallization, which is equal to 3 equivalents, the constituents of this acid are—

		Gay-Lussac.	Prout.	Berzelius.
Carbon	2 equiv. = 12, or	26.566	19.04	33.78
Oxygen	3 equiv. = 24	70.689	76.21	66.22
Hydrogen		2.745	4.75	0.0
	Equivalent 36	100.000	100.00	100.00

The binoxalate is as easily decomposed as the oxalic acid. Owing to the high state of oxidizement of the acid which is its base, no charcoal remains. The pure acid is never used as a refrigerant. In prescribing the binoxalate, it must be borne in mind that neither salts of lime nor of lead can be prescribed in conjunction with it.

3. *Tartaric Acid.*—This acid is formed by the hand of Nature in some part of many plants—namely, grapes, mulberries, gooseberries, tamarinds, the root of Dandilion, the bulb of Squill, some of the Fir tribe, and in Chenopodium *vulvaria;* but seldom in an uncombined state, being usually conjoined with potassa or lime. It is most abundant in the tamarind, the fruit of the Tamarindus *Indica*, a plant belonging to the natural order Leguminosæ*; a native of both the East and West Indies. It is artificially prepared by decomposing the bitartrate of potassa with chalk, so as to form a tartrate of lime, and next decomposing this tartrate with sulphuric acid, which, uniting with the lime and forming an insoluble salt, sets the acid free. In the formula of the London College, thirty ounces of bitartrate of potassa are ordered to be decomposed by twelve ounces of prepared chalk. Now the proportion of excess of acid in this quantity of acid is ten ounces and a half; but, owing to loss in the manipulation, this quantity is never procured. Tartaric acid readily crystallizes in colourless, inodorous, prismatic crystals, the primi-

* Woodville's Med. Bot. third edition, p 448, pl. 161. Richard, Hist. Nat. Med. t. ii, p 727.

tive form of which is an oblique or right rhombic prism. The crystal of Tartaric acid is persistent in the air: soluble in five times its weight of water at 60°, and in a much smaller quantity of boiling water. It is also soluble in alcohol. This watery solution has a very agreeable, acid taste, and reddens strongly the tincture of litmus; but soon becomes mouldy. It is distinguished from all other acids by the solution forming a white precipitate when mixed with any salt of potassa; and from oxalic acid by the white precipitate which it forms with lime-water dissolving readily in an excess of the acid.

Tartaric acid, in its crystallized state, is a compound of 88.16 of the anhydrous acid and 11.84 of water, in 100 parts. The constituents of the anhydrous acid are—

			Berzelius.	Gay-Lussac.	Prout.
Carbon	4 equiv.	= 24 or	35.980	24.050	32.0
Oxygen	5	= 40	60.213	69.321	64.0
Hydrogen	2	= 2	3.807	6.629	4.0
	Equivalent	66	100.000	100.000	100.0

As it decomposes the alkaline carbonates and forms tartrates, it cannot be prescribed in combination with these, unless we are desirous of forming tartrates and extricating the carbonic acid.

This acid, both in its free state, if largely diluted with water, and also in the state in which it is contained in the tamarind, is a useful and agreeable refrigerant. Tamarind tea is employed as ordinary beverage in febrile affections, especially those of a bilious kind; and its utility in nausea, vomiting, and even diarrhœa, is well established. It operates chiefly upon the cerebro-spinal system. The Bitartrate of Potassa, *cream* of tartar, is used in the same cases, in which its aperient property does not interfere.

4. *Citric Acid* is abundantly prepared by the hand of Nature in the fruit of the Citrus *Medica*, and Citrus *Aurantium*, in Gooseberries, Wortleberries, the Bird-cherry, Dulcamara berries, in Heps, and in several other acidulous fruits; but in all it is combined with malic acid, mucilage, and sugar. In the juice of the onion it is found in combination with lime.

Citric acid is prepared from lemon juice by adding prepared chalk to it, so as to form a citrate of lime, and then decomposing this with sulphuric acid. The insoluble sulphate of lime is separated by the filter; and the citric acid obtained in crystals by the due evaporation of the fluid which passes the filter. Forty-nine parts of strong sulphuric acid, diluted with ten parts of water, are requisite to decompose eighty-six parts of citrate of lime. One hundred and sixty pounds of good lemon juice yield ℥x of pure crystallized acid.

Crystallized citric acid is colourless, inodorous, transparent, intensely but agreeably acid, soluble in its own weight of cold

water at 60° Fahr. and in half its weight of boiling water. It is also soluble in alcohol. By exposure to damp air the crystals absorb moisture, and the aqueous solution becomes mouldy by keeping. The crystals, when exposed to heat, are decomposed before all the water of crystallization is driven off. In its crystallized state, this acid consists of dry or anhydrous acid 76.32, + water 23·68, in 100 parts. The constituents of the anhydrous acid are—

				Berzelius.	Gay-Lussac.	Prout.
Carbon	4 equiv.	(6 × 4) = 24	or	41.309	33.801	34.28
Hydrogen	2 ——	(1 × 2) = 2		3.800	6.330	4.75
Oxygen	4 ——	(8 × 4) = 32		54.891	59.869	60.97
		Equivalent 58		100.000*	100.000	100.00

A solution of nine drachms of these crystals in f℥xii of distilled water equals in acidity recent lemon juice: gr. xv of the crystals in solution saturate a scruple of carbonate of potassa; and gr. xxvi a scruple of subcarbonate of ammonia.

Citric acid in solution is distinguished from tartaric acid by not rendering lime water turbid, unless it be in excess, and by forming soluble precipitates with salts of potassa. Its crystals, however, are often mixed with those of tartaric acid, or sulphate of potassa: the first is detected by saturating the solution with carbonate of potassa; the second, by testing the solution with muriate of baryta.

Citric acid is the best of the vegetable acids which are employed as refrigerants. The uncombined acid, however, is less grateful than the recent lemon juice; and fever patients are particularly sensible of this, when it is employed to saturate the carbonate of potassa, or of ammonia, in forming the common effervescing draught for checking vomiting. Largely diluted with water and slightly sweetened with any agreeable syrup, it forms a useful and most agreeable drink in fevers, allaying heat and irritation, and reducing the pulse.

5. *Malic Acid.*—This acid is most abundantly supplied by the hand of Nature in almost all the fleshy fruits; for example, those of the orders Pomaceæ, Amygdaleæ, and Myrtaceæ: grapes, currants, gooseberries, strawberries, elderberries, the fruit of the service tree, Sorbus *aucuparia*, and many other fruits, contain it. It forms, also, in combination with lime, a component in the juice of the Sempervivum *tectorum*, and several of the species of Sedum: and exists in Labdanum, and in Cocculus Indicus†.

When obtained in a separate state, malic acid is deliquescent, crystallizing with great difficulty; and, in its aqueous solu-

* Its composition is so near that of sugar as to lead to the supposition that it is transformed into sugar as the fruit containing it ripens.

† Boullay. Journ. de Pharm. 1828. p. 63.

tion, is decomposed by keeping. Its crystals are colourless, mammillary, pleasantly acid, and soluble both in water and alcohol. One hundred parts of the anhydrous acid consist of—

			Vauquelin.	Fromherz.	Leibig.	Prout.
Carbon	4 equiv. = 24	or	38.3	29.357	41.238	40.68
Oxygen	4 —— = 32		54.9	66.863	55.879	54.24
Hydrogen	2 —— = 2		6.8	4.780	2.385	4.86
	Equivalent 58		100.0	100.000	100.000	100.00

Malic acid is not employed as a remedy in its free state: in combination, it forms the refrigerant principles of many acidulous beverages, for instance, apple tea, diluted currant juice, raspberry vinegar, and others, employed in febrile affections.

** INORGANIC PRODUCTS OPERATING AS REFRIGERANTS.

NITRATE OF POTASSA. L. E. D.—This salt is the spontaneous production of Nature in many parts of the world. In the organized kingdom, it exists in the roots of Pariera *Brava*, and Geum Urbanum, and the rhizomes or tubers of Ginger. In the inorganic kingdom it is most abundant. It is found crystallized on the surface of the soil in India, South America, Africa, some parts of Spain, and in Egypt. It is also found in great abundance in the Pulo de Molfetta—a deep cavity formed by the falling in of several caverns in the province of Puglia, in Naples: it is procured by the lixiviation of the common soil near the city of Klemsan, in the kingdom of Algiers; and in a cave near Mensoora, in Ceylon, there is a very rich impregnation of nitre. In the north of Europe, in Germany, it is obtained from artificial composts, consisting of vegetable and animal substances mixed with calcareous earth, formed into beds, sometimes into walls, over which roofs are raised to protect them from the weather. In France, nitre beds are also formed from the lime and plaster of old buildings, which have been inhabited by man and other animals. These plasters are reduced to powder, after having been for years exposed to the air, and mixed up with offal and decayed leaves; this powder is then lixiviated, and the fluid evaporated. Sulphate of potassa is in the mean time added, to decompose the calcareous salts, which are thus deposited in an insoluble state, leaving the nitre in solution. By repeated separations and evaporations, the nitrate of potassa is thus procured in its crystalline form.

The theory of the formation of Nitre, in these artificial beds, was first clearly pointed out by Mr. Cavendish. The animal and vegetable matters mixed up with the calcareous earth consist of nitrogen, hydrogen, oxygen, and carbon, which principles are evolved during their decomposition, and, reuniting by the operation of new affinities, produce new compounds, among

which we find nitric acid, which is formed by the union of the Nitrogen from the decomposition of the animal matter with the oxygen from that of the vegetable. This accounts for the acid; but how the alkali is formed, or what part the calcareous matter plays in its formation, is still unknown.

The greater part of the nitrate of potassa used in this country is procured from impure nitre, the production of the soil, imported from Bengal. When brought to this country, it is dissolved in water, and boiled until a pellicle form on the surface of the liquid, after which it is poured into leaden coolers, in which it crystallizes.

Nitrate of potassa, when pure, is in six-sided prisms*. It is white, semipellucid, and brittle, inodorous, and has a bitterish, sharp taste, occasioning a sensation of cold both in the mouth and the stomach. The crystals of nitre are not altered by exposure to the air: they contain water, mechanically lodged within them: dissolve in seven times their weight of water, at 60° Faht. and their own weight of boiling water. They are insoluble in strong alcohol. At 616° Faht. nitrate of potassa melts, and, on cooling, concretes into a compact mass; which, run into moulds, is called Sal Prunelle. In a high temperature, it is decomposed, and gives out about one third of its weight of pure oxygen. When nitrate of potassa is mixed with charcoal, and thrown into a red-hot crucible, it deflagrates; and a pure *carbonate of potassa* is the result. Nitrate of potassa consists of 1 equiv. of Nitric Acid 54, + 1 of Potassa = 47.15; making the equivalent 101.15: or, of Nitric Acid 52, + Potassa 48, in 100 parts.

Nitrate of potassa operates either as a sedative or refrigerant, or as an excitant, according as it is taken in small or in large doses; or according to the mode of administering it. In moderate doses of a scruple or more, it produces a powerful sympathetic effect on the nervous system, diminishing the action of the pulse in strength and frequency, and lowering the animal heat: the skin becomes pale, and the person experiences a feeling of languor. Even in considerable doses, as ascertained by Dr. Alexander, in experiments upon himself†, it produces a refrigerant effect; but this is soon followed by reaction. In doses of from six drachms to an ounce, it causes symptoms of gastritis with vertigo, tremors, and cold sweats, which have terminated in death. Post-mortem examinations have displayed evidences of acute inflammation of the villous coat of the stomach. To obtain the refrigerant effect of nitrate of potassa, therefore, the salt must be administered in moderate doses, namely, from a scruple to half a drachm, repeated at short intervals. It owes its refrigerant quality partly to

* It has very remarkable optical properties. Trans. of the Roy. Society, Edin. 1814.
† Experimental Essays, p. 113.

its chemical property of converting sensible into insensible caloric during its solution, thence abstracting it from the stomach; and by sympathy affecting the frame. The dose of the salt should not be dissolved until the instant in which it is to be swallowed: when, however, the coldness thus produced in the stomach causes uneasiness or spasm, the use of the salt should be discontinued.

BIBORATE OF SODA. Syn. *Subborate of Soda.* L. E. D. —This salt is a compound of boracic acid and soda, largely prepared by the hand of Nature. In Thibet it is deposited in a lake, from which it is collected and brought to Europe, under the name of *Tincal.* In this state it is frequently mixed with sand and fat, to prevent it from effloresecing. When it is purified and crystallized, it is soluble in twenty parts of water at 60°, and in two parts of boiling water.

Biborate of soda is now chiefly prepared by saturating with carbonate of soda the boracic acid, procured from the vapour springs of Volterra, near Leghorn, which contain a large quantity of boracic acid in solution in the vapour*. The acid thus procured is nearly pure: it is added to a solution of carbonate of soda in a boiling state, decomposes it and unites with the soda, expelling the carbonic acid in a gaseous form; and when the solution is saturated, the biborate is crystallized. The Dutch were the great purifiers of *Tincal* or crude borax; and such is the force of prejudice, that, on the Continent, the artificial salt prepared with the Volterra acid is obliged to be sent to Holland, and re-exported as Dutch borax.

Borax, or Biborate of Soda, is semitransparent; crystallized in flattened, hexahedral prisms. It is slightly efflorescent, is inodorous, and has a styptic, cool, and alkalescent taste, and an alkaline reaction, whence the incorrect name, Subborate, still retained in the Pharmacopœias. It is soluble in twenty parts of cold, and six of boiling water. Exposed to heat, it loses its water of crystallization, swells up like alum, and becomes a dry, white, spongy mass, without suffering decomposition: in a strong heat, it is vitrified. According to Bergman, the crystallized salt consists of—

Boracic Acid . .	34	or 2 prop.	$(24 \times 2) =$	48
Soda	17	— 1	——————— $=$	31.3
Water	49	— 8 prop.	$(9 \times 8) =$	72
	100		Equivalent	15.3

100 parts of the dry salt contain of Boracic acid 70, + Soda 30 parts. The alkaline salts of Boracic acid are easily distinguished from all others, by digesting them in strong sulphuric acid, evaporating to dryness, and boiling the residue in alcohol. This solution burns with a green flame. Biborate of Soda is de-

* It was formerly prepared in the same manner with acid procured from the waters of Sasso.

composed by all the mineral acids, and the boracic acid set free in the form of small crystalline scales: these acids, therefore, and also muriate of baryta and lime, protonitrate of mercury, and *nitrate of silver*, which decompose it, are incompatible with it in medicinal formulæ. It exerts a peculiar action on bitartrate of potassa, and on honey, which I may take this opportunity of noticing. If six parts of bitartrate of potassa, two parts of biborate of Soda, and six parts of water, be boiled together for five minutes, allowed to cool, and filtered to separate some tartrate of lime which is always contained in bitartrate of potassa, and the solution be then evaporated to dryness, we obtain a deliquescent salt. This salt has been termed Soluble Cream of Tartar by the French chemists. A chemical union is also effected, when biborate of soda is mixed with a solution of honey and water, or with equal parts of honey, and a deliquescent salt is formed with properties altogether new. It is on this salt, therefore, not on the borax, that the efficacy of the mixture of honey and borax, in aphthous affections, depends—a fact which explains the anomaly, that powdered borax, or its solution in water, applied to aphthæ does not produce the same beneficial effect as the honey of borax.

Biborate of soda is seldom prescribed as a general refrigerant in this country; but, on the Continent, both this salt and boracic acid, under the name of Sal Sedativum, is employed in inflammatory febrile affections. It is, however, better calculated for operating as a local than as a general refrigerant.

B. REFRIGERANTS ACTING ON THE SENSIBILITY OF THE BODY.

Cool Air.—The agreeable feeling produced by cool air would lead naturally to its application in a heated state of the body; and might have early suggested to practitioners of the healing art the propriety of employing it as a remedial agent in fever. But such is the perversion of human beings, that the older physicians at one time opposed this instinctive desire for cool air in fever patients, and subjected them equally to the hazard and the torture of a hot regimen. In modern practice, the admission of cool air to the apartments of the sick, in all acute diseases, especially in fever, is fully acknowledged: and nothing is found so soon to change the character of the disease, and to produce a favourable crisis. It is, however, of great importance to distinguish between exposure to cool and cold air, especially in convalescence from fever. The one is a grateful sedative, the other depresses the weak to an alarming degree.

Cold Water—Ice.—If cool air be serviceable in fever, cold water and ice are equally so, and their application is more

extensive. Let us examine the principles upon which these agents operate, and the mode of employing them.

When cold water is applied to the surface, the effect is an immediate abstraction of heat from the part, and a diminution of sensibility; and the extension of this effect, by sympathy, to the rest of the system: thence, this powerful agent is not to be regarded as a local, but as a general remedy; and in cases of augmented temperature, with some exceptions, it may be employed in every case attended with a hot, dry skin, with a quick, hard, or tense pulse. Perhaps much of the beneficial effect obtained from refrigerants is to be attributed to diminished vascular action. Under every circumstance, the temperature of the patient should be accurately ascertained by the assistance of the thermometer; and the water should be about fifteen degrees below the temperature of the body.

There are various modes of using cold water as a topical refrigerant:—it may be used under the form of the cold affusion, cold sponging, and ice.

The cold affusion implies dashing cold water over the body of the patient, who is stripped naked. The temperature of the water should depend on the season of the year, and many other circumstances: but, as a general rule, from 40° to 60° Faht. may be regarded as the average temperature: and it may be employed either with or without saline impregnations. In determining upon the propriety of using the cold affusion, we must be guided both by the condition of the patient and by our knowledge of the influence of the remedy. The sooner the cold affusion is resorted to after the rigors of the first stage of fever have abated, the better: but the safest guide is, to take the temperature of the body at its height: but, even when the thermometer indicates morbid temperature, the cold affusion should not be used if the patient feel much chilliness; nor should it be had recourse to if the temperature be less than that which may be considered healthful. The advantage of applying cold water, with these precautions, in every inflammatory fever, unaccompanied with visceral inflammation, is undoubted: it not only reduces heat and moderates the pulse, but abates, generally, the symptoms. If the temperature of the body is under that which has been already alluded to, the cool affusion, or sponging the body, is to be preferred to the cold affusion: the effect is neither so decisive nor so permanent as the cold affusion: but it relieves the morbid heat, reduces the pulse, and tranquillizes, generally, the irritability of the habit. The temperature of the water should not be below 71°, nor exceed 87° Faht. When a local effect is required to be produced, with the view of obtaining a general benefit—as, for example, in the application of cold to the scalp, whenever a powerful determination to the head, manifested by great heat there, renders it ne-

cessary—the use of ice is to be preferred, or that of evaporating lotions. When cold is to be applied in this form, the scalp should be shaved, and cloths dipped in cold water, or ice enclosed in a bladder, be laid upon it, while at the same time the lower extremities are to be kept warm.

During the hot stage of intermittents, when the surface is dry and parched, and the general heat greatly augmented, cold in every form applied to the surface, and cold fluids taken into the stomach, are not only grateful to the patient, but of the utmost value, lessening the force and frequency of the pulse, cooling the burning heat of the skin, and bringing on the sweating stage. Its use, however, requires some degree of caution; but when it has been begun, it should be continued until the heat is reduced to the natural standard. After this is effected, and the sweating stage has been induced, then the application of cold is no longer proper; as it abstracts the heat too rapidly, inducing urgent sickness and debility. In remittent fevers, the application of cold, and the administration of cold drinks, are to be regulated by the same rules as in intermittents; but the local application of ice or cold water to the scalp is more likely to be required, and to demand attention. In continued fevers, cold is advantageously employed in every form. In those fevers in particular which assume the typhoid type, ventilation and the free admission of cool air into the apartment of the sick are absolutely necessary. Cool air in these cases allays irritation, obviates debility, removes the oppression of the præcordia, and nearly produces all the advantages which can be anticipated from the cold affusion. The dieta aquea of the Italians is a relic of the cold drink of the ancients, which was pushed very far in continued fevers; and certainly no practice could be more judicious. But if the fears of the friends of the patient do not oppose the use of the cold affusion, this method of employing cold in continued fever is the most beneficial. Next to it is the cool affusion, and equal to this is cold sponging. Certain rules are necessary to be observed in the application of these refrigerants.

1. With regard to the kind of fevers in which they may be employed, we may enumerate five:—1. In synocha, or inflammatory fever, a very rare disease, when unaccompanied with topical inflammation, the cold affusion rapidly abstracts the stimulus of heat and diminishes the excitement under which the system is labouring; thus acting as a powerful sedative. The frequency of this disease among the ancients explains the great use made of cold drinks and cold bathing in continued fever. 2. In typhus, the fever most opposite to that just noticed, the disease has been cut short by the cold affusion; and when this has not been the case, the symptoms at least have been greatly alleviated by its employment. 3. In synochus, or inflammatory fever gradually assuming typhoid symptoms, the

cold affusion has been frequently and advantageously employed: nothing, indeed, can be more beneficial when there are no local determinations; but when these exist, particularly when cough indicates a determination to the lungs, much caution is requisite. 4. In intermittent fevers, especially those of warm climates, the efficacy of the cold affusion is undoubted. In yellow fever, its early application is frequently the salvation of the patient. 5. If hectic be symptomatic of determination to, or of disease in the thorax, the cold affusion cannot be employed; but much benefit often results from sponging with cold water mixed with vinegar, whilst the lower extremities remain warm in bed. Even when this fever is not attendant on any obvious local affection, or, as the term is, is idiopathic, the cold affusion can scarcely be regarded as admissible.

2. With regard to the period of fever in which the application of cold is useful, some distinct rules are also necessary. In that state of continued fever, when there is no obvious apyrexia, the cold affusion is especially indicated; and the more early it is employed, when this state shews itself, the better. Dr. Curry found that when used early, within the first three days of the fever, the complete formation of the disease was prevented; and this even occurs on the fifth day, but not later. If the fever be more advanced, the debility is generally too great to permit the system to bear the sedative influence of the cold affusion; thence the warm or tepid affusion must be substituted for it: but, nevertheless, if the symptoms indicating its use present themselves, there is no reason why it may not be employed at any period of the disease. One circumstance strongly against the employment of the affusion, in the advanced stages of fever, is the syncope which generally occurs when the patient is raised into the erect position.

3. In the application of the cold affusion, we must carefully ascertain, as I have already stated, the exact temperature of the body. In this country, in the severest attacks of fever, it has rarely exceeded 108°; but in warm climates it rises to 112°: the higher the temperature, the more benefit is to be expected from the cold affusion. The degree of temperature must be determined by placing a thermometer, with a small bulb and curved at the end, either in the axilla, or under the tongue of the patient with the mouth shut. The sensation of heat is, also, to be attended to in fever before using the cold affusion; for the patient often feels cold whilst the thermometer indicates an augmented temperature: and the opposite state sometimes occurs, the thermometer indicates no increase of temperature, nevertheless the patient feels hot. In both cases the employment of the cold affusion is contraindicated. It is, also, contraindicated if the skin be bedewed with perspiration; and, even when other circumstances are favourable, if the pa-

tient have a great dread of it, it must not be used; for terror has been frequently observed not only to counteract the beneficial effects of it, but even to make it an injurious agent. It is, also, improper during menstruation, and in the latter months of pregnancy.

It is unnecessary to enter into the nature of the various diseases, besides idiopathic fevers, in which the refrigerant powers of cool air and cold water have been found productive of benefit. In all, much depends on the degree of the attendant fever. It must be left to the sagacity of the practitioner to determine whether any local affections exist which forbid the free application of either. In no disease does the powerful sedative influence of cold display itself so conspicuously as in phrenitis. 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. In hæmorrhages of every kind, cold, in all its forms, is the sheet anchor of the practitioner. It is scarcely requisite to notice the havoc made by the employment of the hot regimen in small pox, and the striking advantage obtained from the free exposure of the patient to cool air: indeed, one of the greatest benefits obtained from inoculation, was the introduction of the custom of exposing the patient to cool air. At the same time, it is candid to admit, that little judgment was displayed by those who introduced the cool regimen: it was used in the latter stages, even of confluent smallpox, and much mischief frequently resulted. During the eruptive fever, the body should be freely exposed; as it not only is benefited at the moment, but the disease is rendered milder in its future stages. Even the dread of the eruption should be no reason against the use of the cold affusion, should the body require it. The Hindoo physicians plunge their patients, in this stage of the disease, into cold water, and with the best results. It diminishes the fever; lessens the number of the pustules; and, when small pox formerly prevailed, it was supposed to lessen the risk of pitting. In confluent smallpox, in which the secondary fever is of the typhoid type, cool air and the cold affusion may be used with the same intent and in the same manner as in typhus. In scarlatina, the disease is, as it were, instantly extinguished when the cold affusion is judiciously employed during the height of the eruption.

Such are a few of the most important diseases in which cold in every form is decidedly useful; but much, it must be admitted, depends on the discrimination, the judgment, and the observation of the practitioner, in determining the temperature of the application, the time, and the exact condition of the body in which it should be employed. It is unnecessary to add to these remarks, except to point out the means of coun-

teracting the degree of collapse which sometimes follows the application of cold water, guttatim, to the vertex. In this case, the state of sinking is to be treated exactly in the same manner as when extreme debility suddenly occurs, whatever may be the cause—namely, by external warmth, particularly the application of bladders of hot water to the scrobiculus cordis, friction, electricity, and the artificial inflation of the lungs, if the degree of collapse be very considerable; and, when the individual is capable of swallowing, the administration of excitants, particularly aromatics and ammonia.

SECTION V.

NARCOTICS.—MEDICAMENTA NARCOTICA*.

Syn.—Anodyna†, Hypnotica‡.

SOME of the distinctions between this class of medicines and sedatives have been already pointed out; but there are others that require to be noticed. *Narcotics*, strictly so called, operate as diffusible excitants, and this so decidedly, that, by regulating the doses and the repetition of them, the sleep, which generally follows their administration, may be altogether prevented, and the exciting influence of the medicine only be obtained: now, the effect of a direct *Sedative* is an immediate depression of the powers of the system without any apparent previous excitement. The symptoms of collapse which follow those of excitement, after the administration of a Narcotic, are the consequence of the excitement: and, although this does not occur in the direct ratio of the degree of the excitement, yet, if it be considerable and quickly raised to its acmé, the state of collapse which succeeds is proportionate: this is not the case with sedatives; the depression which they cause is the result of a peculiar action upon the nervous energy, that at once depresses it, and, if the dose be large, destroys both *mobility* and *sensibility*. In a few words, a *Sedative* immediately depresses the vital energies: a *Narcotic* augments these energies; and this is followed by depression.

Regarding Narcotics in the point of view which I have de-

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* From ναρκοτικὸς, derived from νάρκη, stupor.

† From the primitive α, and ὀδύνη, pain.

‡ From ὕπνος, sleep.—Hypnotic, a medicine which causes sleep.

scribed, they may be defined "medicines which, in moderate doses, produce a temporary excitement, succeeded by a depression of the system, generally followed by sleep." In this definition, the soporific effect of this order of medicines is stated as one of their characteristics; but nothing is said respecting the anodyne power which they frequently also exert; for, although it is undeniable that many Narcotics are capable of alleviating pain, yet, this is not a property of all Narcotics.

Let us examine in what manner their influence is exerted upon the organs of the body.

1. *Action of Narcotics upon the Stomach.*—The first influence of the full dose of a Narcotic taken into the stomach is exerted upon the nerves of the organ, and thence communicated to the nervous centres. What primary effect is produced on the organ itself it is impossible to conjecture; but the secondary effect, that which follows the impression on the encephalon and spinal marrow, is one which lowers the digestive powers of the stomach almost to a state of inaction. When the Narcotic substance is taken into an empty stomach, the first obvious effect is to diminish the desire for food: if it be taken during the time of eating, the process of chymification is suspended; if a short time after a meal, that of digestion is arrested; and if after some hours, vomiting follows, and the food is ejected in the state in which it was at the moment of swallowing the Narcotic. These effects are not confined to the action of the opium on the stomach; for they follow its introduction into the rectum, and even its application to the skin. The influence, therefore, of Narcotics upon the stomach is to weaken its powers; and, on the larger intestines, to lessen their ordinary contractility and produce constipation. Some Narcotics, however, are supposed to increase the peristaltic action of the bowels; but these are exceptions to the general rule.

The action of Narcotics upon the alimentary canal is modified by disease. When the mucous membrane is suffering from subacute inflammation, or is in a highly irritable state, Narcotics produce thirst and dryness of the tongue; and vomiting is not unfrequently induced. In a state of diminished vitality of the stomach, they augment the atony, cause indigestion, and produce obstinate costiveness. In cancer of the stomach, if no ulceration be present, Narcotics allay pain; but, when there is either an open ulcer or those spongy vegetations which occur in this disease, they cause an increase of pain, exciting vomiting and rigors, whilst, at the same time, the brain becomes powerfully affected. In irritable states of the coats of the stomach, however, Narcotics, especially Opium, when combined with tonics, instead of producing the effect already described, aid the influence of the tonics in promoting the appetite and favouring the digestive function. In an irritable condition also

of the intestinal canal, especially when spasm is present, they produce an anodyne and a salutary effect, allaying gripings and checking diarrhœa. In peritoneal inflammation, on the contrary, they cause anxiety, general uneasiness, and vomiting: but, in ulcerations and open cancer of the mucous membrane, they allay pain and procure momentary comfort to the sufferers.

2.—*upon the Circulating and Respiratory Organs.*—Nothing is more likely to lead to diversity of opinion than the effect of Narcotics on the action of the heart and arteries. A short time after taking any Narcotic into the stomach, the pulse is found in some instances small and feeble; in others, full and soft; but always more or less irregular. These effects have been referred to variations in the influence of Narcotics on the nervous energy. Their power over the circulation itself, however, is particularly manifested in the capillary system by the passive diaphoresis, the itching of the skin, and the dilatation of all the erectile tissues, which follow the use of any Narcotic. The temperature of the body is also lowered—an effect evidently depending on the diminished action of the capillaries and the slow manner in which the blood is moved through them. With regard to the respiratory organs, the administration of a Narcotic is always succeeded by the number of inspirations and expirations in a given time being much fewer than natural, and consequently by an imperfect decarbonization of the circulating fluid: thence the blood sent to the head is not adequate for the due excitement of the brain, and the whole system necessarily languishes. In cases of poisoning by opium, the blood found in the left ventricle of the heart is of a black colour.

In hypertrophy of the left ventricle of the heart, the administration of Narcotics produces a great tendency to congestion of the brain, manifested by a sensation of weight of the head, a bloated aspect of the countenance, and temporary deafness. In irritations of the mucous membrane of the pulmonary tubes, they diminish the tension and dryness of that membrane, re-establish the exhalation from its surface, and restore the healthy action of the mucous follicles. With respect to the influence of Narcotics on the respiratory muscles, as every muscular fibre is more or less dependent for its state of vigour upon the energy of the brain and spinal cord, the state of these nervous centres must influence the action of the respiratory muscles; and, consequently, according to the effect produced on them, Narcotics may be regarded as influencing these muscles.

3.—*upon the Secerning System.*—Little that is satisfactory is known upon this subject. If Narcotics be administered in doses sufficient to maintain their stimulant operation, without exhaustion, there can be no doubt that the secretions will be augmented, inasmuch as the stimulus is communicated to the glan-

dular capillaries, and an increased supply of blood afforded to them. As an objection to this opinion, it may be said that the alvine evacuations generally indicate a deficient supply of bile after opium has been taken; but, in this case, the defect depends rather upon the paralyzing influence of the opium upon the excretory ducts than upon the secreting power of the liver; and this reasoning may be extended to the rest of the glandular system. That the function of the salivary glands is affected by Narcotics, is supposed to be evinced by the dryness of the mouth which follows the administration of a full dose of opium; but this also may depend on the condition of the excretory ducts. One fact seems to confirm the opinion that Narcotics do not diminish glandular action; namely, that opium has never succeeded in lessening the flow of saliva produced by mercurials: on the contrary, it is asserted by Theussing that it has sometimes produced salivation*. On the urinary organs some Narcotics, especially opium, produce a decided effect; thence its employment in the treatment of diabetes. But it may be questioned whether the diminished secretion of the urine be not owing to the increased perspiration which the opium induces, rather than to any influence which it exerts on the kidney? The aphrodisiac influence of Narcotics does not prove that they particularly augment the spermatic secretion. It has been asserted that opium diminishes the secreting powers of the mammæ: Geoffrey maintained that it augments them†: but observations are wanting to establish the accuracy of either opinion.

Upon the whole, we may safely conclude that the facts which have been brought forward in proof of the influence of Narcotics on the secerning system are not sufficient to enable any decided opinion respecting it to be hazarded.

4.—*upon the Nervous System.*—Narcotics exert their chief influence on the nervous system; for, although they are undoubtedly received into the circulation, and produce almost immediate death when they are injected into the veins, yet, even in this case, their influence is propagated chiefly by nervous communication—a fact demonstrated by the experiments of Messrs. Morgan and Addison‡, who discovered that they produce on the inner coats of the blood-vessels a peculiar impression, which is conveyed to the brain along the nerves. This is, also, demonstrated by the rapid effects on every part of the system, often in a space of time too short for these effects to be referred to absorption; besides, it is well known that, when the dose has been so large as to be quickly followed by fatal effects, the whole quantity of the narcotic administered has been found in the stomach. From the nature of the nervous system, there is no

* Charvet, de l'Action comparée de l'Opium, p. 217. † Mat. Med. vol. ii.
‡ Essay on the Operation of Poisonous Agents on the Living Body, p. 73—89.

difficulty in comprehending the manner in which this communication of impression is effected. But this action of narcotics is not confined to their primary application to the nerves of the stomach; for if any narcotic be applied to the surface of the body, the same results follow, only in a diminished degree: if the application be to an entire membranous surface, the energy of the narcotic influence is in the ratio of the absorbing power of the membrane; and if the narcotic be injected into the thorax, between the lungs and the ribs, the action is still more rapid than when it is taken into the stomach. The fact of the introduction of narcotics into the circulation cannot be denied; but, when a narcotic is applied to a wound, its operation does not essentially depend on its entrance into the blood, although its influence, in a great degree, can be impeded by a ligature on the blood vessels; and when it is injected into the veins, the animal instantly expires, without convulsions. In this experiment, all the muscles af the body, both voluntary and involuntary, are deprived of their contractile power, and, therefore, both the action of the heart and that of the respiratory muscles ceasing, death is necessarily the immediate consequence. Narcotics act on the *brain* and on the spinal *marrow* by entering the circulation, when they are taken in moderate doses; but, when swallowed in doses sufficient to prove rapidly fatal, the effect is the result of their immediate influence on the nervous energy; and, even when they are taken into the circulation, we must still refer their effects to the direct impression which they make on the nervous system.

The nerves more particularly affected by narcotics and sedatives are the respiratory. This was particularly evident in a series of experiments conducted by Mr. Brodie. He introduced, in one instance, a drop of the volatile oil of bitter almonds into a wound in a rabbit; after five minutes, respiration had ceased; but the heart was still felt beating through the ribs; and, by renewing and keeping up respiration by artificial means for sixteen minutes, natural breathing was re-established, all the functions of the brain revived, and life was in fact restored. A most respectable writer on the action of opium asserts, that that narcotic exerts a powerful sedative influence on the contractile tissues, independent of the nervous centre. He, also, contends that the primary excitement is exerted directly on the brain and spinal marrow, the cerebro-rachidien centre, as he terms it, while the sedative effect is the result of the action of the narcotic on the contractile fibre. An experiment which has been frequently made, that of applying opium to the inner surface of the frog's heart, and observing that the immediate cessation of its contractions is the consequence, might be thought to confirm this opinion; and it is certainly difficult to disprove it, in the present state of physiological science; but, if the fact that the sedative

influence is the effect of the previous excitement be admitted, there is no necessity for referring the phenomena to a separate action on two distinct tissues. I must not, however, be misunderstood: I do not intend to affirm that the sedative effect of a narcotic is an invariable consequence of a primary excitement; for, were this the case, we should find that all substances which rapidly exalt the powers of life would produce narcotic effects, which is not the case. Thus, we well know that when nitrous oxide is breathed, it produces a sudden and high state of excitement; yet, it is not followed by that proportional depression which is caused by a dose of opium, large enough to produce an equal degree of excitement. There is still, therefore, something connected with the operation of narcotics which we cannot explain, and which must remain a mystery until we acquire more correct ideas of the nature of nervous energy than our present limited knowledge admits.

5. *Circumstances which modify the action of Narcotics.*—* *Quantity.* The effect of a moderate dose of any narcotic on man is in the first instance stimulant. The activity of the heart and arteries is augmented, and a slight sense of fulness is felt in the head. Some febrile symptoms, also, present themselves, with an unusual degree of exhilaration; which, however, soon subsides, and drowsiness steals on, until it terminates in perfect sleep. If the dose be sufficient to prove poisonous, giddiness and stupor are felt without any previous apparent excitement; as this increases, the individual becomes motionless and insensible to external impressions; he breathes slowly, and his countenance denote deep and sound repose. By degrees, however, the features change and acquire a ghastly character; the pulse sinks, and becomes at length imperceptible; the muscles relax, and death *rapidly* closes the scene.

The period in which these symptoms display themselves varies greatly, according to the kind of narcotic employed, and, also, according to the state of the patient. If opium be the narcotic, sometimes the symptoms will show themselves in a few minutes; but, in some instances, an hour has been known to elapse after a large dose has been swallowed. If the person be habituated to stimulants, many hours may pass before any stupor exhibit itself. Such a case is detailed in the nineteenth volume of the London Med. and Phys. Journal; and, in it, we are authorized to infer the diminished susceptibility of the nervous system; for collapse had already occurred: the individual who took the preparation of the opium (f℥ii of laudanum) was drunk. All that we can assert, therefore, is, that narcotics exert their influence through the medium of the nerves; that their primary action is stimulant; and that this is followed by a state of collapse or depression, provided nothing occurs to interrupt the usual action of the narcotic. From what has been said,

however, it is evident that the stimulant effect of narcotics may be maintained as long as the system can support a state of excitement; but, as this effect is transitory, the dose requires to be repeated at very short intervals; and it must also, as far as regards quantity, be of a nature not to operate in such a degree as to bring on rapidly the state of collapse. Narcotics, therefore, according to the mode of administering them, and according to the extent of the dose administered, may act either as stimulants or as sedatives; and, therefore, in many morbid conditions of the habit, they may be employed to produce either of these effects. In general, however, they are exhibited with the view of obtaining that state of diminished susceptibility of impression which is required in various diseased states of the habit; to allay inordinate action; to obtund the sensibility of the body to the impression of irritating causes; to sooth pain, and to induce sleep. How do narcotics induce sleep? is a question which is very frequently put, but scarcely ever satisfactorily answered. In replying, it is necessary to keep in view the state of the vital functions during sleep: the pulse and respiration are slower than when the individual is awake; the temperature of the body is diminished; the perspiration is decreased, and nearly all the secretions are suppressed. Now, on whatsoever principle narcotics act, if they lessen the force and frequency of the circulation, and at the same time diminish the respiratory effort, the change of the venous blood into arterial must be necessarily impeded; and this, alone, by weakening the energy of the brain, will produce sleep. I offer this explanation, however, rather as a suggestion than with any hope that it will be adopted.

Narcotics cause sleep; but, nevertheless, they cannot be employed for this purpose in cases in which their previous excitement would prove injurious, unless the dose be large enough to induce at once symptoms of diminished sensibility and action; and experience has informed us that this is the result when the dose of a narcotic is sufficiently large. In a practical point of view, the recollection of this fact is of primary importance; since the state of a patient may be either greatly improved, or materially injured, according to the extent of the dose of the narcotic which it may be thought proper to administer. Thus, if we suppose a case of pleurisy, in which the pulse is hard and quick, and the pain of the side so acute as almost to prevent a half-inspiration, so that the breathing is short and difficult; if, after a free and copious abstraction of blood, two or more grains of opium, in conjunction with calomel and tartar emetic, be administered, we may anticipate the most beneficial results: but, if half a grain only were ordered, not only would no advantage accrue from the remedy, but, its stimulant effect only being obtained, the benefit of the bleeding is likely to be counteracted, and the repetition of the dose would tend to increase the evil.

In this respect the action of narcotics does not differ from that of direct stimulants. A large dose of alcohol, or any ardent spirit, produces a depression without any previous, perceptible increased action; whilst, in small doses, it stimulates the system, augmenting the vigour of the muscular tissue, and exalting the nervous energy. In all cases, therefore, of increased excitement, when pain or restlessness demands the administration of a narcotic, the dose should be sufficiently large to obtain, at once, its anodyne effect, without the primary excitement.

The stimulant influence of narcotics, in small doses, may be taken advantage of in the treatment of fevers of a low or typhoid type. The tincture of opium, for example, given in doses of ten minims, at short intervals, increases the strength of the pulse, frequently rouses the vigour of the system, and supports strength more effectually than either wine or any other stimulant.

* * *Habit.*—Like some other excitants, narcotics lose their influence when their use is long continued; and doses have been ultimately taken which would at first have proved fatal. I knew a lady who gradually had arrived at the power of taking, three times a day, a wine-glassful of the officinal tincture of opium, a quantity equal to fifty grains of opium. Of this effect of habit no satisfactory explanation has yet been given, although M. Charvet has attempted one. Assuming that the state of congestion of the vessels of the brain is admitted as the effect of an overdose of opium, he supposes that the frequent use of opium renders this congestion less powerful; or that the brain, accustomed by degrees to the flow of the blood and the resulting compression, at length is enabled to bear it with impunity, in the same manner as when a serous effusion *gradually* occurs, or a tumor is *slowly* developed within the cranium. It must, however, be noticed that this modification of influence on the living system is not common to all narcotics; and, indeed, it is a curious fact, that there is less similarity of action in the different articles of this class of medicines than in those of any other of the Materia Medica. There is no class of medicinal bodies, as Dr. Paris has justly remarked, which are less disposed to bend and conform to an artificial arrangement: each seems to have its own particular mode of operation, and to affect sensibility in its own peculiar manner: thence the practitioner will often find that, after the failure of one narcotic, the administration of another will induce sleep.

* * * *Climate.*—In noticing the effects of climate in modifying the operation of Narcotics, I may mention that Dr. Harrison has recorded two instances in which the ordinary dose, gr. iv, of the extract of henbane produced a temporary amaurosis, which disappeared, and again recurred, on the alternate suspension and administration of the medicine, when taken in Italy; although the same dose of the same parcel of the medi-

cine, taken in England, had produced no effect of the kind. This is the case with many other narcotics: some attention is therefore required to accommodate the dose of a narcotic to the nature of the climate in which the physician is practising. Regard must also be paid to the season of the year: thus, the dose of a narcotic administered in summer requires to be smaller than one for the relief of the same symptoms, cæteris paribus, administered in winter. Hecquet explains this influence of temperature by saying, that as heat favours the flow of sweat, the opium is carried off by it, and is thus prevented from materially affecting the brain: but Charvet, with more probability, supposes that, as copious sweating diminishes the mass of the circulating fluids, and renders the cerebral compression less powerful, the sweating may be regarded as a favourable crisis, which guarantees the brain from over compression. Both opinions are hypothetical: it is more likely to depend on the greater irritability of the habit in summer than in the winter, and the consequent greater susceptibility of impression.

* * * * *Idiosyncracy*, also, is more apt to influence the effect of narcotics than other classes of medicines. I know many individuals on whom opium operates in the most singular manner: in one lady it never produces its soporific effect until the day following that on which she takes it: and an instance of the same peculiarity in a man is mentioned by Lorry, who also details the case of a woman who was thrown into furious delirium, spasms, and convulsions, even by the external application of opium: in some persons, I have seen it produce restlessness, delirium, and convulsions; in others, a miliary eruption of the skin. We may also refer to idiosyncracy the effect of narcotics on the Malay race. When a Malay wishes to revenge some real or supposed injury, he intoxicates himself with opium, and, armed with his cress or dagger, he runs forward, striking all who happen to be in his way, until he be either disarmed or destroyed. In the same people, also, convulsions are frequent results of large doses of opium—an effect which very rarely occurs in Europeans. This may depend on an increased degree of nervous susceptibility, and a higher exaltation of the nervous energy. It is the same condition of the system that renders infants bad subjects for the administration of narcotics: in them they produce rather irritating than calming effects: thence palpitations of the heart and convulsions not unfrequently follow the administration of opium to infants.

There are few nations, either civilized or rude, who have not recourse to the aid of narcotics, either for the purposes of medicine, or for alleviating the cares and sorrows of life. Were moral rectitude the guide of human conduct, and the happiness of mankind founded upon the consciousness of performing aright all the duties of his station, in the exercise of his social

affections and those of his faculties either of body or mind, narcotics and stimulants would soon lose the value which is attached to them as aids to the pleasures of sense, and cease to be hailed as the resources of the wretched—"cura et molestia liberans, et omnium malorum oblivionem inducens." But as this is not the case, these best gifts of Providence, those designed for the removal of pain, are too often abused, and erroneously regarded as the balm of sorrow and the promoter of pleasure. "The Western Asiatic," says Christen, in his excellent work on Opium, "obtains it from his Agaric; the Southern from Opium and Bang; whilst the more polished Europeans in wine and spirituous liquors 'ducunt sollicitæ jucunda oblivia vitæ.'"

6. *Poisonous effects of Narcotics.*—Before commencing the consideration of particular Narcotics, I deem it necessary to make a few remarks on their general action as poisons. Many diseases present symptoms that closely resemble those produced by Narcotics when operating as poisons. Dr. Christison has given the best and most succinct view of these; and, in offering the result of my own observations, I shall borrow freely from the facts which his industry and research have accumulated.

When an overdose of a Narcotic has been taken, the ordinary symptoms are headache, vertigo, dulness of vision, stupor, or perfect insensibility; occasionally convulsions of a tetanic kind and coma precede the fatal termination. Post-mortem examinations of the body display the brain gorged with blood, and frequently water is found in the ventricles. Some of the symptoms attending apoplexy closely resemble those of the narcotic poisons. They may be distinguished, however, by several circumstances: thus, if there have been warning symptoms, such as giddiness, vertigo, palsy, and noise in the ears; if the patient be above fifty, and the attack begins abruptly during a meal, or very soon after it; if, when after the sopor has commenced the patient cannot be roused to any consciousness, and the pupil is greatly dilated, with a bloated appearance of the face—we may conclude that the case is apoplexy. There is also another symptom which is very conclusive—the absence of any odour of the narcotic in the breath; for although, after death, no trace of opium can be discovered in the stomach, yet, during life, the odour of the narcotic is generally more or less perceptible in the breath. It is only in cases of what is termed simple apoplexy that the post-mortem appearances closely resemble those displayed in the brain in poisoning by Narcotics. In congestive apoplexy, the minute injected state of the brain, with extravasation, forms a ready diagnosis; and in serous apoplexy the distinction is equally obvious.

Between some cases of poisoning by Narcotics and *Epilepsy* the diagnosis is more difficult: for instance, the effects of belladonna, conium, stramonium, and some of the poisonous

Fungi, closely resemble the symptoms of epilepsy: but the epileptic fit is more abrupt in its attack; the state of sopor is different, and the patient cannot be roused from it. The sleep, also, which closes an epileptic fit terminates suddenly; the patient awakes, rises, and seems as if nothing had occurred: but the sopor of narcotics passes off slowly, and leaves the habit weak, tremulous, and exhausted. When death occurs in epilepsy, it never takes place in the first attack—a circumstance in itself sufficient to distinguish death from epilepsy from fatal cases of poisoning by Narcotics. The distinction between Narcotic poisoning and *Meningitis*, as well as inflammation of the substance of the brain, are sufficiently obvious, although some writers have stated the possibility of their being confounded with one another; nor is there any difficulty in forming the diagnosis in *Hypertrophy* of the brain, which is always a chronic disease; and, even in the event of a sudden termination, the appearances which the brain presents are sufficient to guide the medical jurist in his decision. Instead of simple turgescence of vessels, as in Narcotic poisoning, there is unusual emptiness of the blood vessels both of the brain and its membranes, which are also, in general, uncommonly dry.

Narcotics may be arranged under two distinct heads. Those which exert a direct influence on the nervous system, without necessarily entering the circulation, I would designate *Direct Narcotics:* those which enter the circulation before acting on the nervous system I would designate *Indirect Narcotics.* It is not my intention to maintain that the theory of the operation of direct Narcotics is exclusively that of sympathetic action; although I contend that, even when they enter the circulation, their influence is still exerted on the nervous system. Indeed, if we even admit the accuracy of the experiments of the Continental physiologists, and the inference that the Narcotic must be transmitted to the brain through the blood before it acts, these opinions do not stand in the way of the greater probability that, in large doses, direct Narcotics operate by an immediate impression on the sentient extremities of the nerves. The views opened by Messrs. Morgan and Addison, demonstrate that, even in entering the blood vessels, *Narcotics*, and more especially opium, produce on their inner coat an impression which is conveyed along the nerves, a powerful evidence in favour of the doctrines which I maintain.

TABLE OF NARCOTICS.

A. DIRECT NARCOTICS.

* *Organic Products.*

a. MORPHIA—
combined with Meconic Acid, in
Opium;
Extract of Poppies:
———*with Sulphuric Acid*, in
Sulphate of Morphia:
———*with Muriatic Acid*, in
Muriate of Morphia:
———*with Acetic Acid*, in
Acetate of Morphia:
Battley's Sedative Solution?
Black Drop?
———*with Citric Acid*, in
Citrate of Morphia.

b. ATROPIA—in the leaves of
Atropa *Belladonna*. 5. 1. Solaneæ.

c. ACONITIA—in the leaves of
Aconitum *Storckii*. 13. 3. Ranunculaceæ.

d. CONIA—in the leaves of
Conium *maculatum*. 5. 2. Umbelliferæ.

e. DATURIA—in the herbaceous part of
Datura *Stramonium*. 5. 8. Solaneæ.
——— *Ferox*. — — ———

f. DIGITALIA—in the leaves of
Digitalis *purpurea*. 14. 2. Scrophularineæ

g. HYOSCIAMIA—in the leaves of
Hyosciamus *niger*. 5. 1. Solaneæ.

h. LUPULIA—in the strobules of
Humulus *Lupulus*. 22. 5. Urticeæ.

i. CAMPHOR—obtained from
Laurus *Camphora*. 9. 1. Laurineæ.
Dryobalanops *Camph*. 13. 1. Dipterocarpeæ.

k. UNKNOWN PRINCIPLE—contained in
Rhododendron *chrysanthum*. 10. 1. Erinaceæ.
Lactuca *sativa*. 19. 1. Compositæ.
——— *virosa*. — — ———
Arnica *montana*. 19. 2. ———
Rhus *Toxicodendron*. 5. 2. Anacardiaceæ.

* * *Inorganic Products.*

l. ETHER—
* *free*—
Ether sulphuricus.

* * *combined*—
Spiritus Etheris Sulphurici.
——— Etheris Aromatici.
——— Etheris Sulphurici compositus.

B. INDIRECT NARCOTICS.

m. TINCTURES OF NARCOTICS.
n. VERATRIA—contained in
Colchicum *autumnale* 6. 3. Colchicaceæ.

C. MENTAL NARCOTICS.

Music;
Gentle friction.

ORGANIC VEGETABLE PRODUCTS WHICH OPERATE AS NARCOTICS.

a. MORPHIA. Syn. *Morphina. Morphine.*—This is a saline body which exists in the opium, in combination chiefly with *meconic acid*, but occasionally, also, with sulphuric acid, in the form of a bimeconate, and a sulphate.

Morphia, when pure, is in white, small, flat, hexangular, prismatic crystals. It is inodorous and has a bitter taste; is scarcely soluble in cold water or even in boiling water; and is nearly insoluble in ether; but it is very soluble in boiling alcohol, from which it precipitates on cooling. Its alcoholic solution restores the blue colour to litmus feebly reddened with an acid; and forms crystallizable salts with the acids; thus proving its alkaline nature. When nitric acid is poured on Morphia, both the acid and the salt are decomposed, and an orange-red solution is produced, closely resembling that caused by the action of nitric acid on Brucia; from which it is readily distinguished by the addition of proto-muriate of tin changing the red of the solution of Brucia to violet, whilst it does not affect the Morphia. When to a solution of Morphia is added a solution of iodic acid, decomposition takes place, iodine is evolved, and may be easily detected by mucilage of starch.

Morphia, when exposed to heat, melts, if the temperature be not too high, and, on cooling, assumes a crystalline, radiated appearance; but, in a strong heat, the melted mass is charred, white fumes are disengaged, and, if the air be freely admitted, the mass burns like any other vegetable body. Strong sulphuric acid also charrs Morphia.

According to the experiments of the following chemists, Morphia consists of—

	Bussy.	Pelletier and Dumas.	Brandes.	Henry and Plisson.	Liebig.	Equiv.	
Carbon	69.0	72.02	72.00	70.52	72.34	35 =	210
Hydrogen	6.5	7.01	5.50	7.98	6.36	18 =	18
Nitrogen	4.5	5.53	5.50	4.78	4.99	1 =	14
Oxygen	20.	14.84	17.00	16.72	16.31	6 =	48
	100.0	99.40	100.00	100.00	100.00	equiv.	290

It is owing to the decomposition of the natural meconate, and the insolubility of Morphia, that precipitates occur when the alkalies, particularly ammonia; acetate of lead, salts of baryta, and astringent infusions, are added to solutions of opium.

Morphia was discovered and named by a German chemist of the name of Sertüerner, an apothecary at Eimbeck in Hanover, in 1804*; but he did not publish his method of procuring it until 1817. It has since been examined by various other chemists, particularly by Robiquet; and its properties have been fully described. It was Sertüerner who ascertained that it exists in opium†.

Morphia is separated from opium by many methods. I will notice a few only of the most approved. M. Hottet proposed a modification of Sertüerner's method: he takes eight ounces of opium and macerates them in repeated portions of cold distilled water; and evaporates the filtered fluids till they acquire a specific gravity of 1.012: when half cooled, 24½ grains of carbonate of ammonia are to be added to the inspissated solution, and the precipitate allowed to fall; the fluid is then to be decanted and 141 grains of carbonate of ammonia added to it. The whole is now to remain at rest for twelve hours: then to be filtered, and the residue evaporated with f℥xvss of alcohol and 141 grains of animal charcoal, filtering after the alcohol has boiled. As the spirituous solution cools, the morphia crystallizes.

Instead of using ammonia, Robiquet boils the aqueous solution of opium with calcined magnesia. The magnesia decomposes the meconate of morphia, forms a meconate of magnesia, and throws down the morphia with the meconate of magnesia; by washing these, alternately, with very dilute cold

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* Ann. de Physik, vol. xxv, p. 26.

† Ludwig, in his work, Dissertationes de Pharmacia, the second edition of which was published in 1688, mentions a salt which he calls magisterium opii, procured from opium by dissolving it in an acid and precipitating by an alkali: Wedel, in his Opiologia, speaks of the salt of opium, which Hoffman also observed, and describes its crystals as prismatic and acicular, resembling those of the flowers of benzoin: Neumann, Beaumé, and Accard, also mention the salt of opium.

and hot spirit, the colouring matter is taken up; after which, by boiling the residue in strong alcohol and filtering, the morphia crystallizes as the spirit cools; the meconate of magnesia remains insoluble. Another method, proposed by Stratinghs, is to boil ℥viii of powdered opium with ʒvi of sulphuric acid, diluted with f℥xvi of water, for half an hour, and then to strain through a linen cloth; the residue is next to be boiled with f℥xviii of water acidulated with fʒvi of sulphuric acid; and the filtered solutions precipitated with potassa. This precipitate, dried on the filter without heat, is next to be boiled in f℥vi of strong alcohol. Crystals of morphia fall as the alcoholic solution cools. For practical purposes, perhaps, the simplest of all methods is either to rub up ℥viii of opium with f℥xxx of water acidulated with distilled vinegar, and, after filtering and evaporating to f℥x, to precipitate by ammonia: the following method is suggested by me. Digest ℥viii of opium, in powder, with f℥xxx of distilled water for twenty-four hours, then triturate the whole well together, strain the solution, and, having evaporated to f℥xii, precipitate with muriate of baryta. Separate the meconate of Baryta by filtration, and precipitate the morphia from the dissolved muriate by ammonia. In both cases the precipitates are Morphia—coloured, it is true, but sufficiently pure for practical purposes.

The chief objections to the processes for procuring Morphia in beautiful crystals is the waste of alcohol: to obviate this, Messrs. Henry and Plisson have suggested the following method of separating it with a very small quantity of spirit. They rub up opium with twice its weight of water, acidulated with hydrochloric acid, and repeat this operation three times. The filtered fluid is reduced by evaporation to $\frac{2}{3}$, and solution of ammonia added in slight excess. After separating the precipitate, some more hydrochloric acid is added to the mother water, which is then evaporated and decomposed as before. The residue is now to be neutralized with hydrochloric acid, boiled with animal charcoal, and evaporated to form crystals; the mother water, again evaporated to yield more crystals, and so on until all are obtained. The crystals thus procured, after three crystallizations, are to be dissolved in a water acidulated as before, and decomposed by a slight excess of ammonia. The Morphia separates under the form of a light yellow powder, free from narcotina, and furnishes, when boiled in alcohol and animal charcoal, extremely beautiful crystals. A simpler method is, first to form the muriate of Morphia by precipitating the watery solution, by means of the muriate of baryta; and then precipitating the solution by means of magnesia; boiling the precipitate with alcohol, and proceeding as ordered by Robiquet.

The proportion of Morphia procured from a given weight of opium varies according to the process employed to extract

it: but the average quantity is about fifteen per cent. The opium grown in France has yielded to M. Petit from sixteen to eighteen per cent. From one specimen of French opium, M. Caventou obtained twenty-eight per cent. I have made no experiments on English opium with this view; but, as its narcotic powers are superior to those of Turkey opium, we may conclude that the per centage is equal to that of the French opium.

Morphia combines with the sulphuric, muriatic, acetic, and citric acids, and forms soluble salts, all of which are used as therapeutical agents. If the mineral acids be employed to neutralize it, they must be previously diluted with water, as the concentrated acids decompose Morphia.

2. *Sulphate of Morphia.*—For preparing the sulphate, the Morphia is to be dissolved in the diluted sulphuric acid gradually added until the solution is neutralized, which can easily be determined by means of litmus paper. If wholly evaporated in this state, the solution acquires some degree of colour; and, therefore, after evaporating one half, it should be boiled with animal charcoal, and filtered while hot. On cooling, the salt is deposited in groups of acicular crystals. It consists of 1 equiv. of Morphia = 290, + 1 of acid = 40, + 6 of water 54, making the equivalent 384. The solution of the sulphate of Morphia is decomposed by driving off all the water of crystallization, by potassa, soda, and ammonia, and the Morphia precipitated in a nearly insoluble state: it is also precipitated by lime water, the salts of baryta, those of lead, and all substances which have a powerful affinity for sulphuric acid. It is a useful Narcotic: the dose is half a grain.

3. *Muriate of Morphia* may be prepared by the direct combination of its constituents, dissolving the Morphia in dilute muriatic acid; it is thus obtained in the form of tufts of prismatic crystals, devoid of colour. My method of preparing it from opium is, to decompose the concentrated aqueous solution of opium by muriate of baryta: the baryta unites with the meconic acid, and forms a meconate, which is precipitated, whilst the freed muriatic acid combines with the Morphia, and forms a soluble muriate, readily procured in crystals by evaporation. The crystals form in beautiful tussocks; which, being a little coloured, require to be dissolved, boiled with animal charcoal, and recrystallized. If it contain any narcotina, pure potassa renders this solution milky, and, when it is heated, woolly floculi subside. It has a bitter taste, but is nearly tasteless when largely diluted: it is decomposed by the alkalies and their carbonates, by magnesia, lime, nitrate of silver, acetate of lead, phosphate of soda, and infusions of astringent vegetables, which, therefore, cannot be prescribed in conjunction with this salt; but it is not affected by the muriate of baryta, nor by car-

bonate of magnesia, nor bichloride of mercury, which may therefore be prescribed with it. This is the best of the salts of Morphia, affecting the head little, and scarcely displaying any exciting powers. Its dose is half a grain.

4. *Acetate of Morphia.*—This salt is best prepared by adding Morphia to diluted acetic acid, until litmus paper is no longer tinged red. The solution is then to be evaporated to dryness; and the salt reduced to a powder, and kept in well-stopped phials. The manner of effecting this evaporation is apt to vary the strength of the preparation: if it be conducted in vacuo, it may be obtained in crystals. This acetate is probably the active ingredient in the Black Drop, and also that of Battley's Sedative Solution. It possesses one advantage over all the other salts of Morphia, that it may be administered in combination with the salts of lead.

5. *Citrate of Morphia* is formed by the direct combination of its components. It has only been used in solution, in a preparation which has not come into general notice.

*Meconic acid**, the only base with which morphia has yet been found naturally united, is obtained free in a crystallized state, generally of a reddish colour; but, when it is sublimed with care, at a temperature of 248°, it is procured in white octohædral prisms. It is readily procured by decomposing the meconate of baryta with sulphuric acid. It has a slightly acid taste, slowly changing to nauseous bitter: it is inodorous; is soluble in water and in alcohol, reddens the tincture of litmus, and, when united with solutions of persalts of iron, acquires a deep cherry-red colour; a saturated blue with salts of gold; emerald-green with salts of copper, and a white with those of lead. The discovery of this acid affords a solution of the effects of these reagents on the tincture of opium. It possesses no medicinal powers. Like morphia, it was observed to exist in opium before it was actually obtained in a separate state; which was effected by Sertuerner, and its properties ascertained in 1804.

Towards the close of the seventeenth century, it had been noticed that a watery solution of opium effervesced with carbonate of potassa and ammonia; and Tournefort, from its effects on vegetable colours, suspected that it contained a free acid; but this was supposed to be the acetic, or the malic. Meconic acid is separated from the morphia, with which it is combined in the opium, by precipitating an aqueous solution of opium by means of ammonia, or a salt of baryta, or acetate of lead. When ammonia is used, the meconate thus formed is retained in solution: when a salt of baryta or of lead is em-

* Named from Μηκων, the poppy.

ployed, the meconates precipitate. These may be decomposed by the sulphuric acid, and the meconic acid procured in a separate state. Other methods have been also employed: thus Robiquet prefers using magnesia instead of ammonia for precipitating the meconic acid. This meconate of magnesia is dissolved in diluted sulphuric acid: by the addition of muriate of baryta, a sulphate and *meconate* of baryta are precipitated, and muriate of magnesia remains in the solution. By digesting the precipitate in hot very dilute sulphuric acid, and filtering, crystals of meconic acid are procured as the filtered fluid cools. One disadvantage arises from the use of magnesia; it never can be totally freed from the acid.

This acid is supposed to be procured in its purest state by sublimation*: it melts at 289° of Faht. and then sublimes; but the sublimed salt does not possess the same chemical properties as the common acid, and is probably a pyro-acid. In a greater heat, it chars and is destroyed. It is owing to this acid that so many precipitations take place in the aqueous and alcoholic solutions of opium on the addition of the solutions of the metallic salts; meconates of their bases being readily formed and precipitated. The exact quantity of Meconic acid in opium has not been ascertained, as it exists both in the free and in the combined state. Its only apparent use in the opium is to confer solubility on the morphia.

The meconate of morphia, prepared by the hand of Nature in the living system of the white poppy, the Papaver *Somniferum*, is the narcotic principle of opium.

Opium is the inspissated proper juice of the Papaver *Somniferum*†, a native of Persia; but it is also found growing naturally in all the warmer parts of Asia, in Japan, the Mauritius, in Egypt, and in Greece: and it is now naturalized to nearly the whole of Europe. There are two varieties of the plant; one, named the *black* Poppy, with purple-coloured petals, open capsule, and blackish-grey seeds; the other, the *white*, with white petals, a short capsule, and white seeds. The latter is that which is most generally cultivated in this country‡.

All the parts of the poppy, except the seeds, contain a white or milky-looking proper juice, possessing narcotic powers: the seeds contain a bland fixed oil and a farinaceous albumen,

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* M. Choulant, however, has stated that when meconate of baryta is mixed with equal weights of vitreous boracic acid and exposed to heat, it readily separates from the baryta, and sublimes in fine white shining scales.

† Woodville's Med. Bot. 3d edit. p. 376, pl. 138. Richard, Hist. Nat. Med. t. ii, p. 280.

‡ Professor Murray, in his celebrated work, Apparatus Medicaminum, has fallen into the extraordinary mistake of stating that the height of the poppy, in Persia, is forty feet.

highly nutritive. It is from the capsule of the Poppy that Opium is extracted. The method of procuring it and the periods chosen for collecting it are the same, as far as regards the growth of the plant, as those described by Dioscorides and Pliny. It is extracted from the half-ripe capsule seven days after the petals fall, when the capsule begins to harden. The incisions are made with an instrument called *nahrea*, which has five cutting points; and are repeated every second day for a fortnight. They are made both longitudinally and *transversely*, on one side of the capsule, at night, or at least after sun-set. If we reflect that the sap-vessels, in which the proper juice is contained, run vertically, the advantage of the transverse incisions will be obvious. These vessels lie immediately under the cuticle of the capsule, and therefore it is of importance not to make the incisions too deep. The juice exudes during the night, and is scraped off with a small iron scoop on the following morning before the sun shines on the plant; and, in the evening, the capsule is again wounded, on the opposite side, for another gathering of the juice. The effluvium is so great, says M. Freygau, who witnessed the operation in Georgia, that the gatherers, who are generally women and children, are sallow, meagre, and often palsied. There are three collections in Persia: the first, which is called *gobaar*, is strong and of a pale yellow colour; the two others are weaker than the first and almost black. When the collection is completed, the whole is wrought up together with wooden spathulas, in wooden vessels, to the consistence of pitch: it is then formed into cakes, and covered over with leaves. Such is the mode of procuring Opium in Persia, whence it is brought for European consumption, under the name of *Turkey* Opium. According to Olivier, the best Opium of Persia is that which is gathered in the southern provinces. The same method is followed in Bahar, and in Bengal, where the East Indian Opium is collected; and some specimens have been lately sent to Europe, which, in appearance, are equal to Turkey Opium; but no satisfactory analysis has ascertained the quantity of morphia which this improved Bengal Opium contains*. Some Egyptian Opium has also been lately brought to England.

There are four *varieties* of Opium known in commerce: Turkey, East Indian, Egyptian, and European Opium.

a. Turkey Opium is in thick round cakes or masses, flattish on one side and convex on the other, and covered with the capsules of some species of Rumex. The best Turkey Opium is solid, tenacious, of a clear, fresh, reddish-brown colour,

* Opium is probably also a production of the animal kingdom: an hemipterous insect, the Coccinella *bipunctata*, ejects from its joints a yellow fluid which has a strong smell of opium.

breaking, when dry, with a shining fracture, having a heavy, strong, narcotic odour, and a bitter, hot taste; its specific gravity is 1.336; it is very inflammable, and burns with a clear flame. When dry, it is easily pulverized, yielding a yellowish-brown powder, which is again aggregated if wrought in the hand. Dr. Christen and others state that it is nearly wholly soluble in water; but I have never met with any which did not leave some insoluble portion, generally one part in twelve; and this has a plastic character, somewhat resembling the gluten of wheat, is of a deep-brown colour, and perfectly tasteless. Turkey Opium is bad when it is of a deep-brown colour, almost black, of a soft, plastic, unctuous or grumous consistence, or if it be friable and rough; if the odour be empyreumatic, the taste sweetish and neither very bitter nor acrid; if it tinge the saliva brown or black when charred; and if it afford a deep-yellow solution with water, and can scarcely be filtered.

Turkey Opium is frequently adulterated. When the adulteration is the aqueous extract of the capsule or that of the whole plant, the Opium is blacker than usual, and it is harder; the taste is weaker than genuine Turkey Opium; it is also empyreumatic; is not inflammable; is totally soluble in water, and affords a turbid alcoholic solution. When the adulterating substance is the extract of the horned poppy, Chelidonium *Majus*, the solution has a yellowish colour and a peculiar odour. Adulterated with the extract of liquorice, it is brittle and tastes sweet; and, with gum Arabic or Tragacanth, besides being fragile and shewing a smooth, shining fracture, it forms, when rubbed with one part of alcohol and two of water, a gelatinous mixture. Opium, adulterated with any fatty matter, gives a turbid tincture: when with sand and gravel, which is very common, in order to increase the weight, it feels gritty between the teeth, and these matters, being insoluble, are left when it is dissolved in water*.

b. East Indian Opium is distinguished from Turkey Opium by its smell being more empyreumatic, and its taste less bitter and less acrid, than the Turkey Opium: it is also smoother, blacker, more friable; and, when triturated with water, the whole is taken up, eight parts in twelve being perfectly *dissolved*, and four *suspended* in the fluid. The finest specimens of Bengal Opium lately sent home, are in square cakes, weighing about four ounces each, and packed in neat wooden boxes with plates of mica between each piece†.

c. Egyptian Opium closely resembles Turkey Opium, except its form, which is that of a small cylinder. That formerly brought from Thebes, in Upper Egypt, was in great esteem:

* Stones and leaden balls are occasionally found in the masses or lumps of Turkey opium.

† Opium is cultivated in India chiefly for the China market. The produce is so great, that the sales in 1808 produced £594,978.

thence the name *Thebaicum* is still used to imply select Opium. Of late years, the Pacha of Egypt has encouraged the growth of Opium.

d. European Opium is chiefly the production of France and of England. In France, however, it is rather an extract from the stem, capsules, and leaves of the unripe poppy than Opium; the object of those who have cultivated it having been rather to procure an extract containing a large proportion of morphia than real Opium*: such is the *opium indigène* of M. Ricart Duprat of Toulouse†, of M. Loiseleur-Deslongchamps, and of M. Barbier. M. Peyre, however, the Apothecary General of the Military Hospital of Toulon, has prepared some Opium after the Oriental manner, in Provence; and M. Lainé has also prepared it in the same manner at Malley, near Lausanne‡. In England, the efforts to make good Opium have been very successful, the experiments having been conducted on the plan adopted in Persia. The most successful English cultivator has been Mr. John Young§. His opium has been analyzed, and found to equal the average Turkey Opium: it contains even more meconate of morphia; but it has little perceptible odour of Opium, owing, it is said, to the volatile oil being dissipated by the heat employed in its preparation‖. Besides Opium, an excellent extract, Extractum Papaveris, containing one grain of morphia in seven grains, is made from the capsule of the Poppy, for the purposes of medicine.

Opium, whether the production of Asia or of Europe, besides the meconate of morphia, contains four other active principles, *Narcotina*, discovered by M. Derosne, in 1802¶, and regarded as the soporific principle, until I proved the error of this opinion by a comparative analysis of East India and Turkey Opium; *Codeine; Narceine; Meconine; a volatile oil*, on which the peculiar odour of good Opium depends; *Gum*, including *bassorine; Extractive*, partly simple, partly more than usually oxygenated; *Resin*, closely combined with colouring matter; *Caoutchouc*, or rather a substance resembling birdlime; *Sulphates of lime and of potassa; Lignine* or woody fibre.

In taking a view of each of these components, I shall confine my remarks to those which exert some activity on the animal system; admitting, at the same time, that all of them may more or less influence the virtues of the medicine.

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* Mem. sur les Succedan de l'Opium, t. ii, p. 81. † Journ. de Pharm. 1823.

‡ Journ de Pharm. vol. viii. § Transactions of the Society of Arts, vol. xxxvii.

‖ Mr. Morewood states that the quantity of Opium imported into England, in fifteen years prior to 1801, was 286,271 pounds, of which 247,619, or 16,508 pounds annually, were consumed in the country[1]; and it is probable that both the supply and the consumption are now considerably greater.

¶ Journ. de Pharm. 1827.

[1] Essay on Inebriating Liquors, p. 106.

1. *Narcotina* has been supposed, by M. Majendie, to be the stimulant principle of opium; but this opinion is too hypothetical to be hastily adopted. In the crystallized form, it is in white, inodorous, insipid, rhomboidal prisms, scarcely soluble in water, but very soluble in alcohol, in ether, and in volatile oil. It does not display the alkaline properties of morphia; nitric acid forms with it a yellow solution. It is easily distinguished from morphia by putting some of it on blotting paper and submitting it to a moderate heat: it melts and is imbibed by the paper as if it were resin. *Narcotina* is most readily procured by digesting what remains in ether, after the separation of the muriate of morphia, evaporated to the consistence of an extract. The etherial solution is to be distilled to save the ether, and the residue treated with weak alcohol, which only takes up the narcotina. If it be really the stimulant principle of Opium, the proposal of Robiquet to separate it by agitating the extract with ether, as soon as it acquires the consistence of syrup, by which the narcotina is taken up, would greatly improve this preparation. From the experiment of Orfila, it appears that the solution of narcotina in oil proves fatal to dogs in small doses; but its effects on man are yet undetermined: it is not employed as a medicine*.

2. Narceine is a late discovery of M. Pelletier. It is obtained from the fluid which remains after the morphia and narcotina have been separated, by adding to it muriate of baryta; so as to neutralize all the meconic acid. The excess of baryta is to be separated by carbonate of ammonia; after which, the fluid is to be concentrated, and left at rest in a cool place, until a deposit is formed, which is to be pressed through linen; and, after being treated with alcohol, and passed through pure charcoal, left to crystallize. These crystals are Narceine: they are white, silky, quadrilateral prisms, soluble in alcohol and water, insoluble in ether; and have a bitter, styptic, metallic taste. They melt at 199° Faht. and at a higher temperature are decomposed: when combined with concentrated acids, they strike a beautiful blue colour and form neutral salts. Pelletier regards the following as the components of Narceine: Carbon 54.73, + Nitrogen 4.33, + Hydrogen 6.52, + Oxygen 34.42, or 16 prop. of Carbon = 96, 1 prop. Nitrogen = 14, 24 prop. Hydrogen = 24, 8 prop. Oxygen = 64, making the equivalent = 198. The action of narceine on the animal œconomy is unknown.

3. *Meconine* is also a new principle obtained from the ether

* Orfila and Dr. Bally assert, that, when narcotina is dissolved in very dilute hydrochloric acid, it may be given with impunity in doses of sixty grains: but half that quantity dissolved in weak acetic acid produces the same effects as in cases of poisoning by the salts of Morphia. One curious circumstance follows the administration of the acetate to dogs: in doses of gr. xxiv, it produces convulsions, with a strong impulse to move backwards.

used to procure the narcotina. It is soluble in hot water, and crystallizes on cooling.

4. The *volatile oil*, although affording a powerful odour to Opium, yet is in such small quantity that it can scarcely be procured in a separate form. Water in which Opium is distilled takes it up and has a turbid milky aspect; and on this account it was at one time thought to be narcotic; but it has been given to animals in large quantities without producing the smallest narcotic effect. When administered to man, it is productive of that slight cephalalgia which many other odours excite.

5. The *Resin*. Pelletier has ascertained that this differs from common resin in not being soluble in ether. Its components are—

Carbon	59.825	or	16	prop.	= 96
Nitrogen	4.816		1		= 14
Hydrogen	6.813		23		= 24
Oxygen	28.546		6		= 48
	100.000			Equivalent	182

Before the discovery of the Meconate of morphia, it was regarded as a very important part of Opium; and to its presence the stimulant quality of the medicine was referred. It exists in not more than nine per cent.

All the salts of morphia are decomposed and precipitated by that combination of tannin with gallic acid which is contained in astringent vegetable infusions and decoctions; consequently none of them admit of combination in prescriptions with these preparations.

The manner in which Opium acts upon the animal œconomy involves an enquiry of great importance and deep interest, in a practical point of view: in proceeding with it, let us first enquire into the operation of Opium in the form in which Nature has supplied it, the simple, inspissated, proper juice of the Papaver *Somniferum*, *Opium;* and afterwards into the peculiar effects of one of the active principles which chemistry has extracted from it, *Morphia*, and its compounds.

The writings of Hippocrates inform us that the most striking effect of the operation of Opium on the animal œconomy, its soporific power, was known to the Greeks; as we find in them the phrase υπνοτικονμηκωνιον, the sleepy juice of the poppy. But, nevertheless, the introduction of Opium as an article of the Materia Medica is due to Serapion, the chief of the empirics who flourished 248 years before the Christian era.

Like all other narcotics, the primary effect of Opium is excitant. The experiments of Charvet have demonstrated that its influence is not confined to the human species, but is felt by all animals, mammalia, birds, reptiles, amphibiæ, fishes, zoophytes*: it also influences the vegetable œconomy. In the

* De l'Action comparée de l'Opium.

human race, its effects are produced whether it be introduced into the stomach or the rectum, or inserted into a vein, or applied to parts endowed with great sensibility, or to wounds and ulcers, or to the surface of the body even when the cuticle is entire. The exciting effect first produced is followed by sopor and coma; and, if the dose be large, death ensues. In the mammalia, with the exception of man, no cerebral congestion is induced: in them it operates on the general nervous centre as an irritant, and death takes place amidst convulsions.

When taken into the stomach of a healthy man, Opium undergoes partial digestion; the inert parts of its components pass into the composition of the chyme, in the same manner as ordinary food: but, during this process, some degree of fulness is felt at the epigastrium, and the sensation of hunger, if it existed, disappears. In the mean time, the active principles of the Opium, being probably in a great degree separated from its other components, begin to display their influence on the nervous system by a sensation of heat in the face, and distension in the temples: these feelings are followed by hilarity of mind, and a vivacity of imagination similar in many respects to that resulting from wine or alcohol. Opium, however, produces effects both *similar* and *different* from those of wine and alcohol. Like wine, it rouses the animal appetites and inspires courage; so that the Turks and other oriental people employ it as an aphrodisiac, and before going into battle. During the existence of its exciting influence, whilst mental energy and the corporeal powers are considerably augmented, the cuticular secretion is increased, but most of the other secretions are diminished: the urine is scanty and high-coloured; and the pale clay-coloured aspect of the alvine discharges indicates a greatly diminished excretion of bile, although, from the turgid state of the biliary ducts, in those poisoned by Opium, it is evident that this secretion is augmented. Such are the primary effects of Opium: if the dose be not repeated, the person gradually becomes dull and languid, and sleep ensues. This sleep, however, although sometimes like "the golden slumbers of repose," yet, is also as frequently disturbed and restless, and accompanied with the most terrific visions.

If the dose be large enough to prove fatal, the effects are giddiness and those of a sudden depression of all the powers of life; the sleep, that quickly follows, appears at first deep and perfect; the breathing is slow and soft; the eyes are shut and the pupils contracted; by degrees, however, it assumes the semblance of that caused by sanguineous compression of the brain; and is sometimes accompanied by stertorous breathing, as in apoplexy. There are also the same cold sweats, and, occasionally, convulsions: but the state of the pulse differs greatly from that attending apoplexy, being small and less frequent, instead

of full and quick. As the influence of the poison increases, the countenance becomes ghastly, the pulse feeble and imperceptible, the muscles relaxed, and death follows. Sometimes no apoplectic symptoms supervene; but the fatal event steals on imperceptibly, and the person expires as if in a deep and sound sleep: on the other hand, Nature has been known to bear up against the force of the poison, and the patient to awake, after a long sleep, without any consciousness of what has passed.

If the dose of Opium be moderate, and not repeated, its effects upon the habit gradually subside, and the health remains unimpaired: but if it be large, or have been frequently or daily repeated, it wears out the powers of both mind and body; the person becomes melancholy, dull, stupid, and unfit for the business of life: emaciation of the body follows; and his countenance, "like the title-page of a tragic volume, foretells the issue;" he sinks into a state of premature old age; palsy generally seizes him; or, as a drivelling idiot, he dies in a state of the most miserable fatuity.

Let us now enquire upon what principles these effects can be explained. In this enquiry, five important queries present themselves:—1. Is the primary action of Opium always stimulant? 2. On what does its sedative effects depend? 3. Upon what part of the animal organization does it directly operate? 4. Is its general influence on the habit sympathetic, or is it absorbed into the blood? 5. How is its action modified by *age*, *sex*, *temperament*, *habit*, *climate*, and other circumstances?

1. With regard to the first object of enquiry, although I have stated that the primary effect of Opium is stimulant, yet, upon this point there have existed great differences of opinion. It is not my intention to discuss opinions; let us look to facts. When taken into the stomach, Opium causes a sensation of heat, quickens the pulse, excites the system, and exhilarates the mind. If it be dissolved in water, and applied to the eye, the urethra, or any tender, irritable surface, it causes pain; and the same thing occurs if it be applied to a denuded muscle. These effects are analogous to those of other excitants; they take place both in the healthy, and also in the diseased state of the habit. Numerous instances might be adduced of the primary excitement which it produces. In the Teriakihana, the opium shops of Constantinople, it is mixed with rich syrups and confections, and taken in divided doses of from ten to one hundred grains. The sombre Turks sit in a row, and the person who administers the drug as he passes along, throws, into the open mouth of each, a small lozenge* containing the apportioned dose. This is repeated at certain intervals, until the symptoms of in-

* These lozenges are stamped with the words *Mash Allah*, "the gift of good."

toxication present themselves, when the delirious Turk is thrust out of the house, and reels along the streets in the same manner as the habitual drunkard, after his usual dose of gin or brandy. De Tott, in his Memoirs of the Turks, mentions that his language master used to get drunk and poetical with Opium or brandy indiscriminately. The stimulant effect of Opium in supporting the Turkish couriers in the long and rapid journeys which they perform, without tasting food, is another unanswerable proof of its exciting properties. In disease, also, its exciting power is equally conspicuous: thence, in the low and sinking stages of typhus, it is often advantageously administered in small, frequently repeated doses, instead of wine: and thence the injury it causes in all cases of existing excitement: as, for instance, in affections of the chest, attended with an accelerated circulation, and hard, dry cough. But, in stating this fact, it is also necessary to add, that much depends upon the extent of the dose, and the mode of administering the medicine; something on the state of the stomach at the time; and even on the hour of the day at which the dose is given.

a. If the dose be small, that is, from a quarter of a grain to a grain, in about three-fourths of an hour after it is taken, besides the symptoms already described, the mouth and pharynx become dry, and the pulse is accelerated, although, at other times, it is contracted, unequal, and intermitting. If the dose be from two to four grains, in addition to these symptoms, in an augmented degree, there is the sensation as if an ample meal had been taken; the pulse is frequently full and strong; the patient restless and fidgity: and, with the mental excitation, there is often more or less of a tinge of melancholy, according to the natural bias of mind of the individual. After a short time, the sensation of oppression at the stomach increases to nausea, and sometimes to vomiting, which is followed by an overpowering inclination for repose; exterior impressions are feebly perceived, the ideas become vague and indistinct, and sleep supervenes. During this sleep, which is far from being natural, the pulse continues slow and full, the respiration is deep, and a profuse sweat bedews the whole of the body. On the following day, all the feelings that usually succeed a debauch of wine are experienced, with a costive state of the bowels. If the dose be still greater—if, for instance, from ten to thirty grains be taken, and not quickly rejected by vomiting—the primary excitement is scarcely perceptible; the pulse is small, rarely accelerated, almost always slow and irregular. In a short time, however, extreme agitation, tremors, anxiety, and spasmodic twitching of the tendons, come on; these are soon followed by a flushed face; the eyes are brilliant and prominent; the pupils dilated and immoveable; the look fixed and stupid; and throbbing of the carotids indicates a high cerebral action. In this state the patient may be roused

from the comatose sleep which stupifies him ; but, as soon as he answers any question, he again drops asleep ; the respiration becomes laborious and stertorous; occasionally, it appears interrupted altogether for a few moments ; cold sweats, with a feeble intermittent pulse, follow ; and the sedative influence of the medicine is felt in every part of the system. At this period the fate of the patient is inevitable : the whole muscular system becomes paralyzed ; liquids fall into the œsophagus as if into an inert tube ; the destroyed irritability permits great distension of the intestinal canal, the respiratory muscles cease to act ; and death supervenes in the midst of combined symptoms of asphyxia and apoplexy. In these results of the administration of Opium, the stimulant and sedative influence of the medicine is obvious when the dose is moderate ; but when it is very large, the sedative effects supervene without any previous excitement: so much is the operation modified by the extent of the dose.

b. With respect to the mode of administering the medicine, if the effects of a moderate dose of Opium are dissipated, the administration of a smaller dose, after a short interval, produces more intense effects than the first dose ; although the reverse of this follows the continued use of the drug.

c. If the stomach be empty when the Opium is taken, the excitement is great, the pulse remains small and hard, and symptoms of cerebral congestion rarely appear: on the contrary, if the same dose be taken after a meal, congestive phenomena appear soon and are very obvious.

d. With respect to the influence of the period of the day in which the Opium is administered: if a grain be taken into a fasting stomach in the morning, the excitement is great, and sleep seldom follows ; if the same dose be taken in the evening, scarcely any excitement supervenes ; or as soon as the first symptoms of it appear, the desire of sleep is overpowering. The sleep, however, is not sound, but is disturbed by dreams ; a bitterness is felt in the mouth, and costiveness is as great on the following day as if a large dose had been taken. It has been asserted that Opium exhibited per anum has a much greater influence upon the habit than when it is taken into the stomach ; and this is said to be owing to the gastric juices altering the nature of the medicine and weakening its narcotic power ; whilst in the rectum, if the gut be not loaded with fæces, the Opium is rapidly carried into the habit. But this reasoning is more specious than true : the gastric action tends merely to disengage more quickly the morphia, which is indigestible, whilst no such evolution takes place in the rectum. Thence, notwithstanding the results of some recent cases, much larger doses of Opium can be administered by the rectum than by the mouth. Such are the facts which establish the primary stimulant influence of the internal administration of Opium.

2. With regard to the nature of its sedative influence.

Some experiments of Dr. Crumpe throw considerable light upon this subject. He separated the skin from the muscles in the posterior extremities of several frogs. On some he poured a strong watery solution of Opium, on some ammonia, on others alcohol, and through some he passed electrical sparks. The limb was deprived of sensibility and motion: this followed the use of the Opium in ten minutes, the ammonia in one minute, the alcohol in three minutes, and the electricity in an imperceptible space of time. On cutting out the heart of a frog and subjecting it to the same substances, he found its irritability destroyed by the Opium in ten minutes, by the ammonia in two, by the alcohol in three, and by the electricity in a moment. In another experiment, having brought the heart into view, and injected the Opium, the ammonia, and the alcohol into the intestines, he found that the action of the heart was at first excited by all of them; but its velocity soon gradually diminished, and its action at length altogether ceased. From these experiments, it is evident that opium excites the powers of the system, and that its excitement is followed by collapse, and that the degree of this is in proportion to the violence of the primary excitement. But opium produces, also, peculiar effects dependant on its sedative influence. Thus, the sleep which follows the excitement of this narcotic is not that which follows the intoxication of alcohol; and no ordinary excitant possesses the anodyne power of Opium. It is, therefore, fair to conclude, that whilst Opium is a substance possessing some properties in common with other excitants, it, at the same time, possesses some peculiarities, as far as concerns its sedative influence over the living system, distinguishing it from all other substances.

3. With respect to the part of the organization on which the influence of Opium is chiefly exerted, there is much diversity of opinion. The early opinions are scarcely deserving of attention. Among those worthy of notice, is that of Fontana, who, from some minute experiments, drew the following conclusions: That the blood is the medium through which Opium acts, and that it operates independently of the nervous system. He drew this inference from observing, that when it is applied to the brain or the nerves, it produces no effect; that when the heart of a frog is cut out and placed in a solution of Opium, it is not deprived of its irritability sooner than when it is placed in common clean water: but that when the Opium is injected into the veins, it instantly causes death. Some physiologists, again, have supposed that it acts solely on the muscular fibre, destroying its contractile power.

With regard to the part on which it more immediately operates, it has been maintained by Dr. White and Dr. Alexander, that it acts on the part to which it is applied. In support of this

opinion, they contend—1. That the action of Opium, in large quantity, is so sudden that there is no time for absorption. 2. That when a small quantity is injected upon the heart, the irritability is destroyed and death generally ensues. That when, instead of throwing the injection into the heart, it is introduced only beneath the skin, the irritability of the heart remains for a considerable time after death — a proof that no Opium had reached it; that when the transmission, by the absorbents, is cut of, the effects of the Opium are still felt over the whole system; and, lastly, that it causes a paralytic condition of the muscles of the parts. The contrary opinion was maintained by the elder Monro and others, who maintained that, after the nervous connection between the trunk of the body and the extremities is destroyed, still Opium applied to the limbs produces the same effect as when the connection is entire; that when a large portion is exhibited, all the excretions, the milk, the urine, the perspiration, smell of Opium; and that the application of it to the surface relieves pain in a distant part, in the same manner as if it had been taken into the stomach.

4. Although my own opinion is, that Opium acts upon the habit independent of the medium of the circulation, yet I do not deny that it is also taken into the circulation under peculiar circumstances: but such an absorption is not essential to the production of its effects. The most formidable arguments in favour of absorption are the following:—1. The time which supervenes between taking a dose of Opium and the manifestation of its influence on the system—being sufficient for the absorption of the narcotic. We must nevertheless recollect that the intimate combination of the meconate of morphia with the other constituents of the drug requires some time before it can be so far separated that it can act with energy on the sentient extremities of the nerves of the stomach; for we find that the time which supervenes is in the direct ratio of the state of solution of the Opium in which the meconate exists. 2. The augmentation of the symptoms during ten or twelve hours, although the Opium is as much in contact with the nerves in the first quarter of an hour as at the end of the twelve hours. This certainly appears to indicate absorption. 3. The greater influence of morphia combined so as to form a soluble salt, than in its pure insoluble state. But it is obvious that whatever operates on the nervous system is likely to prove more energetic in the ratio of its solubility; so that this supplies no argument in favour of absorption. 4. The rapid effects which follow the injection of the Opium in solution into the veins. I shall have occasion very soon to explain the reason why this effect should take place, even if the hypothesis of direct action on the nervous system be admitted as applicable to Opium. It must, however, be admitted that there are facts which tend to shake the

opinion that the whole effect of Opium results from its direct influence on the nervous system. One of the strongest is, that an infant is affected through the milk of the mother who has taken a large dose of Opium. Still, there are phenomena attending the administration of this narcotic that cannot be explained, in any way, by the doctrine of absorption, nor without admitting the influence of a direct impression on the nervous energy. It is by this supposition only that we can explain the fact that many of its most striking effects take place long before any appearance of cerebral congestion is evident: namely, the dilatation of the pupils, the immediate relief which its application affords to a decayed tooth when under the influence of toothache, and the immediate effect of opiate frictions in allaying local pains. It is only by admitting the influence of Opium on the sentient extremities of the nerves, that we can readily explain the relief obtained in these instances.

5. Passing from conjectural points, on which a difference of opinion must always exist, let us now enquire what circumstances influence the action of Opium on the system.

a. Age has a powerful influence in modifying the action of Opium. The younger the individual, the more energetic is its action on the system: thence the caution requisite in its administration to infants, in whom it proves more irritating than sedative; and instances are recorded in which convulsions and even epilepsy have followed its administration to children. In general, even in the form of syrup of poppies, a preparation too frequently given to children by lazy nurses, marasmus follows its frequent use, with a slow nervous fever depending upon the continued cerebral excitement produced by the medicine gradually undermining the powers of the constitution.

b. Sex influences the operation of Opium less than any other circumstances; but still we find that spasms, dyspnœa, and obstinate vomitings, more frequently follow its use in *women* than in *men*.

c. With regard to *temperament*—Opium influences those of a *sanguine* more than those of a melancholic temperament; those who labour under plethora, likely to favour cerebral congestion, than those in a spare condition of habit—facts which ought never to be lost sight of in practice. In those individuals also who are easily affected by wine, and in whom inebriety is quickly produced, a small dose of Opium causes powerful cerebral excitement: thence the truth of the maxim of Tralles—"Illi vero omnes qui vinum non bene ferunt vix bene ferent opium."

d. Custom powerfully modifies the action of Opium on the animal system. The enormous doses of it taken with impunity by individuals who have long accustomed themselves to the use of it are scarcely credible. Dr. Russell, in his History of

Aleppo, describes a Turk, of the name of Mustapha Shatar, an Opium-eater in Smyrna, who took daily three drachms of the drug; and even then found a necessity for increasing the dose; and M. Dhere, a French writer, mentions a French officer who took a drachm of it daily. Such individuals sometimes appear in good health; but, in general, they are pale and emaciated; and, in the case of the French officer, an alvine evacuation was procured once only in eight days, sometimes once only in fifteen days. The discontinuance of this habit is extremely difficult. In proof of this, Chardin mentions a particularly striking instance of some Turks, Persians, and Arabs, who, having been taken prisoners, were at sea so long that their stock of Opium was exhausted; and, as it could not be replaced, they all became ill, and were sinking one after another into a state of disease; until it occurred to the captain to give them wine, which answered the same purpose. The habitual use of Opium produces a peculiarly depressing influence on the habit: as soon as the excitement it causes is over, a dejection of spirits, almost bordering on despair, follows, and the person becomes more and more wretched, until a judicious renewal of the stimulus is resorted to, when this appears to revive him. Marsden, in his History of Sumatra, relates that the Malay soldiers, who use Opium to excess, commonly appear emaciated; but, on the other hand, the Limen and Batang Assi gold traders, who are an active, laborious class of men, indulge as freely in the use of the drug as the Malay soldiers, and, nevertheless, are the most healthy and vigorous people in Sumatra.

This effect of the abuse of Opium must not be confounded with the use of it in extraordinary doses in the treatment of disease. When pain is present, it is truly wonderful to what extent it may be administered. I have given, during the passage of gall-stones and of renal calculi, upwards of eight hundred drops of the tincture of Opium in less than twelve hours, without any apparent effect, except that of relieving the excruciating torture under which the patient was suffering. Dr. Chapman mentions an instance in which a wine-glassful of laudanum was taken several times in twenty-four hours, for many months in succession, to alleviate pain in passing biliary calculi; and yet, after the patient was finally recovered, no bad effects whatsoever were perceptible on any of the functions. He also states that Dr. Monges and La Roche of Philadelphia had given it, in a case of cancer of the uterus, to the extent of three pints of laudanum, besides a considerable portion of solid Opium, in twenty-four hours, without any effect except that of relieving pain. It is not easy to account for this effect of Opium on the diseased habit: but the fact is indisputable; and

it instructs us how far we may proceed in administering it in cases of disease.

e. Combination also greatly modifies the operation of Opium on the animal system. In combination with antimonials, its diaphoretic powers are greatly increased; and it is rendered less likely to impede the other secretions. With acids, half the usual dose will produce the effect of a full dose—a result depending on the production of a soluble salt. When it is intended to procure sleep, Opium should not be combined with *aromatics*, which increase the stimulant effect of the medicine and lessen its sedative influence. It is by combining it with confections of aromatics and syrups that the Turks are enabled to use it as wine. In Persia, in particular, it is taken in this form in society, in the same manner as we take tea and coffee; and, instead of becoming drowsy, those who partake of it become more lively, and often more quarrelsome, than if they had indulged freely in the use of wine.

f. Climate modifies considerably the effects of this narcotic. In those who pass from colder to warmer climates, smaller doses of it are requisite to produce the desired effect than were necessary in the climates from which they have passed. It is supposed also that Opium acts with more energy on some races of men than on others. The Javanese slaves commit the most furious and desperate acts under its influence, not only immolating the objects of their hatred, but also every one who comes in their way. This is what is termed running a *muck*—a practice very common among the Malays. It is not easy to explain this powerful influence of Opium on the Asiatic and Malay races: on the European or Caucassian race it certainly never occurs. M. Charvet has attempted to account for it on the supposition that there is a greater comparative quantity of nervous matter in these races than in the European; consequently, that they are more susceptible of impressions on that part of the system: but this opinion is purely hypothetical.

Let us now examine the mode in which the salts of morphia operate.

1. *Acetate of Morphia*, administered in doses of $\frac{1}{4}$ of a grain to a grain, at the end of a short time, produces a sensation of fulness in the head, some obscurity of sight, tingling of the ears, cephalalgia, vertigo, a tendency to sighing, and sleep. The pupils are sometimes dilated, sometimes contracted, and occasionally not at all affected: the pulse is not much accelerated: but, after some time, if the large doses have been taken, there is a sensation of itching all over the skin; frequently nausea; and a difficulty to pass the urine. These symptoms gradually subside, leaving behind them a slight degree of nausea, and costiveness. When a still larger dose has been administered,

the cerebral excitement is alarming. In the Hôpital de la Pitié, in Paris, where experiments were made with this salt of morphia by M. Bailly, it was observed that sometimes, after a full dose of Acetate of Morphia, if the patient were in the horizontal position, he was attacked with shocks, as if he had been electrified; the head, in these convulsions, was thrown backwards; and the person, if asleep, was suddenly awoke in a state of surprise. The muscles lost much of their contractile power when the use of the medicine, in such doses, was continued for some time; and the sight became greatly impaired. In doses of two grains, it neither augments the function of the skin, nor increases its temperature. In one instance, however, where six grains of the acetate had been swallowed by a medical man, the sweats were so excessive that the patient was forced to change his linen nineteen times in one night. There is no diminution of the secretion of the kidneys; but the bladder is paralysed. M. Megraux seems to think that this depends on the action of the morphia on the brain. It is more probable that the organ itself is primarily affected; as, in one case, this paralysis was removed by the application of two blisters. In still larger doses, acetate of morphia acts as a virulent poison. Besides the symptoms already detailed, when Opium operates as a poison, the upper part of the body is often bathed in a viscid sweat, whilst the lower extremities are cold; there are violent nervous shakings; and the body acquires a blue or livid complexion: the face is pinched and exhibits a cadaverous aspect; and death follows without convulsions.

2. The *Citrate*, the *Muriate*, and the *Sulphate* of *Morphia*, act in a similar manner to the acetate, except that they do not cause violent sweating. The Muriate affects the encephalon less than any of the others: its stimulant influence is obscure; its sedative very obvious.

In comparing these effects of the salts of morphia with those of Opium, we are struck with some differences. From *acetate* of morphia, we find neither heat of skin, no elevation of the pulse, nor any sign of the violent propulsion of the blood into the capillaries, as is the case when the entire Opium is taken into the stomach. It is of some importance to notice the distinction between the action of *Opium* and that of *acetate* of morphia; in order that we may be able to accommodate the dose of the remedy to the condition of the habit. Thus, in the cold stage of intermittents, and all cases in which there is a deficiency of blood in the capillaries, Opium in its entire state is to be preferred to the salts of morphia. The stimulant property of the Opium excites the capillaries, which relieves the internal congestions and brings on sweating as a critical excretion.

3. *Narcotina*, the second active constituent of Opium, not

being soluble in the animal juices, possesses little or no activity on the living body. In some instances, however, the vehicle in which Opium is administered may bestow some activity on Narcotina; as, for instance, when it is dissolved in *olive oil*, or in weak *acetic acid*. In both of these vehicles it displays narcotic powers on the systems of some quadrupeds, in particular on that of the dog: but no experiments have yet correctly decided its influence on the human animal, or whether it acts as a stimulant or a sedative. The experiments of Majendie have led him to conclude that Opium contains both a stimulant and a sedative principle; and he affirms that *Narcotina* is the former: but the effects of the salts of morphia on the habit of man completely refutes this position; as both stimulant and sedative effects result from a dose of any of them. When Narcotina is dissolved in water acidulated with weak hydrochloric acid, it may be given to the extent of a drachm for a dose with impunity: M. Bailly, who made numerous experiments with it in the Hôpital de la Pitié, in Paris, remarked that it occasionally produced slight nausea, some disturbance of vision, vertigo, and tremors, with an excitement of the venereal appetite in both sexes: but these were rare. On one occasion he gave 120 grains to a young man, who experienced only slight vertigo, which soon disappeared. The same effects of Narcotina upon man have been observed by other physicians. In some individuals, however, of a peculiar idiosyncracy, agitation and headache follow its administration.

4. *Meconic acid*, as I have already stated, is perfectly inert: and when Opium has been deprived of all its morphia and Narcotina, the residue may be given in any quantity without risk. We know nothing of the effects of Coneine, Narceine, and Meconine on the animal system.

Opium is exhibited both in the *solid* and in the *fluid* form. Let us examine the properties of its preparations, in both these states.

In prescribing crude Opium, there is one disadvantage—we never can rely on the strength of the specimen, this depending on the season of the year, the soil, the climate, and even the mode of collecting the drug: an Extract is consequently ordered by the London and Dublin Colleges of Physicians. The Dublin is the best, for reasons which I have already stated. In prescribing these, it is necessary to recollect that their solutions are precipitated by lime water, muriate of baryta, nitrate of silver, bichloride of mercury, sulphate of copper, acetate of lead, and all astringent vegetable infusions. An acidulated extract is ordered in the Brunswick Pharmacopœia, which affords a useful mode of exhibiting the Citrate of Morphia in a solid form. It is prepared by dissolving four ounces of Opium in forty-eight ounces of water acidulated with six ounces o

lemon-juice, filtering, and evaporating to the consistence of an extract in a water bath. The citric acid in this case decomposes the meconate of morphia, and affords a more soluble salt, in combination with the gummy and extractive matter of the Opium. Another useful extract is prepared, according to a process suggested by Deyeaux: Opium is fermented with yeast in water, at a temperature favourable to fermentation; and, after the fluid has become clear, it is diluted with more water, and boiled until all odour is dissipated: the solution is then filtered, and evaporated to the consistence of an extract. In this case the morphia exists in the form of an acetate; and, as several of the other constituents are sacrificed to the formation of the acetic acid by the fermentation, little more remains than the resin, a small portion of the extractive, and acetate of morphia. One grain of this extract is equivalent to gr. iss of the common aqueous extract.

In noticing the extracts, I may mention a preparation called *Chandoo**, which the Chinese make for the purpose of smoking; it is a very carefully prepared gummy extract. The Chinese smoke it in the same manner we do tobacco; and receive from its use a feeling of calm enjoyment, which is peculiarly grateful to them. I am much disposed to think it might prove useful in affections of the lungs; for instance, spasmodic asthma, and, perhaps, even phthisis. The quantity of Opium contained in the

Pulvis Cornu usti c. opio, the dose of which is gr. x to ʒss, is $\frac{1}{10}$
—— Cretæ comp. cum opio, ——— gr. v to gr. 40.....$\frac{1}{40}$
—— Kino comp. ——— gr. v to ϑi.....$\frac{1}{20}$
—— Ipecac. comp. ——— gr. v to ϑi.....$\frac{1}{10}$

In the three first of these preparations the power of the Opium is greatly weakened by the chemical action of the chalk and

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* *Method of preparing Chandoo by the Chinese.*—A ball of Patna opium weighing 3lb. 10½oz. is divided into two equal parts; the whole of the soft part of the opium is carefully removed from the two sections, and put into a separate vessel; the inner layers are peeled off in shreds, and put into a vessel resembling our skillet, with about a quart of cold water, and boiled. While boiling, the mixture is stirred with a large wooden spatula, without intermission, until the whole is of the consistence of a soft pulp, or smooth paste. The soft opium is then added to the mass, and kept over a brisk fire until it acquire the consistence of extract of opium of the shops. The whole is then removed, equally divided, and spread very evenly on the exterior surface of two shallow vessels, which are inverted over a *very gentle fire*, for the purpose of evaporating it to dryness (this part of the process would probably be better conducted in an oven); when sufficiently dry, the whole mass is reduced to powder. The powdered ingredient is then mixed with repeated portions of filtered boiling water, until the fluid pass through colourless; after which, it is filtered and again evaporated with the aid of a brisk coal fire, in a deep copper vessel, to the consistence of good treacle. This very pure extract has a smooth uniform appearance, like a transparent jelly, with a sweetish and rather agreeable odour, resembling soft extract of gentian. The whole process being gone through, it should yield 1lb. ʒxii and ʒvi, or very nearly 50 per cent. of the original weight of the opium employed.

the kino upon the meconate of morphia. Vogler has proposed a substitute for the compound powder of ipecacuanha, which might be advantageously introduced into the British Pharmacopœias, for some particular cases, as a convenient mode of giving a combination of opium and ipecacuanha in children's diseases. He orders one grain of ipecacuanha, two grains of opium, one drachm of nitre, ʒi of bitartrate of potassa, fʒiv of water of accacia flowers, and fʒiv of the syrup of the red poppy. I have been in the habit of prescribing a mixture containing fʒii of ipecacuanha wine, and of tincture of opium, ʒiss of nitrate of potassa, fʒiv of lemon juice, fʒiv of camphor mixture, instead of Dover's powder. Two table-spoonfuls of this mixture are equal to gr. x of Dover's powder, and more certain as a diaphoretic.

The *Pilula Saponis cum opio* contains $\frac{1}{3}$ of opium; its dose is gr. iii to gr. x.

Confectio Opii contains $\frac{1}{36}$ of opium; its dose is gr. x to ʒss.

Nothing can be more injudicious than the usual method of prescribing this confection with astringent mixtures; the Morphia being thrown down, so that the mixture remains merely a compound of aromatics and astringent matter; without possessing any Narcotic influence.

The *Tinctura Opii* contains $\frac{1}{19}$ of opium; its dose is m. xix to fʒi.

——— *Opii Ammoniata*, E.

No preparation displays less chemical knowledge than this: instead of the full proportion of Morphia in the quantity of Opium employed, the preparation contains only as much as weak spirit can take up; the Opium being decomposed by the ammonia, and the Morphia thrown down.

The *Tinctura Camphoræ composita* contains gr. ii of opium in fʒi of the tincture; its dose is fʒi to fʒiv.

Vinum Opii —— fʒi contains gr. iii of opium; but the opium in the present preparation is undoubtedly in a less active state than in the old preparation, when wine was the vehicle, owing to the tartaric and acetic acids contained in the wine. The cinnamon and cloves are bad additions, as they partially decompose the salts of Morphia: but were the oil of cinnamon and of cloves used instead of the cinnamon and the cloves, the preparation would be valuable in cases in which a combination of stimulants and Narcotics is indicated. The usual dose is from m. x to fʒi.

Laudanum Liquidum Sydenhami, is the original of the Vinum Opii, with double the quantity of opium; and with wine

as the menstruum. One fluid drachm contains ten grains of Opium: under all circumstances, it is preferable to the Vinum Opii of the present Pharmacopœia.

Linimentum Opii et Saponis, E. D. although it possesses no advantage over the extemporaneous addition of Tincture of Opium to the soap liniment, yet is a useful external application.

Extractum Papaveris is merely an inferior preparation of the gummy extract.

Syrupus Papaveris albi is a bad preparation, owing to the uncertainty of its strength. It acquires more active properties when it ferments.

Black Drop.—This preparation was made upwards of one hundred years since, by Edward Runstall, of Bishop Aukland, in the county of Durham. It has been stated by the late Dr. Armstrong and others, that it is prepared by slicing half a pound of Opium, and boiling it, in conjunction with an ounce and a half of nutmegs, and half an ounce of saffron, in four pounds of verjuice; then adding a quarter of a pound of sugar and two table-spoonfuls of yeast. This compound is allowed to ferment for six weeks in a warm place; after which it is decanted, filtered, and bottled, adding a little sugar to each bottle. Were this recipe correct, it is evident that the black drop would contain an acidulous acetate of Morphia: it is affected by most of the usual tests of the tinctures, and other preparations of Opium; and indicates the presence of Morphia by nitric acid and permuriate of iron. The nature of this preparation is, however, yet unknown: it is much more powerful as a narcotic than the officinal tincture, three drops of which are only equal to one drop of the Black Drop.

Battley's Sedative Solution.—I am inclined to believe that this preparation contains acetate of Morphia, the resin and extractive being separated; but this opinion is merely conjectural, as the preparation is kept secret. It does not exceed the officinal tincture in strength, and its only advantage is, that it is less stimulant.

Acetum Opii. Dub. prepared by macerating four ounces of Opium, rubbed to a pulp, in a pint of distilled vinegar, for seven days, with frequent agitation and filtering. This is a simple solution of acetate of Morphia, in a most convenient form for medicinal purposes. It contains the gummy matter of the opium, and the colouring principle, which are no disadvantage. The dose is from twelve to fifteen drops; being stronger than the officinal tincture in the proportion of three to two.

Of all the salts of Morphia, in my opinion the muriate is the best and the most certain in its effects. They may all be extemporaneously formed. Thus, by adding the common tincture of opium to mixtures containing either the sulphuric, muriatic, acetic, or citric acid, we obtain sulphate, muriate, acetate

or bitartrate, of Morphia. In employing the ready-formed salts, it is necessary, in adding other saline constituents, to be aware of those which are likely to decompose the salts employed. If, for instance, we wish to combine a salt of baryta with a salt of Morphia, we must adopt the muriate, and avoid employing the sulphate; if with the nitrate of silver, the muriate must not be selected. We may prescribe the citrate with lime-water.

Many of these salts have been employed in their impure state, in the form of tincture: thus, as I have already remarked, Battley's Sedative Solution may be regarded as an impure acetate in solution. A citrated tincture has also been employed from a suggestion of Mr. Potter, of Bristol; and I have lately suggested a tincture of the muriate which has the advantage of containing no narcotina, and may be combined with many of the alkaline and some of the metallic salts, without suffering decomposition.

Such are the various preparations of Opium. Some of them are most unchemical, and defeat the object for which they are intended: these ought to be rejected from the Pharmacopœias.

With respect to the remedial employment of Opium, we must always keep in view both its stimulant and sedative influence; and in those diseases in which the first would be injurious, whilst, at the same time, the second is required, we ought not to administer it until the previous excitement has been subdued by bleeding and other means.

In intermittent fevers the best period for administering Opium is that recommended by Sydenham—an hour before the expected paroxysm: it weakens the force of the attack, and sometimes prevents it altogether. This result is probably due to its stimulant quality: the dose should therefore be large—from forty to sixty minims. As it increases the cutaneous function, Lind recommended it to be given during the hot stage also; and experience has shewn that no disadvantage attends this practice, except in plethoric inflammatory habits. It not only renders the hot stage shorter and milder, but also tends to lengthen the intermission; and greatly promotes the influence of bark, and of sulphate of quinia. I have found it a most useful addition to calomel in obstinate tertians, which resist the bark, sulphate of quinia, and arsenic. A pill, containing one grain of calomel and one of opium, taken at bed time, has generally, in a very few days, enabled the bark to operate efficaciously, although previously it had exerted no power. Dr. J. Clark, in his treatise on the Diseases of Long Voyages, states that he found Opium most useful in the remittent and intermittent fever of Bengal, "by taking off inquietude, inducing sleep, and by bringing on perspiration:" and not less so in continued fever, by raising the spirits and procuring sleep; and, when given early, preventing delirium. After full evacuations, he

generally prescribed a large dose of Opium, as a preparation for the immediate use of cinchona; and he continued the exhibition of calomel and Opium at bed time, as an addition to the bark.

With regard to the rationale of the use of Opium in intermittents, its efficacy in preventing the accession of the paroxysm is certainly due to its stimulant property; which, by exciting the action of the heart and arterial system, prevents the congestion which takes place on the accession of the paroxysm. But, as the repetition of it tends to produce debility, it should not be given in successive paroxysms, if it fail to check the accession.

The propriety of administering Opium in continued fevers, is questioned by many. In the acute form of fever, its use is at least doubtful. If required to allay pain, or to procure sleep, it should be given in full doses, combined with calomel and tartar emetic; in which combination its stimulant properties are scarcely perceptible: but, even under these circumstances, it should not be prescribed if the temperature of the surface exceed much the natural state: but, when there is a tendency to perspiration, it accelerates this, and undoubtedly proves beneficial. Dr. Currie used it with advantage after the cold affusion; and it is still more useful if it be combined with calomel and James's powder. In the more advanced stages of continued fever—both in typhus and in the synochus of Cullen—it was formerly administered as a general stimulant, in doses of from six to ten minims of the tincture, or in half these doses of the black drop, in combination with camphor and other cordials; but this practice is now discontinued. When the fever is a synochus, it is difficult to fix exactly the time for the administration of Opium. In the first stage of this disease, the pulse is full and hard, the heat is greater than natural, the thirst is considerable, and, if there be any derangement of the mental powers, its use is generally accompanied with extreme headache. In this condition of the system, Opium is not admissible; but in the second stage of the disease, when debility supervenes, it may be given with advantage, and is strongly recommended by Lind, Blane, and others. Opium, however, as a general stimulant, is inferior to wine when it can be procured. In typhus, the symptoms that chiefly indicate the use of Opium are watchfulness, diarrhœa, and subsultus tendinum; but if delirium be present, it must be recollected that this may be the consequence of high cerebral excitement, or the sthenic diathesis, as it is termed, as well as of debility: and it is necessary to distinguish between these states in administering Opium. It should not be given if the delirium be accompanied by flushing of the face, impatience of light, or throbbing of the temples. If, however, there be much low-muttering delirium, which has been pre-

ceded by an unusual inattention, Opium, in combination with ammonia, is to be preferred to wine; it is also to be preferred in all cases attended with diarrhœa. In some habits, however, it increases instead of diminishing delirium; in which case it ought to be either discontinued or externally applied, by means of friction, dissolved in oil. In whatever manner it is exhibited, the Opium in this species of delirium should be given in small doses, frequently repeated; and, at the same time, cool air should be freely admitted to the chamber of the patient. When watchfulness is the symptom for which the use of Opium is indicated in continued fever, we must bear in memory that this may arise from very opposite causes; and the advantage or disadvantage attending the exhibition of Opium depends very much upon the existence of one or the other. When the watchfulness is attended with increased heat of the surface, restlessness, or tossing about in the bed, and determination of blood to the head, Opium proves highly injurious; instead of it, bleeding and other antiphlogistic means, with the local application of cold to the head, are more likely to prove beneficial. But if the opposite state of the case exist, then Opium is the best remedy. For promoting sleep, under these circumstances, it should be given in full doses, and at the usual time of rest, that is, in the evening. As my friend, Dr. Tweedie, in his Clinical Illustrations, remarks, it should be a full dose of *solid* opium combined with calomel; and during its administration the scalp should be enveloped in a cloth wet with a cold lotion. Diarrhœa is another symptom for which the use of Opium is indicated in continued fever, especially when it arises from irritability and relaxation of the whole system.

The most advantageous form for administering Opium in continued fevers is that of spirituous or vinous solution; the quantity can be better determined and regulated; thence the tincture of the Pharmacopœia, the sedative solution of Battley, and the vinum opii, or the laudanum of Sydenham, are the best forms of preparation. Many circumstances may occur to vary the extent of the dose; but it may be regarded as a general rule, that it should be double that which the patient requires to produce sleep in a state of health. Opium is usually combined in this case with etherial preparations: as, for instance, the compound spirit of sulphuric ether of the Pharmacopœia; but it is, perhaps, more likely to prove beneficial when given alone. In cases in which the individuals are apt to suffer from Opium in its entire state, either in the solid or the fluid form, the salts of Morphia, especially the *muriate* or the *acetate*, may be advantageously employed.

Inflammation is both active and passive. In the former, Opium has been employed; but it requires to be administered with great caution, as it is apt to accelerate the progress of gan-

grene. In gangrene, however, of one description, namely, dry gangrene, which affects the toes and gradually extends to the feet and limbs, Opium may be regarded as the sheet anchor; but this affection probably depends on inflammation of the passive kind. Passive inflammation, also, may arise from both general and local debility; and in many instances of the phlegmasiæ we find it to be of the latter kind; for example, in malignant, ulcerated sore throat, and in chronic rheumatism. But even when the inflammation is of an active kind, as in pleurisy, if venæsection be freely employed, I know of no method of subduing it so rapidly and certainly as the administration of a large dose of Opium, from one grain to three grains, according to circumstances, given in combination with calomel and tartar emetic, immediately after the bleeding. When the inflammation is in the substance of the lungs, as soon as the difficulty of breathing has been subdued by bleedings, which should be repeated until this is effected; when the urgent symptoms are reduced to cough and want of sleep, then, as Cullen has judiciously pointed out, Opium may be exhibited with the greatest advantage. The dose in this case should be sufficient to ensure its sedative effect; and it is always requisite to combine it with tartar emetic or other antimonials, so as to determine to the surface; and the further addition of calomel, as recommended by Dr. Hamilton, of Lynn Regis, never fails to aid its sudorific influence. All acute affections of the chest are relieved by the use of Opium, thus preceded by the antiphlogistic treatment; indeed, this is essential in all, with the exception of catarrh, which may be at any time checked, in the commencement, by an opiate combined with an antimonial taken at bed time. It seldom, in this case, produces diaphoresis; and, generally, arrests the disease more certainly when this does not occur: but if the disease be fully formed, this mode of giving Opium is more likely to prove hurtful than beneficial.

In peripneumonia notha—that state of pulmonary inflammation in which there is a greater flow of humors into the lungs than in common inflammation of these organs—both in that variety which constitutes the catarrhus suffocativus of old age, and, also, in that which is characterized by congestion of blood in the pulmonary vessels, Opium is useful. In the first, it may be combined with ammoniacum and squill; and, in the second, after a judicious abstraction of blood, the liberal administration of Opium, in combination with stimulants, and in conjunction with cupping and blisters, has been productive of the greatest benefit. This statement may be regarded as at variance with the opinion that Opium prevents or restrains expectoration. Now, let us examine briefly the ground on which the opinion of the efficacy of Opium in Pneumonic affections is built. What is the state of the chest? We find that the pain is aggravated

by a full dilation of the chest, consequently that a perfect inspiration is not procured, and that even this, imperfect as it is, must be procured in the erect posture. Now, in this condition of the chest, the necessary change cannot be effected on the blood; and, in the irritable state of the bronchial membrane, the secretion is hurried, and the sputa consequently thin and irritating. Under these circumstances, if Opium taken into the stomach, through its influence on the pneumogastric nerves, and its power of allaying pain, admit of a fuller and more perfect inspiration, it is easy to comprehend that the thicker and more slowly secreted mucus will be coughed up more easily than thinner and irritating matters. Thence, Opium, instead of restraining, will promote expectoration.

In ophthalmia, Opium may be internally administered under the same restrictions as in Pneumonia; and it is admissible in full doses when the pain and irritation are excessive, even before venæsection has been resorted to, if it be combined with calomel and tartar emetic. Externally, no application is more useful, after the inflammatory action has been subdued by topical bleeding; and from the commencement, when the inflammation is of a passive kind. The Vinum Opii of the London Pharmacopœia is used for this purpose; but it is less serviceable than the old Solutio Opii Vinosa, as it contains only half the quantity of Opium. The liquid laudanum of Sydenham is admirably adapted for this purpose. It is dropped into the eye, and acts partly by inducing a new and more healthy action in the organ, and partly by its sedative influence in allaying irritation.

In rheumatic affections, even in the acute form of the disease, Opium is now more employed than formerly, and the use of the lancet thereby superseded. My opinion on this subject is founded upon the following grounds:—1. That the inflammation of rheumatism differs from that which is termed phlegmonous, both in its progress, which is often intermittent, and its termination, which is never in suppuration, nor in gangrene. 2. That the pain often continues after the pulse is brought considerably below the natural standard. 3. That experience has not demonstrated the advantages of loss of blood, but rather that it can only be used as a prefatory measure to the use of Opium: 4. That, when health has been restored, after much blood-letting, the affected part has remained very irritable, and the general habit in an atonic condition. On the contrary, Opium, when employed so as to determine to the surface, aiding its action by external warmth and copious dilution, has cured the disease, and left the habit in a better state than it enjoyed previous to the attack. It is always proper to purge first, then to repeat the dose of Opium every third or fourth hour. With regard to chronic rheumatism, there can be only one opinion as to the utility of Opium: it is an excellent addition to the bark,

or, what is preferable in this variety of rheumatism, the infusion of the Menyanthes *trifoliata*.

In gout, physicians have now dropped the idea that pain, which indicates the use of Opium, should not be put down by it, and are convinced that patience and flannel alone are not likely to cure the disease. Even in that variety which is termed retrocedent gout, Opium is truly our sheet anchor; and it must be given in full doses. In some cases, ten grains have been administered twice a day with advantage; and, when the necessity of administering it is over, no disadvantage is felt by the constitution, if the dose be not too hastily let down. In the acute form of the disease, Opium has been judiciously combined with colchicum. This is not the moment to enter into an examination of the value of colchicum and of the nature of its action; but I may here venture to say, that more is due to its purgative quality and to its power of emptying the liver by powerfully stimulating the gall-ducts and the duodenum, than to its supposed narcotic or specific influence in gout. It has been supposed that Opium diminishes or stops the biliary secretions, because frequently the evacuations, after a dose of Opium, become pale; but this only proves a diminished excretion. In the lower animals poisoned by Opium the gall-bladder and ducts have been found turgid with bile, although very little had found its way into the duodenum. Now, if colchicum stimulates the gall-ducts, the combination of this remedy with Opium sets aside the objections made to Opium in gout, as far as the biliary secretion is concerned.

It is almost unnecessary to state that, in cases of biliary calculi and in nephritic inflammation arising from the irritation of calculi in the pelvis of the kidney, or in their passage from the kidney to the bladder, the best results are obtained from the use of Opium. In these cases, particularly when a calculus is passing along the ureters, the stomach is so irritable that it quickly rejects every thing received into it: in this case, and also on account of the advantages of proximity in the local influence of medicines, more benefit is derived from administering the Opium per anum, in the form of enema, dissolved in oil, than from giving it by the mouth. In suppressions of urine, also, from calculi irritating the bladder, Opium, in combination with calomel, is the remedy chiefly to be relied upon. The same combination, namely, from one and a half to two grains of Calomel, and the same quantity of Opium, taken every second or third hour, has been found powerfully anodyne in the chordee and painful micturition of gonorrhœa virulenta. I have generally ordered from six to eight grains of the calomel and two of Opium once in eight hours. This practice originated with the success obtained by Dr. Hamilton, of King's Lynn, Norfolk, from the employment of Opium, in this combination, in suppres-

sion of urine from strictures. Large doses of Opium do not produce the same results; nor does calomel alone: it is from the combined influence of both that the salutary effect proceeds.

Smallpox is the disease, among the exanthemata, in which Opium is most decidedly indicated; and it is to the sagacity of Sydenham, relying on observation and rejecting theory, that we owe this fact. In distinct smallpox, he gave laudanum on the fourth day: but, except when convulsions occur, or when the eruptive fever is accompanied with much restlessness, Opium is not required. In confluent smallpox, Sydenham deemed Opium a specific: he generally commenced with eighteen minims of his liquid laudanum, which are equal to twenty-five of the officinal tincture; and this was repeated every night until the tenth day, when he gave an ounce and a half of his Syrupus Meconii, a preparation resembling syrup of poppies, in the evening, and an ounce in the morning, daily, for some days. He usually moderated the dose, if it checked the diarrhœa, which he considered necessary to carry off the dregs of the complaint. Although, in confluent smallpox, the eruptive fever is of an inflammatory type, yet the epileptic fits that precede the eruption are always alarming: and, as by exhausting the strength they increase the debility, therefore Opium must be exhibited and in large doses, frequently repeated. The form of enema is perhaps the best in this case; and it operates, if not as powerfully, at least as rapidly, when thrown into the rectum as when taken into the stomach. But, in the majority of cases, Opium is not required during the continuance of the eruption, although it may be occasionally necessary to promote the maturation of the pustules. After the eruption, however, it is indicated, under the same circumstances as in typhus fever, in conjunction with bark and wine. It is also useful in the secondary fever when diarrhœa supervenes, which, notwithstanding the authority of Sydenham to the contrary, ought most certainly to be restrained.

In measles, the inflammatory state of the system contraindicates the employment of Opium in the commencement of the disease; but when the excitement is subdued and the cough remains, then Opium, combined with calomel and ipecacuanha, may be employed: and also when the diarrhœa, which in moderation is useful at the close of the disease, proceeds too far. In the rubeola maligna, or black measles, which is attended with typhoid symptoms, Opium may be advantageously given through the whole course of the disease, in the same manner as in typhus.

With regard to the propriety of giving Opium in hæmorrhages, there is much difference of opinion. When febrile symptoms exist, these should be reduced before administering it; and this is perhaps best accomplished by allowing the flow of blood to proceed to a certain extent. When the hæmorrhage

is connected with great debility and laxity of the solids, and a watery state of the blood, then Opium, in conjunction with tonics and astringents, may be immediately administered, with the view of obviating that irritability which is the result of this condition of the habit. When no symptoms of a phlogistic or inflammatory state of the system is discoverable, and the bleeding seems to be kept up by the irritation of coughing, and is accompanied with watchfulness, then Opium proves beneficial. And even, in the opposite state, if much irritation exist, it ought to be administered: but in this case it should be combined with sedatives, as acetate of lead, hydrocyanic acid, and cold both topically and generally applied.

In phthisis pulmonalis, Opium is used to allay the cough, and to moderate diarrhœa. If the accession of the hectic paroxysm be well marked, it should be given at that period; as it lessens the irritation which excites the febrile symptoms; and, even after hectic is formed, when administered immediately before the accession of the evening paroxysm, it always diminishes its intensity. In such a case the dose should be large. When given at bed time, it is very apt to increase the perspirations: and on this account it is preferable to administer it either early in the evening, or in the morning, when the cough is usually most severe. The advantages ascribed to some medicines given in conjunction with it are probably altogether due to the Opium. Thus Dr. Bourne prescribes Uva Ursi combined with small doses of Opium, with great advantage, in some cases of confirmed consumption, and refers the benefit wholly to the Uva Ursi. In this disease, the soluble salts of Morphia, especially the muriate and acetate, are preferable to the entire Opium, on account of their not exciting perspiration in the small doses necessary for allaying the cough and irritation. I have found a mixture, consisting of one fourth of a grain of muriate of Morphia, one fluid drachm of distilled vinegar, and ten fluid drachms of the decoction of Lichen Islandicus, very serviceable in this state of the disease, in allaying cough and promoting sleep, without increasing the disposition to sweating.

In no disease has Opium been more frequently employed than in dysentery. In the commencement of the disease, the fæces are to be evacuated freely with calomel combined with Opium, which seems to benefit by retaining the mercurial in the duodenum. If pains and tenesmus continue after this, the Opium should be conjoined to ipecacuanha, in order to determine to the surface: and, at the same time, castor oil may be exhibited; as it is of importance not to allow the bowels to become confined. When the tenesmus is very urgent, the Opium may be conjoined with demulcents, in the form of enema; and towards the close of the disease, when it degene-

rates, if I may be permitted the expression, into diarrhœa, Opium is then the proper remedy.

In bilious colic, and other affections of the bowels, where there is much pain and spasm, arising from highly irritating matters on the coats of the intestines, and when purgatives do not act freely, Opium is advantageously united with the purgatives and with calomel. With the calomel in large doses, it allays the irritation both of the stomach and of the intestines, removes spasm, and consequently aids the operation of purgatives. Indeed, in all spasmodic affections, Opium is justly regarded as the means to be relied on for procuring relief. In idiopathic tetanus it is a remedy of great power. In the traumatic form of the disease it is of less value, even in the largest doses; and I am not aware of any case on record cured by its means. In my own practice, I have seen two cases of traumatic tetanus terminate successfully; but in neither could I attribute much to the Opium employed, which was not carried to any great extent. In idiopathic tetanus, the Opium should be administered in the first period of the disease; as the progress is very rapid, and the power of deglutition quickly lost. The extent of dose which can be borne in this disease is enormous. Persons unaccustomed to the use of the medicine have taken many ounces of the tincture before the least effect was produced. A case of tetanus is recorded in which fifteen hundred grains of Opium were given in seventeen days; and one in which f℥xx of laudanum were swallowed in twenty-four hours: both cases were recovered. Indeed, we may persevere in the use of Opium, in this disease, to any extent, as long as it shows no particular action on the habit. The quantity, in the first instance, must be determined by the nature of the case: thus, if the spasms do not threaten much severity, ten minims may be given every hour; if no relief be afforded in three or four hours, the dose should be doubled, and so on until the benefit looked for be obtained; after which, it should be diminished in the same manner. In general, too little attention is paid to the progressive increase of the dose and its frequent repetition. No intermission, day nor night, should be permitted as long as the spasms continue. In some violent cases, one hundred drops have been ultimately administered every hour, with the best effect. When deglutition is impeded, it may be exhibited per anum, and solutions of the medicine in oil applied to the surface. I have seen these oily solutions prove useful in trismus, when rubbed upon the jaw.

Opium has been extolled as a remedy in *Epilepsy*; but, in my own practice, I have never seen any advantage derived from its use, except when the disease has been kept up by habit, after the irritation which had caused the convulsions had ceased

to exist. In this case, a large dose of Opium may prove beneficial, by breaking the habit. It should be administered when the paroxysm is expected, if this can be ascertained. In no disease is it of more importance to guard against the constipating property of Opium.

In *Chorea*, Opium was long regarded as the principal remedy; and Sydenham bears testimony to its influence. If the disease be complicated with hysteria, Opium, freely administered, may produce a remission of the urgent symptoms; and in this case, as it is of great importance to evacuate the primæ viæ, the mode of administering Opium least likely to interfere with this part of the treatment is to give it per anum. But the plan of treating chorea by powerful evacuants, and afterwards by carbonate of iron or nitrate of silver, is so successful as to leave us little to regret, that Opium often proves useless. In another painful affection, *Tic douloureux*, we naturally look to Opium for relief. It has too frequently disappointed our hopes; but, in one or two cases, I have seen it successful when combined with calomel and continued until ptyalism was induced. The dose should not exceed two grains, and be repeated every third or fourth hour. Opium, indeed, might be regarded as generally useful in all spasmodic diseases; but there are exceptions: thus, in Hay asthma, it augments fever, headache, and the wheezing and suffocating tightness across the chest which characterizes that disease.

The watchfulness of maniacal patients has rendered practitioners anxious to obtain the means of alleviating this distressing symptom; and Opium, under proper management, has deservedly obtained a high reputation as an anti-maniacal remedy. The only objection to its employment in mania is its tendency to cause costiveness; but this is obviated by combining it with aloëtics, which operate without interfering with the soporific power of the Opium. Its indiscriminate employment, however, has frequently been productive of much evil: for it may injure under the degree of arterial excitement which so generally prevails in insanity. Nevertheless, Opium has cut short the disease, when given in full and timely doses; and, by procuring sleep and severing the catenation of morbid sensations, it has thus opened, as it were, "the way for the gradual return of rational perceptions." This effect of Opium has been particularly observable in cases of the disease arising from continued and excessive drunkenness. In these cases there is generally a pallid countenance, a cold clamminess of the surface, and other symptoms of great debility, accompanying the want of sleep: and, under such circumstances, the question of *life* or *death* is often involved, in administering or withholding the use of Opium; and in no situation are the judgment and discrimination of the practitioner more required.

When the disease becomes as it were quiescent, and all febrile heat and flushing of the countenance subdued, Opium, properly administered, either separate or combined, is of infinite utility: it leads the way for the more permanent use of digitalis, particularly where the corporeal functions, exhausted by the waste of vital power, become inert and feeble. There are objections, as I have stated, to Opium, owing to its constipating property; but this is not the case with some of the combinations of its active principles with other acids than the meconic; as, for instance, the acetic. Acetate of Morphia has been found most useful in the low form of insanity, and in melancholia. The dose is seldom necessary to be carried beyond half a grain.

Dr. Michaelis, the physician of the Hessian troops in the service of Great Britain, during the American war in 1779, regarded Opium as nearly a specific in all syphilitic affections; and it is curious to compare the results of his practice with those of the opposers of the employment of mercurials in the present day. He found that, when Opium was used alone, the proportion of cases cured, to those not cured, was as 3 to 1; and that Opium succeeded when mercury failed. He generally began with giving three grains in divided doses in the course of the day, and gradually increased the quantity to ʒss. A remarkable effect of these large doses was an increased secretion of urine; and, in a few cases, the production of salivation. What is remarkable, it often produced severe diarrhœa: the pulse at first was raised, but soon became full and soft: it occasionally produced tremors and great depression; in which case it was abandoned. In the perusal of these details by Dr. Michaelis (London Med. Communications), one thing is evident,—namely, that much benefit may be obtained by taking advantage of the sedative power of Opium, and giving it in combination with mercury, or alone after a course of mercurial medicines, in order to allay that highly irritable state of the habit which often remains after the virus of the disease has been subdued. We may thus sum up its good effects:—1. It enables the system to bear a large quantity of mercury with impunity: 2. it allays the morbid irritability which often remains after the cure of syphilis; and consequently it favours the return of health: 3. it cannot eradicate the virus without the aid of mercury.

In diabetes mellitus, Opium has a powerful influence in restraining the quantity and moderating the saccharine quality of the urine. The dose requires to be carried to the extent of not less than six or eight grains in twenty-four hours, before the salutary effect is produced; but, too often, the evil returns as soon as the dose is diminished. In one case, recorded by Dr. Warren (Medical Transactions, vol. iv), five grains of

solid Opium were taken four times a day, without any effect, except the relief of the symptoms. This has been referred to its increasing the action of the skin, and lessening that of the kidneys: but other diaphoretics do not cure diabetes; this explanation, therefore, is not satisfactory.

Besides these complaints, Opium is resorted to in numerous morbid states of the system, to lessen irritation, relieve pain, and induce sleep; and, whether applied externally or taken into the stomach, its place, for these purposes, cannot be supplied by other substances. This frequent use of it renders it liable to be overdosed. The effects are not immediately perceived; and the period that elapses before the symptoms of poisoning display themselves, varies according to circumstances. If the Opium be in the solid state, half an hour, in general, passes over before it displays its influence: if in the fluid form, the time is shorter; unless the patient be in a state of intoxication at the moment of taking the dose. In general, the pulse is much slower than natural, but full and strong as in apoplexy: when convulsions occur, it is quick, or rather hurried, "and does not become slow until the coma becomes pure," as Dr. Christison properly remarks. The respiration is always slow, rarely stertorous: the pupils are most usually much contracted and insensible. In general, the countenance is pale and ghastly; but, in a few cases, the expression has been furious. It is impossible to say what quantity of Opium will poison an adult: ʒss of the tincture, equivalent to gr. xvi of solid Opium, has proved fatal. Even the external application of Opium, in poultices to sores, has caused death. To afford relief in such cases, we must keep two objects in view: 1, to evacuate from the stomach the Opium, when it has been swallowed, as rapidly as possible: 2, to obviate the narcotic influence which necesarily follows, especially if the poison be not removed. The first of these intentions can, now, easily be accomplished by means of the stomach pump: but, should this not be in readiness, vomiting must be excited by those emetics which exert a direct influence on the stomach; for instance, the sulphates of zinc and of copper, given in doses of from gr. x to gr. xxx. In promoting their action, we are directed to dilute freely: but, in my opinion, this is a dangerous practice, tending to spread the narcotic poison over a greater surface, and to promote absorption and carry it into the system. The power of deglutition is often destroyed; therefore we must pass the emetic substance into the stomach through a tube, or introduce it into the veins. But the excitement of vomiting by injecting emetic substances into the veins should never be resorted to until all other modes fail; and in performing the operation, the utmost care is requisite not to introduce air into the blood vessel; as a single globule of this, arriving at the heart, instantly proves fatal. The second indication is an-

swered by rousing the powers of life by administering excitants. If the torpor be so great that the patient cannot be kept in motion, artificial respiration should be resorted to, and maintained long enough to permit the effect of the Narcotic to pass off. Wine, ammonia, and other stimulants, even flagellation, have been employed to keep up the powers of the system; but the most certain mode of effecting this, is dashing cold water on the head and breast; which, besides awakening, as it were, the vital energy, promotes the action of the emetics. In the advanced stage, some caution is requisite in using this remedy, particularly if the body be cold and the breathing scarcely perceptible.

Among other chemical means of decomposing the Opium in the stomach, magnesia has been suggested, in the hope of throwing down the nearly insoluble morphia; introducing ammonia at the same time to rouse the powers of the system. Infusion and tincture of galls cause a copious precipitate of a tanno-gallate of morphia, which has no activity on the animal œconomy. Orfila has therefore recommended it as an antidote. The best method of using it is to introduce a decoction of any astringent vegetable with the stomach pump. After the stomach has been fairly cleared, and no vestige of the poison left, the mineral and vegetable acids may be advantageously administered, to subdue sickness, to relieve headache, and revive the patient: but nothing is so likely to cause mischief as their administration as long as any of the poison remains in the stomach; as they form soluble salts with the morphia more active than the Opium. Under every circumstance, much depends on keeping the patient awake; for nothing is so dangerous as to permit the least return of the sopor. He must be walked about, shaken, and roused by every means, for ten or twelve hours; and when he is permitted to sleep, the repose must occasionally be interrupted, by dashing cold water on his head.

b. Atropia.—This is one of those alkaloids which the industry of our Continental brethren in the field of science has brought to light. It is a white, shining, saline body, crystallized in needle-form prisms, inodorous, insipid, scarcely soluble in water or in cold alcohol, but very soluble in boiling alcohol; insoluble in ether and in oil. It is susceptible of being united with salifiable bases, and of forming neutral salts.

Atropia was first discovered by M. Brandes; and procured from the leaves of Atropa *Belladonna*, Deadly Nightshade, an indigenous plant, which flowers in June and ripens its seed in September: it belongs to the natural order Solaneæ*. The following is M. Brandes' process for preparing Atropia: Bruise the mature plant, and boil it in water acidulated with sulphuric

* Woodville's Med. Bot. 3d edit. p. 230, pl. 52. Richard, Hist. Nat. Med. t. ii, p. 84.

acid, then filter the decoction, and precipitate with potassa. After washing the precipitate, treat it with sulphuric acid, and again precipitate with potassa. The product, being collected on a filter, well washed and dried, is to be submitted to the action of boiling alcohol: the spontaneous evaporation of the filtered alcoholic solution furnishes pure Atropia. The sulphate crystallizes very beautifully*. M. Runge also prepared Atropia, by pouring on a solution of sulphate of magnesia just enough of the solution of potassa to decompose the sulphate, and to form a hydrate of magnesia mixed with a sulphate of potassa and magnesia, to which he added extract of belladonna mixed with water. He then evaporated the mixture to dryness, and, having reduced it to powder, treated it with boiling alcohol, which, by spontaneous evaporation, yielded the Atropia under the form of white crystals. The salts are prepared by the addition of the acids. According to M. Brandes, the composition of the sulphate is—Atropia 38.93, Sulphuric Acid 36.52, Water 24.55, = 100.00. The muriate contains 39.2 of Atropia, + 35.4 of Acid, + 25.4 of Water.

Atropia, combined with the malic acid and other constituents of the plant, is formed by the hand of Nature in the leaves, and more particularly in the seeds, of the Atropa *Belladonna*†. All the parts of the plant are narcotic. Prior to the discovery of Atropia by M. Brandes, Belladonna had been examined by M. Melandri and M. Vauquelin. Melandri discovered in the leaves a soft green resin, an animal extractive, mucus and extractive, besides binoxalate of magnesia, oxalate of lime, and muriate of potassa. In the berries he found a colouring matter, a sensible test of acids and alkalies. Vauquelin obtained from the juice of the plant an azotized matter, which partly coagulated by heat and partly remained in solution, owing to the presence of some free acetic acid—a bitter, nauseous matter, which, in combination with tannin, became insoluble, and yielded ammonia by destructive distillation—nitrate, muriate, sulphate, binoxalate, and acetate of potassa. M. Brandes' analysis followed that of Vauquelin; and, after Brandes', M. Peschier of Geneva examined the plant. Besides the alkaloid, he procured an acid which retained the phosphate of lime in solution.

The poisonous qualities of the berries of Belladonna have been long known. Buchanan, the Scottish historian, ascribes the victory of Macbeth over the Danes to the infusion of these berries in some ale and wine sent to Sweno during a truce. "Vis fructui," he adds, "radici ac maxime semini somnifera, et

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* Journ. de Pharm. vi, p. 548.

† The generic name is derived from Atropa, one of the Fates. Dr. Paris informs us that the specific name Belladonna originates from the Italian ladies using the fruit to render their faces pale, as an aid to beauty.

quæ in amentiam si largius sumantur." The intoxicating effects of the root of the plant seems also to have been formerly well known*. The symptoms of intoxication are accompanied with fits of laughter and violent gestures: these are followed by a low and feeble pulse, paralysis of the intestines, imposthotonos†, convulsions, and death. Dissection demonstrates that the stomach and intestines have been inflamed: the most rapid decomposition of the body takes place after death.

The narcotic power of Belladonna is frequently advantageously taken advantage of, and the extract employed both internally and externally as a narcotic. It requires to be given in minute doses at first, and to be gradually increased until symptoms of its influence on the system become apparent. These are *dryness* of the throat, vertigo, dilatation of the pupils, slight dimness of the sight, extravagant delirium, and an eruption over the skin closely resembling that of scarlatina. In intermittent fever, in a case published by Dr. Ducres, of Marseilles, it appears to have proved successful after the sulphate of quinia had failed. Lambergen, Cullen, De Haen, Juncker, and others, employed it with advantage in the early stages of cancer. Ritcher, Munck, Mayerne, and more recently Professor Brera, speak of its use in hydrophobia! Its chief influence certainly is exerted in allaying painful and spasmodic diseases: and perhaps it has more claim to the title anodyne than any other of the narcotics. Its beneficial effects in neuralgia have been well ascertained; and in this disease the local application of the extract as a plaster over the pained part greatly obtunds the pain and adds to the comfort of the patient. It has been found useful also in mania accompanied with pain.

Dr. Golles, in a paper published in Hufeland's Journal in 1825, recommended the root as a remedy in hooping cough. He gave it in doses of one eighth of a grain, combined with a quarter of a grain of Opium, every third hour until the countenance became flushed. I have ordered the extract in doses of one eighth of a grain to a child of eight years of age, and gradually increased the dose to a quarter of a grain. Its power over the cough is extraordinary. It produces a state of the skin closely resembling scarlatina, accompanied with fever, suffused eye, dimness of sight, and frequently, although not always, headache. Whilst these symptoms continue, the cough remains absent; but it returns as soon as they disappear. By keeping the habit for a sufficient time under the influence of the remedy, the period of the disease has always been greatly shortened. A singular use of Belladonna has arisen from the circumstance of its pro-

* In the tragedy of Macbeth, when the Witches vanish, Banquo is made to remark—

Have we eaten of the *insane* root
That takes the reason prisoner?

† A spasmodic flexion of the body forwards.

ducing the eruption alluded to: in 1807, Professor Hahneman, of Leipsick, suggested its employment as a preventive of scarlatina, and his statements have been supported by Hufeland and other German physicians. Hahneman's directions are to dissolve three grains of the extract in f℥i of cinnamon water, and to administer three drops of this solution twice a day to a child a year old; adding one drop for every year, until twelve be taken for a dose. He advises this plan to be begun at the commencement of the epidemic, and to be continued whilst it rages. Notwithstanding the seeming absurdity of expecting any effects to be produced on the system by one fifty-third of a grain of extract of Belladonna, even in the youngest child, this practice has been supported. Dr. Randhaken, physician of the Orphan Hospital of Langerdorf in Prussia, affirms that by this means he secured safety to one hundred and sixty children exposed to the contagion: and, as I have already mentioned, Hufeland states, from his own experience, that he is able to confirm the efficacy of Belladonna as a preventive of scarlatina. One German physician, however, Dr. Lermann of Torgau, has stated that, in a fatal epidemic which occurred in that place in 1825, he tried the preventive powers of Belladonna without benefit.

The influence of Belladonna on the radiated fibres of the iris, led to its being proposed as a method of facilitating the extraction of the cataract by Professor Reimarus. A small quantity of the extract softened with water is to be applied upon the eyelid: it acts on the radiated fibres, dilates the pupil, and the effect continues for some time. An ointment formed with one drachm of the extract and seven drachms of lard affords great relief in hæmorrhoids, and in chordee when rubbed upon the perineum: and the powdered leaves, sprinkled upon open cancerous sores, abate pain.

From these effects of Belladonna, there can be no hesitation in admitting that it exerts a direct influence on the nervous energy; and, under proper caution, is a narcotic of great value. It may be administered in the form of powder, in infusion, and in extract: under all these forms, alkalies should not be combined with it.

Dr. Reisenger has proposed the employment of Atropia instead of the extract of Belladonna, on the ground that it exerts a direct sedative influence, whilst the primary effect of the extract is stimulant.

An overdose of Belladonna produces such an effect on the stomach, that it cannot be excited to vomiting by any emetics: the advantage of the stomach pump in this case, therefore, is great. After the stomach has been relieved, vinegar is said to be the best antidote; but, previous to the use of the vinegar, I would recommend the administration of alkalies, to decompose the malate of Atropia which may yet remain in the stomach:

and it is not until the whole of this is evacuated that vinegar ought to be given. The cold affusion on the head and body is superior to all other means.

c. ACONITIA is the narcotic principle of all the species of the genus Aconitum. Many of the species of Aconitum are more poisonous than the *Napellus;* the most so is the Aconitum *ferox**. The Aconitia was first detected by Pallas†; and has been examined by M. Brandes, who ascertained it to be an alkaloid. It is in the form of yellow transparent needles: very bitter to the taste. Unlike the other vegetable alkaloids, it is soluble in cold water; but scarcely so in cold alcohol, although very soluble in boiling alcohol.

The plant which yields this principle is a native of the North of Europe, belonging to the natural order Ranunculacæ‡. It is not the *Napellus*, but, as De Candolle has accurately determined, the *paniculatum*, or rather a variety of that species, which he has named *Stoërckianum*, to distinguish it as the plant which was introduced into practice by Stoërck.

The whole of the genus Aconitum is poisonous§. The root is the most poisonous part of the plant. The powdered leaves have at first a sweetish taste, which, however, is soon followed by an acrid, burning sensation, accompanied with profuse salivation; and, if the extract of them be given without the greatest caution, it acts at first on the stomach, then on the nervous system, producing vomiting, hypercatharsis, vertigo, cold sweats, delirium, and convulsions, which terminate in death. If it be placed on the eyelids, it causes tears to flow; but it produces no sensation of heat: and when the powder is sprinkled upon an ulcer, it causes neither heat nor pain. It resembles strychnia in its effects on the posterior extremities, when administered to quadrupeds. Post-mortem dissections display few evidences of local inflammation. The poisonous effects of Aconite were confirmed on a large scale by the experiments made with it upon condemned criminals at Prague, by order of the Emperor Ferdinand I; and also at Rome, under Pope Clement VII. If it be overdosed, after emptying the stomach, either by the

* A species figured by my friend Dr. Wallich, in his splendid work Plantæ Rariores Asiaticæ. It is used often by the natives of India to poison tanks of water, to check the progress of an army. This attempt, says Dr. Wallich, was actually made, in the Nepal war, at Hotouura; but it was discovered in time to save the soldiers. It is also used for poisoning arrows.

† Journ. Chirurg. Med. t. i, p. 194.

‡ Woodville's Med. Bot. thrid edit. p. 461, pl. 165. Lond. Dispen. art. Aconitum. Richard, Hist. Nat. Med. ii, p. 595.

§ It is curious to trace the fables of the ancients in reference to this quality of the Aconite. Ovid relates that when Hercules descended into hell to recover Alcestes, he left upon the ground, when he returned, a scum which engendered the plant. It was the principal ingredient in the poisonous cup that Medea prepared for Theseus; and it was the poison employed to execute the barbarous law in the Island of Ceos, which condemned to death all who were no longer useful to the state: thence the old men, who had become useless, were presented with a draught of the juice of Aconite.

stomach pump or by emetics, powerful stimulants, namely, coffee, brandy, and ammonia, should be administered, and blisters applied over the stomach.

Chemical analysis has thrown little light on the medicinal properties of Aconite. The dried plant which has been examined, often contains little active matter; at other times a great deal. M. Peschier, of Geneva, found that it contains an acid, which forms an insoluble compound with baryta; a small quantity of waxy matter; phosphate, malate, and carbonate of lime: and it is owing to these salts that the infusion precipitates nitrate of silver and subacetate of lead, and all the metallic sulphates.

Notwithstanding its poisonous properties, Aconite was introduced by Stoërck as a remedy in chronic rheumatism and other painful diseases: he also prescribed it in amauroses, scrophula, cancer, syphilis, and in intermittents; but it has never been much employed in this country. Avicenna recommended it in cases of lepra; and I have administered it with advantage in inveterate psoriasis, commencing with $\frac{1}{4}$ of a grain of the extract for a dose, and gradually rising to two grains. Busch proposed to diminish the morbid irritability and sensibility in the early stages of phthisis by Aconite. He preferred the powdered leaves to the extract, and gave them in doses of gr. ii, every two hours, increasing the dose to a drachm daily: Portal recommends the extract in that species of phthisis which is termed rheumatic; but, from the trials of Dr. Roberts, Aconite merits no confidence in phthisis.

The only officinal preparation of this plant in the British Pharmacopœias is the inspissated juice: on the Continent, a tincture and wine of the seeds are used, and regarded as not only more certain in their doses, but much better adapted for conveying the influence of this Narcotic into the habit than the inspissated juice. In every form of preparation it is a medicine of extreme virulence, and requiring the utmost caution in its administration.

d. CONIA is a narcotic principle, which exists in the leaves of the Conium *maculatum*, an indigenous plant belonging to the natural order *Umbelliferæ**. It flowers in June and July; at which time it is in perfection. It is distinguished by its *maculated* stem; the *deep shining green* of its lower or supra decompound leaves; and its disagreeable odour when fresh and bruised, resembling that of the urine of the cat.

The medicinal property of Conium is connected with this odour of the plant, and the green colour of its leaves. Its narcotic principle varies greatly, according to the nature of the

* Woodville's Med. Bot. 3d edit. p. 104, pl. 42. London Dispensatory, art. Conium. Richard Hist. Nat. Med. ii, p. 369.

season and the localities of the plant. Thus it is a more virulent poison in Greece, Italy, and Spain, than in England: in other places it is so inert, that we are informed by M. Steven, a Russian botanist, that the Russian peasants eat it with impunity, after it has been boiled in several waters.

Schrader has given the following as the result of an analysis of the fresh leaves of Conium: in 100 parts he found of Resin 0.15, Extractive 2.73, Gum 3.52, Albumen 0.31, Green Fecula 0.18, Heterogeneous mass 92.4. This heterogeneous mass was a compound of acetic acid, sulphate, hydrochlorate, and nitrate of potassa, malate and phosphate of lime, with the phosphates of iron, magnesia, and manganese. M. Brandes has obtained an alkaline principle from the leaves, to which he has given the name of *Cicutin*, or *Conin*. It is prepared by evaporating the alcoholic solution of the plant to dryness, then treating the residue with water, and adding to it magnesia. The whole being then evaporated to dryness, and the residue treated with a mixture of alcohol and ether, the *Conin* is procured by the evaporation of the filtered solution. This principle possesses the following properties—1. It furnishes a reddish precipitate with tincture of iodine: 2. it precipitates yellow the solutions of sulphate of mercury and hydrochlorate of zinc: 3. its action on the animal œconomy resembles that of strychnia; and the post-mortem examination of animals killed by it displays the vessels of the head, the right auricle of the heart, the vena cava superior, and the jugulars, gorged with blood: but no traces of irritation appear in the abdominal viscera.

About twenty-five years ago, by acting upon hemlock with ether, and evaporating the etherial tincture on the surface of water, I obtained a rich green resinous-like substance, which possesses, in an eminent degree, the odour and taste of the recent plant; and half a grain of which produces headache and vertigo. To this principle Dr. Paris proposed to give the name *Conein*, which I have ventured to change to *Conia*. It appears to operate in smaller doses than Brandes' principle.

Many circumstances concur to alter the powers of Conium on the animal system: some relate to the plant itself, and its preparations; others to the temperament and idiosyncracy of the patient, and the nature of his diseases.

As far as concerns the plant, the leaves should be gathered in June; they should be healthy, and of a deep green colour; and, as soon after being gathered as possible, they should be quickly dried in an obscure place, as light deteriorates them; the powder should also be secured from the action of light, and preserved in small bottles, almost hermetically closed. The extract, which is the form most commonly used, is prepared in two ways: the expressed juice is evaporated to the consistenee of syrup, and the powder then added to bring it to a proper

degree of thickness for making pills: or the green feculant part of the expressed juice is separated by the filter, and added to the other part after it has been slowly evaporated and clarified over a low fire. Much care is requisite in these processes: a high temperature in any of the steps may be sufficient to destroy the efficacy of the preparation. It would also be advantageous were the plant, for medicinal use, collected in the south of Europe; dried in an obscure place, without heat; powdered and sent to this country, and to other parts in the north of Europe, in well-soldered tin canisters. By such means, if no adulteration occurred, an efficient medicine would be obtained.

With respect to the state of the patient, Conium affects less those of a melancholic temperament than those of a sanguine; and idiosyncracy interferes less with the operation of Conium. These circumstances, therefore, not only tend to perplex the practitioner, but to produce very varying opinions respecting the general powers of the medicine. That Conium operates as a local excitant is evident from the effect of poultices made with it. The primary action, therefore, of the active principle is on the tissues to which it is applied—the throat feels dry, heat is felt in the epigastrium, and colic and nausea are excited. It next enters the circulation, and, acting upon the heart, augments the force of the pulse, and renders it irregular: and this action, extending to the capillaries, causes the suffusion of the eyes, the heat, itching, and eruptions on the skin, that accompany its use. But its chief influence is exerted on the cerebro-spinal organs. It seems to act by its acrimony on the whole brain, causing headache, beating in the temples, pain in the orbits, heat in the cranium, noise in the ears, and, when the dose has been large, high delirium. Its action on the spine is marked by tremblings in the extremities, flying pains, palpitations of the heart, nausea, and vomiting. Under these circumstances, it is evident that the nervous plexuses of the great sympathetic are affected; and, indeed, a new action of a morbid kind appears to be set up by it, in every part of the nervous system. By its action on the vascular system, the blood is determined to the head, and congestion takes place, evidenced by drowsiness, weight of head, muscular debility, and an embarrassment in the respiratory function.

From this catalogue of symptoms, the powerful influence of Conium as a therapeutical agent may readily be conceived: and unless these symptoms are present in a moderate degree, it produces no beneficial results. Besides these effects, it also determines to the genitals, and, on this account, it is prescribed in impotency, in Germany*.

Upon the whole, we may affirm that Conium is a Narcotic of considerable power; that, if due attention be given to prepare it,

* "Impotentiam virilem sub usu Conii curatam observavi, in viro quodam plusquam quadragenario, qui omnem erectionem penis prediderat, postinde tamen plures liberas procreavit," says Bergius, an author of great credit.

so that its preparations may always be of uniform strength, and if the dose be carried to its utmost extent, it merits more attention than has hitherto been paid to it by British practitioners.

Conium has been advantageously employed in all diseases connected with nervous irritability: in hooping cough it is preferable to opium for allaying the cough; but neither, in my opinion, are much to be relied upon in that spasmodic affection. It has been beneficially employed in that variety of paralysis which is complicated with rheumatism, in which the deficiency of motion is attended with acute pain. In chronic rheumatism I have witnessed much benefit result from its administration: even when the disease is not removed, the pains, in general, are kept under. In chronic sciatica I have seen it produce more beneficial effects than any other medicine.

In those headaches which assume a periodical character, Conium, in combination with sulphate of quinia and arsenic, is generally productive of much benefit. In scrophulous affections, the diseases for the relief of which Stoërck chiefly vaunted the influence of Conium, I have not been able to perceive that it effects more than any other narcotic, whether internally administered or externally applied; and in phthisis, except in allaying the cough, I may pass the same sentence upon it. The dose of the powdered leaves is from gr. iii to gr. x; that of the Conia is from $\frac{1}{4}$ to $\frac{1}{2}$ grain: and that of the tincture from m. x to m. xxx, in any vehicle, except one of an acid nature, which destroys its narcotic power.

When Conium has been overdosed and acts as a poison, its effects greatly resemble those caused by opium. It first produces giddiness and headache, which are followed by drowsiness, so intense that the patients fall asleep whilst they are conversing: coma and convulsions follow, and, if proper means be not taken to obviate the fatal result, death rapidly ensues. It also affects the respiratory function; the breathing becoming constricted and laborious; the pulse small, and beating scarcely thirty in the minute; the extremities become cold, the countenance bloated, bluish, and turgid with blood, like that of a man in the act of strangulation. Post-mortem examinations of the body display great turgidity of the vessels of the head, and a remarkable fluid state of the blood, which appears to depend on some chemical influence of the Conium, as a small portion of the infusion prevents fresh-drawn blood from coagulating. The same effects are produced by the etherial extract, which I have named Conia; but as Brandes' *conin* operates more like strychnia, the mind is left in doubt regarding the real nature of the active principle of Conium. The most prompt means of abstracting the poison from the stomach must be resorted to: if the stomach-pump be not at hand, the strongest direct emetics should be administered. I am not aware that any agent acts chemically upon the poison. But vinegar and the vegetable

acids diminish its energy. The extract of the recent plant is the only preparation of Conium in the London Pharmacopœia; and it is objectionable, owing to the difficulty of preserving it. Whenever a saline efflorescence appears on the surface, this extract is of no value. The dose of the extract is from i gr. to vi grs., but it may be gradually raised to half a drachm; and when carried to this length, it should be continued for some weeks. The best form of preparation is the tincture of the Edinburgh and the Dublin Colleges. Much comfort has also been procured by applying the extract as a topical dressing to cancerous sores.

e. DATURIA.—This is an Alkaloid, the active principle of the Datura *Stramonium*, a plant belonging to the natural order Solaneæ, a native of America, now naturalized to our soil*. The whole plant has a strong narcotic odour and a bitter nauseous taste, imparting a green tinge to the saliva when it is chewed.

The *Daturia* is found, in combination with malic acid, in the seeds of the Datura *Stramonium*, and some other species of the same family. It is procured by macerating the seeds in boiling alcohol, decomposing the malate thus taken up by magnesia, and again treating the precipitate with alcohol, which by evaporation deposites the Daturia. It is almost insoluble in water and in cold alcohol, but very soluble in boiling alcohol; and it forms soluble salts when united with acids. It was discovered by M. Brandes, and is justly regarded as the active narcotic principle of Stramonium. Wedenberg found that, besides the Daturia, Stramonium contains mucus, resin, and a small proportion of a volatile matter. I find that the volatile matter is carbonate of ammonia, and that it also contains a small proportion of tannin. In a more recent analysis, Promnitz found, in 200 parts of Stramonium, 58 of extractive, 6 of chlorophylle, 64 of albumen, 15 of resin, 12 of phosphate of lime and magnesia, and 45 of lignin or woody matter.

The narcotic properties of some of the species of Datura have been long known in the East. It has always been smoked in Ceylon to relieve asthma; the poorer Turks use it instead of opium; and the Chinese infuse it in beer, to produce intoxication. In the Carnatic, the native practitioners use the Datura in all painful affections, even in cancer. The Arabians were early acquainted with its narcotic powers, and employed it both as a poison and as a medicine. Its influence on the animal system so closely resembles that of belladonna, that it is scarcely necessary to enter into details. Indeed, so closely does it resemble belladonna, that even, in the intoxication which it pro-

* Woodville's Med. Bot. 3rd edit. p. 197, pl. 74. London Dispensatory, art. Datura. Richard, Hist. Nat. Med. t. ii, p. 107.

duces, the same follies are committed. In some parts of Europe, this effect is so well known, that the plant is vulgarly called "Herbe aux Sorciers."

It is given in the form of extract and of tincture. The former varies according to the mode of preparation, and therefore is an uncertain medicine. Prepared in vacuo, Dr. Marcet found it extremely useful in sciatica, in doses of from $\frac{1}{8}$ of a grain to a grain; and Dr. John Davy bears testimony to its value in chronic coughs which have nightly exacerbations. The dose of the extract, if well prepared, should not exceed gr. ss at first, but it may be gradually carried to gr. vi. In the minimum dose, I have found it extremely useful in uterine irritation, and in cases of painful menstruation, in combination with Plummer's pill and Foxglove. I have had no experience of the extract, but have used the tincture of the seeds, and find it a valuable Narcotic. ℥ii of the bruised seeds are digested in f℥xvi of alcohol for six days, and filtered. The dose is from m. x to m. xx. M. Kirchoff, a French surgeon, states that, by rubbing this tincture on the part affected with neuralgia fifteen times a day, and continuing this for some time after the pain is relieved, he has completely cured this painful disease. The same practitioner, and Dr. Englehart of Utrecht, have found it efficacious in all the cases in which belladonna is useful.

In overdoses, Stramonium operates as a poison. The determination to the head, which follows, points out the necessity of blood-letting. This, however, does not interfere with the evacuation of the stomach and bowels, which is essential. When death ensues, the post-mortem examination displays congestion of the brain; and in a case recorded by Haller, extravasation into the ventricles had taken place. When recovery takes place, a very troublesome itching remains for some time after the effects of the poison are subdued.

f. DIGITALIA.—This saline substance is conjectured to be the active principle of the leaves of the Digitalis *purpurea*, or Foxglove; but it is probably a compound substance, and the product of the process by which it is procured. The determination of this point is, fortunately, a matter of little moment, as the leaves of the foxglove, when properly dried and well preserved, are active in such small quantity, that little benefit would result from a separation of their active agent.

Digitalis *purpurea* is a plant belonging to the natural order Scrophularineæ*. It is a biennial plant, very common on elevated ground, where the soil is dry, sandy, and gravelly. The beauty of the flowers has given the plant a place in gardens; but its properties as a medicinal agent are much deteriorated by

* Woodville's Med. Bot. 3d edit. p. 218, pl. 78. London Dispensatory, art. Digitalis. Richard, Hist. Nat. Med. t. ii, p. 74.

cultivation. The best plants for medicinal use are those which grow on elevated situations, and exposed to the sun. The leaves should be gathered before the plant flowers.

When ℥i of the leaves of foxglove are acted on by alcohol, the spirit takes up about gr. xx, and leaves, on evaporation, a green matter, resembling tallow in consistence, but more tenacious, and having a disagreeable, virulent smell. It does not furnish ammonia by distillation, and is not acted upon by acids. This is not Digitalia, which is a brown, pitchy, dequescent substance, capable of being crystallized, but scarcely ever obtained in the crystalline state. It is intensely bitter, and possesses all the activity of the plant in an eminent degree. This substance is extracted from the dried leaves by acting on them with ether, both cold and warm, and evaporating to an extract, which is to be acted upon by distilled water, to throw down some chlorophylle. The aqueous solution, which reddens litmus paper, is next to be precipitated by acetate of lead, filtered, evaporated to dryness, and again acted upon by ether and evaporated: the result is Digitalia. M. Pauguy has also obtained from Digitalis a white crystalline substance, in fine acicular crystals, insoluble in water, but soluble in alcohol and ether; but, as it does not display any of the virtues of the plant, I shall make no comments upon it.

The Pharmacopœias order an infusion and a tincture of Digitalis; but there is great uncertainty in both preparations, owing to the careless manner in which the leaves are frequently dried. It would be of great importance to obtain a vehicle which should always ensure a preparation of a definite strength: I am disposed to think that such a vehicle will be found in ether, which takes up the whole of the soluble matter, and, when evaporated, leaves a green principle, possessing in a high degree the properties of the plant. The solution of this in alcohol might be employed with advantage.

As a Narcotic, foxglove operates upon the nervous system, producing first stimulant, and afterwards sedative effects. This was first satisfactorily ascertained by Dr. Hallaran, in a case of Insanity, in which the tincture of foxglove was given by mistake for the tincture of opium; and he concluded, from observing its action in different states of mania, that foxglove cannot be advantageously exhibited under "the pressure of high arterial action*." This fact, indeed, had been previously noticed in some experiments by Dr. Saunders†; and during the employment of foxglove as a diuretic: it seldom succeeded if the dropsical patient was in a state of vascular excitement; but this was ascribed to other circumstances than to the primary stimulant action of the foxglove. Dr. Hallaran employed foxglove

* Practical Observations on Insanity, p. 105—109.

† Treatise on Pulmonary Consumption, p. 243, 8vo. Edin. 1808.

with great advantage as a Narcotic in cases of diminished excitement of a maniacal kind: and my own experience has enabled me fully to confirm the accuracy of Dr. Hallaran's observations. This opinion is farther confirmed by the experiments of the Leipsic Club of Experimentalists. They found that from half a grain to three grains of the powder excite, directly and powerfully, the brain and the alimentary canal; and that its secondary effects are sedative, and evident on the circulation, which it depresses. Its influence on the brain is indicated by giddiness, dull headache, heat of face, obscure sight, and intoxication: its operation on the alimentary canal, by heat in the pharynx, colic, and costiveness: its secondary or sedative influence, by a small, feeble pulse. It is only by regarding it in this point of view, that we can account for contradictory statements of practitioners respecting the influence of foxglove in diseases of excitement; for example, pneumonia, phrenitis, and similar affections; the effects of the remedy being in a great degree regulated by the period of the disease at which it is administered. I have had several opportunities of putting this mode of employing foxglove, as a Narcotic, to the test of experience; and when the system was unloaded, previously to the commencement of the use of the tincture, which I have carried to the extent of sixty minims, three times in the twenty-four hours, I have seldom failed of procuring sleep, quiet, and the restoration of the patient to sound health and intellect. In one of these cases, which has since remained under my eye, the lady, a woman of eighty years of age, has continued for upwards of seven years in perfect mental health. In producing its effects, Digitalis cannot, with safety or advantage, be ventured on where the inflammatory diathesis presents itself; and, therefore, in other diseases, as well as in mania, in which its narcotic influence may be required, the habit should be prepared by previous depletion.

From these remarks, it is easy to ascertain the periods of disease in which Foxglove is most likely to prove beneficial. In phthisis, it is fitted for the advanced stages of the disease, provided the inflammatory pulse have been previously subdued by the use of the lancet. M. Neuman, of Berlin, has found it an admirable remedy in chronic catarrh, when this depends on a state of erethrism of the mucous membrane of the bronchi. He infuses ʒii of the dried leaves in fʒvi of boiling water, and gives one spoonful of this infusion every hour, until nausea, or a sense of constriction of the throat, or irregularity of pulse, follow. The use of the medicine is then suspended for a week, and again renewed if the disease be not removed.

The utility of Foxglove in affections of the heart has been questioned: but experience has confirmed its efficacy in hypertrophy of the left ventricle, with or without dilatation of its cavity: it diminishes the action of the diseased organ, and with

this, the vertigo, pulsation in the head, singing in the ears, and other sympathetic affections of the encephalon attendant upon this condition of the heart.

The effects of Digitalis, when overdosed, are those of a powerful narcotic poison. Sinking of the pulse, clammy perspirations, nausea, vomiting, and purging, are the most marked symptoms produced by it: sometimes salivation supervenes, and suppression of urine. These symptoms arise from collapse, the effect of its stimulant influence. Like mercury, Foxglove accumulates in the system, when long administered, even in moderate doses; and continues to produce its constitutional effects after its use has been discontinued. The symptoms, in such a case, are nausea, vomiting, giddiness, want of sleep, sense of heat over the body, pulsation in the head, depression of spirits, sometimes diarrhœa; occasionally, profuse salivation and convulsions supervene, with a peculiar forgetfulness and delirium. Even when death does not follow, the effect on the pulse does not disappear for many days. When symptoms of poisoning occur, they are to be counteracted by immediately suspending the use of the medicine, and administering cordials, as brandy and water, ammonia, opium, and the application of a blister to the pit of the stomach. Yellow cinchona bark, also, is an excellent antidote, as it forms an insoluble compound with the tincture and infusion of Foxglove.

The most common form of using the leaves of Foxglove is in powder. But this should not be employed unless it possess the beautiful green colour and the odour of the fresh plant; and to secure this state, it should be preserved in opaque bottles. The dose at first should not exceed a grain; but it may be repeated once in eight hours, until the action be obvious, after which the dose should not be given oftener than once in twelve hours; then, in a day or two, once in twenty-four hours; and, ultimately, once in forty-eight hours. The infusion is incompatible with acetate of lead, infusion of Cinchona *cordifolia*, and the alkalies. The tincture is assuredly the best of the officinal preparations: it should be made with the leaves, collected in warm weather, and dried without artificial heat. In prescribing it, we must bear in recollection that both the bichloride of mercury and nitrate of silver are incompatible in prescriptions with it.

g. HYOSCIAMIA.—This is an alkaloid, the active principle of Henbane, Hyosciamus *niger*, an indigenous annual, belonging to the natural order Solaneæ*. It grows on waste ground, and flowers in July. All the parts of the plant have an offensive, fœtid odour, a clammy, slightly adhesive feel, and an

* Woodville's Medical Botany, third edition, p. 204, pl. 73. London Dispensatory, art. Hyosciamus. Richard, Hist. Nat Med. t. ii, p. 98.

appearance indicative of its poisonous character: its taste is mucilaginous and slightly acrid, causing heat in the throat, nausea, a hot skin, an accelerated pulse, a tendency to sleep, headache, vertigo, and dilated pupils. The active principles of the plant are taken up both by water and alcohol: decoction destroys them. The infusion is not affected by diluted acids: the alkalies change its colour to deep greenish-yellow; it is copiously precipitated by subacetate of lead, nitrate of silver, and sulphate of iron. Several chemists have analysed Henbane. M. Peschier obtained from it, in addition to hyosciamia, a crystallizable acid resembling wax, and phosphate and carbonate of lime*.

By precipitating an infusion of the seeds of Henbane by means of an alkali, M. Brandes obtained the peculiar principle now under consideration, *Hyosciamia*, in the form of oblong crystals or prisms, which form neutral salts with nitric and sulphuric acids. The same alkaloid is found, also, in the root and the leaves, but in less quantity than in the seeds. M. Planché procured an extract from the dried plant, by macerating one part of it in four parts of alcohol, for four days, filtering the tincture and evaporating to dryness in a water bath: it has a beautiful green colour, retains all the virtues of the plant, and probably contains the real active principle.

As a Narcotic, Henbane has been regarded analogous to opium in its effects. It operates directly on the nervous system, invigorating the pulse, producing an increased heat of the skin; and, after these effects have subsided, inducing sleep. It does not confine the bowels, neither does it affect the head so much as opium. In large doses, however, it acts as a virulent poison; causing in the first instance sickness, stupor, dimness of sight, hard pulse, delirium, coma, and dilatation of the pupils; afterwards, weakness, tremulous pulse, cold sweats, petechiæ, and frequently death. One effect of an overdose is singular: sometimes, the sense of sight seems for a few moments lost; again, objects appear much larger or much smaller than natural, more distinct or nearer, or they seem to move, dance, or fall, or they appear wrapt in a cloud, or of ever-varying colours. In some habits it excites a pustular eruption.

The ancients were acquainted with the narcotic powers of Henbane: Stoërck investigated its effects, and established its use as a Narcotic. In ileus and colica pictonum, it is very serviceable, in combination with Colocynth and Scammony. In mania it is much used, in combination with camphor; and certainly seems to soothe and procure sleep in these cases with less inconvenience than opium. But, under all circumstances, the narcotic powers of Henbane in mental affections are inferior

* Bibloth. Univers. Sept. 1820.

to those of acetate of morphia. The extract of Henbane is given in doses of five grains, repeated three or four times a day; but, in my own practice, I have seen more good derived from eight or ten grains, combined with ten grains of camphor, and given at bed-time, than from the repetition of smaller doses. But Henbane merely procures temporary relief; and if more be expected from it in mania, disappointment must follow. In melancholia, however, it is supposed to operate in a manner essentially different from that of any other Narcotic, producing tranquil sleep without dreaming or spectral visions, removing pain where it exists, and exciting a gentle breathing perspiration, without quickening the pulse like opium. In cases accompanied with cramps, spasms, or convulsions, it may be combined with Ipecacuanha or James's powder; or, if much languor be present, with Serpentaria. It is regarded as peculiarly adapted for puerperal insanity. Mr. Brande recommends it for allaying the irritation caused by red gravel in the kidneys; and it is generally useful in every case of pain, particularly in neuralgia, affecting the facial nerves. Smoking the leaves in the manner of tobacco allays the pain of toothache, and the difficulty of breathing in asthma. When applied to the surface, it also diminishes pain, dilates the pupil, and soothes greatly the irritation of scrophulous ulcers and cancerous sores. It therefore possesses anodyne as well as narcotic powers. The tincture is the best form of exhibiting Henbane; but it is most frequently given in that of extract; much, however, depends on the goodness of the extract. The dose of the tincture is from m. xv to ʒi; that of the extract from gr. iii to gr. xvi; but it has been gradually carried to gr. lx. It should not be prescribed in combination with alkalies, nor with lime water, as these destroy its narcotic power.

Fatal cases of poisoning by Henbane and its preparations exhibit, on dissection, inflamed and gangrenous spots on the inner surface of the stomach. With a gorged state of the vessels of the brain, vinegar has been recommended as an antidote; but, from the action of the alkalies, I should feel disposed to place more confidence on them: the first step, however, is to evacuate the stomach; after which, the habit may be roused by ammonia and cordials.

h. LUPULIA is a peculiar compound principle, spontaneously formed in the strobules of the hop, the Humulus *Lupulus**, a well-known plant of the natural order Urticeæ.

The Lupulia is produced in the strobules or female flowers only: it was first brought into notice by Dr. Ives, of New York; and the hop was soon afterwards chemically examined

* Woodville's Med. Bot. third ed. vol. v, p. 90, pl. 22. London Dispensatory, art. Humulus. Richard, Hist. Nat. Med. t. ii, p. 478.

by M. Payen and Chevalier, two French chemists. The result of their experiments led them to conclude that it contains a volatile oil, carbonic acid, subacetate of ammonia, traces of osmazome, gum, malic acid, malate of lime, a bitter principle, a large proportion of resin, silica, traces of carbonate, muriate and sulphate of potassa, carbonate and phosphate of lime, oxide of iron, and some sulphur. As might reasonably be supposed, no light was thrown upon the medicinal character of Lupulia by the display of this long list of constituents of the hop. It is easily extracted from the hop by merely sifting the ripe strobules. The examination of this principle, chemically, has ascertained that its constituents are tannin, extractive, bitter principle, wax, resin, lignin, and a volatile oil; and, from the result of reagents on the infusion of hops, it is probable that hops contain nearly the same constituents. Its infusion is rendered turbid by all the mineral acids; its colour is greatly deepened by the alkalies, but no precipitates are thrown down by them: the salts of lead, iron, mercury, and zinc, are decomposed, and form precipitates in it.

The expectations that were some years since raised respecting the narcotic properties of hop and Lupulia, have been completely disappointed. The hop itself, as a remedy, can only be regarded as a pleasant bitter; the best mode of exhibiting which is in well-brewed beer. The Lupulia is a weak Narcotic: it may be administered in the form of powder, in doses between ten grains and a scruple, or in that of tincture or of extract. From forty to sixty minims of the tincture are said to act kindly as a soporific.

CAMPHOR, *Camphora*. L. E. D.—Camphor (page 169) possesses both stimulant and sedative properties, which closely remble those of opium, the stimulant being followed by collapse in the direct ratio of the excitement: it also displays anodyne effects, producing sleep* and relieving pain.

When dangerous doses have been taken, the symptoms are burning heat of skin, a hard, full, and quick pulse; the eyes sparkle, the face is red and swelled, with great weight of head, anxiety, agitation, a sensation of burning in the stomach, intense cephalalgia, vertigo, and disordered vision. These symptoms have followed a dose of one hundred and sixty grains. The best treatment is the repeated administration, every half-hour, of a spoonful of vinegar and gruel. In a case related by Professor Wendt†, the sufferer, who was thus treated, became more calm; the headache, cephalalgia, and anxiety diminished;

* Haller states, that persons employed to empty bags of Camphor become first highly exhilarated, and then fall asleep, even when they are conversing.

† Professor Wendt, Rust's Magazine, tom. xxv, states that the man, who was seventy-three years of age, swallowed four fluid ounces of Camphorated Spirit: but here the quantity of alcohol was a dangerous dose.

a copious sweat broke out, and this was succeeded by three hours of tranquil sleep; the pulse, nevertheless, continued quick and full; the urine was obstructed, and for some time was passed with difficulty. Under the use of an infusion of Foxglove and Acetate of Potassa, his health was gradully restored. In a few instances a cutaneous eruption has followed its use; but this indicates some peculiar idiosyncracy. It causes no irritation of the mucous membrane of the intestinal canal; excites neither pain nor borborygmi; but occasionally causes constipation. Such are the narcotic effects of Camphor when it is taken into the stomach of a healthy man; but disease has a powerful influence in modifying its action.

Many unsatisfactory experiments have been made to ascertain the real influence of Camphor as a narcotic, on the animal œconomy. When it is intended that it should exert a stimulant effect, it should be given in small doses frequently repeated; on the contrary, it should be given in large doses, and at considerable intervals, when its sedative influence is required.

Camphor has been prescribed in every kind of fever: in intermittents, during the paroxysm, to allay irritation and procure sleep. Cullen affirms that, in nervous fevers attended with delirium and much watchfulness, he frequently employed it with advantage; but, in this respect, it is greatly inferior to opium, to which, however, it forms an agreeable and useful adjunct. Galen prescribed it in hectic: Poterius, who was a disciple of Paracelsus, employed it in the form of vapour, in combination with assafœtida, in phthisis: Lieutaud, Burserius, and Dr. Percival, were also advocates for it in phthisis: and Dr. Rollo recommends it, in conjunction with hepatized ammonia and conium, in the incipient stage of the disease. In the phlegmasiæ, Camphor has been prescribed often on mistaken principles, under a conviction that its primary action is sedative. As an external application, it has been frequently employed in ophthalmia; but, in the active form of this disease, it is injurious, and is best suited for that passive state which is the result of the scrophulous diathesis, or in old chronic inflammation of the conjunctiva.

In all spasmodic diseases, Camphor is frequently employed; and it operates either as a stimulant or a sedative according to the manner in which it is administered; but its effects are, in every respect, inferior to those of opium and many other narcotics. It is a powerful agent for soothing cramps and colic when externally applied; in this instance, operating as a counter-irritant. In mania, its powers have been greatly overrated: yet it is a curious fact that the pulse of furious maniacs falls as low as fifty when they are under the influence of Camphor; and a sedative effect follows; but without any diminution of their sufferings. "By its duration," says Dr. Hallaran, one of the

most sensible writers on maniacal complaints, "the countenance eventually assumes a livid aspect; the extremities also become cold and insensible, and equally livid with the face. The arterial blood seems as if concentrated in the vessels immediately issuing from the heart; the action of the lungs is impeded; and congestion, determining to the head, is often the inevitable consequence. The power of reaction of the heart, under such difficulties, is, in fact, suspended; and the torpor of the system, previously existing, is thus greatly aggravated." Dr. Hallaran regards it as a very uncertain medicine in the treatment of mania. Nevertheless, Dr. Perfect relied on it in insanity, and illustrated his opinion by details of a hundred and three cases in which it produced most essential benefit. He gave it in doses of two scruples night and morning.

In nymphomania, a disease depending on a morbid sensibility of the uterus and its appendages, after copious bleeding and other evacuations, Camphor has been found highly beneficial: it is also an admirable adjunct to opium in mania, produced by a continued course of intoxication from wine and spirituous potations.

Camphor is exhibited in various forms as a narcotic. The quantity requires to be considerable, to produce a soothing effect; and therefore it should be given either in substance, in the form of pill, or precipitated from alcohol and diffused in almond emulsion or mucilage and water; or it may be dissolved in water impregnated with carbonic acid, as with that acid it forms a complete solution. Some of the Continental physicians advise Camphor always to be administered in the state of vapour, when its anodyne powers are required. This is effected by placing the patient on a chair with an open cane bottom, beneath which a chafing dish, covered with a plate of iron, is placed; and the whole being surrounded with a blanket, pinned round the neck of the patient, a dessert spoonful of Camphor in powder is thrown upon the hot iron plate, which volatilizes it, and involves the body in an atmosphere of the vapour. The patient perspires freely, and in three-quarters of an hour afterwards is to be rolled in the blanket and carried to bed. The sweating is then to be kept up by tepid fluids. In chronic rheumatism, the disease for the relief of which this Camphor bath is chiefly used, the fumigation may be repeated three or four times a day; and it ought to be continued for some time after the pains have disappeared*.

The remaining organic *Direct Narcotics* owe their efficacy

* The most recent and best account of Camphor and its virtues is contained in the Traité de Camphor of Graffenaur, published at Strasburg in 1823.

to an unknown principle variously combined. Chemists have looked for alkaloids in every medicine which displays narcotic properties: but, in various instances, the alkaloid is the production of the operation employed to obtain it; and, consequently, the influence of the vegetable, in its entire state, must depend on something else than the alkaloid. No alkaline principle has been found in the following Narcotics.

a. RHODODENDRON CRYSANTHUM, *Yellow Rhododendron*, E. is a Siberian plant, belonging to the natural order Erinaceæ*. Either from the effects of drying and transport, or from the nature of the constitutions of the patients in this country, the effects of this narcotic have been very different, when used in Britain, from those experienced in Siberia. There, its influence as a narcotic is so well known, that its vulgar name implies *intoxicating tea*. Its chief use is in gout and rheumatism. The Siberians infuse two drachms of the leaves in twelve fluid ounces of hot water, for a night, in a warm place. This dose is taken in the morning, on an empty stomach: it soon nauseates; and while this continues, no food is allowed to be taken. After some time, it generally produces a copious, black, fœtid motion; and the patient rises free from pain, if the disease be rheumatism: if it be gout, the medicine requires to be repeated for three successive days before the paroxysm yields. Could such effects be obtained from it in this country, it certainly would be a most valuable addition to our Materia Medica.

b. LACTUCARIUM. L. E. D.—The genus Lactuca yields a white proper juice which has much of the sensible properties of opium when inspissated. This juice, termed *Lactucarium*, was first introduced to the notice of the profession by Dr. Coxe, of Philadelphia. An expressed inspissated juice of the lettuce, termed *Thrydacé*, from θρίδαξ, the Greek for lettuce, is used by the Continental physicians.

The Lactucarium is procured from both the L. *virosa* and the L. *sativa*†. M. Schutz procured from one plant of the virosa fifty-six grains of dry Lactucarium, and seventeen grains only from a plant of the same weight of the garden lettuce. The best time for procuring Lactucarium is when the plant is in flower; for at this time the vessels are so turgid with proper juice, that merely touching the flowering pedicels causes it to exude. This effect is justly ascribed to the greatly increased irritability of the plant at this time. When the vessel is excited, the part contracts so suddenly as to burst the coat of the next portion in which the superabundant juice is thrown.

Various means are employed for collecting this proper juice:

* Woodville's Med. Bot. third ed. p. 299, pl. 105. London Dispensatory, art. Rhododendron.

† Woodville's Med. Bot. third ed. p. 76, pl. 31. London Dispensatory, art. Lactuca.

the simplest is to make transverse incisions in the stems of the plants, to scrape off the exuded juice with a thin silver spatula, and collect it in a glass or porcelain vessel, in which it should be left to thicken in the ordinary temperature of the air, or exposed to a heat not exceeding 120° Faht. The *thrydacé* of the French differs in being the expressed juice of the lettuce, and consequently in containing a variety of products besides the proper juice of the plants.

Lactucarium has the colour, and in some degree the odour and taste, of opium. Water dissolves 50 parts in 100 of it: this consists chiefly of mucus and the narcotic principle of the preparation, whatever this may be; the other constituents, according to an analysis of Pfaff, are 8.10 parts of wax, 7.4 of resin, and 22 of caoutchouc. Caventou, Dublane, jun. and Ganzel, examined it expressly with the view of obtaining morphia from it; but could procure none. The narcotic principle of Lactucarium is, therefore, still unknown.

The narcotic properties of lettuce were very early known: Galen, who in the decline of his life suffered from wakefulness, found much comfort in eating a lettuce in the evening; and every one who has indulged in the same luxury must have experienced the soporific effects of this plant. Celsus also mentions its soporific powers: "Somno vero aptum est lactuca, maximeque æstiva, cujus cauliculus jam lacte repletus est*." Dr. Coxe made a set of experiments to ascertain how far Lactucarium resembled opium in its medicinal effects: he found that they were precisely the same as opium: but although it may be used as a substitute for opium by persons who, from idiosyncracy, cannot take opium without suffering, yet its properties are not exactly the same: his results were confirmed by the subsequent experiments of Dr. Duncan, sen. The dose of Lactucarium, in the solid form, is from one grain to twenty grains.

c. ARNICA MONTANA. *Leopard's Bane.* E. D.—The flowers of this plant also possess narcotic powers depending on some unknown principle†. The action of the flowers of Arnica is at first powerfully stimulant, irritating the whole of the alimentary canal when the dose exceeds ten grains: it excites the brain, accelerates the pulse, and increases the function of the skin. These effects may result from one dose, and usually continue longer than twenty-four hours: they are followed by sleep. The flowers of Arnica are seldom or never employed in this country.

d. RHUS TOXICODENDRON. *Poison Oak.* L.E.D. This shrub belongs to the natural order Anacardiaceæ. It is a native of North America‡. The proper juice of the plant is white;

* De Medicina, lib. ii, § xxxii. † Woodville's Med. Bot. third ed. p. 41, pl. 17.
‡ Ibid. vol. v, p. 67. London Dispensatory, art. Rhus.

but it becomes black when exposed to the action of the air, and on this account it is used as a varnish in Japan. A volatile principle is exhaled from the living plant which acts powerfully upon the skin, inflaming and blistering it. Van Mons, who examined this exhalation, states that it is given out chiefly during the night, and is combined with carburetted hydrogen gas. This opinion, however, is of little weight, and merely conjectural.

The leaves, the parts of the plant medicinally employed, yield their virtues both to water and alcohol. Besides their unknown narcotic principle, they contain also a large proportion of tannin, mucus, and extractive; on which account the infusion yields precipitates with sulphate of iron. Acids discolour it; the alkalies greatly deepen the colour.

As a narcotic, the leaves of the Toxicodendron have been much praised by Dr. Alderson, of Hull, in paralysis. They cause a sense of heat and pricking in the affected limb—symptoms that anticipate the relief or the cure of the disease. These facts, which were first promulgated by Dr. Alderson, have not been confirmed by other practitioners in this country; but Dr. Gevesins, in some experiments with this plant in paralytic diseases, found that four out of five of the cases treated with Toxicodendron were cured. He gave it in doses of a quarter of a grain twice a day. The dose may be gradually increased to four grains.

INORGANIC PRODUCTS WHICH OPERATE AS DIRECT NARCOTICS.

ETHER.

* *Free.*

a. ÆTHER SULPHURICUS. *Sulphuric Ether.* L. E. D.—Like all other diffusible excitants, Sulphuric Ether produces narcotic effects; but it is seldom administered except in combination with more decided narcotics than itself.

* * *Combined.*

b. SPIRITUS ÆTHERIS SULPHURICI. *Spirit of Sulphuric Ether.* L. Syn. *Æther Sulphuricus cum alcohole.* E. *Liquor Æthereus Sulphuricus.* D. In whatever manner prepared, this is a simple mixture of Ether and Alcohol. Its narcotic powers are precisely the same as those of Ether. The addition of the aromatics contained in the *Aromatic Spirit of Ether* of the London Pharmacopœia merely renders this preparation more grateful.

c. SPIRITUS ATHERIS SULPHURICI COMPOSITUS. *Com-*

pound Spirit of Sulphuric Ether. L. Syn. *Hoffman's Anodyne*. In preparing Sulphuric Ether, by continuing the process after white fumes are disengaged, sulphurous acid is evolved, and a yellowish fluid, termed *etherial oil*, passes into the receiver: two fluid drachms of this oil and one pint of spirit of Sulphuric Ether form the preparation now under review. The etherial oil has a fragrant odour and a bitter, pungent taste: its specific gravity is 1060. It is to this oil that this preparation is supposed to owe its anodyne and soporific powers. In doses of thirty minims, in a fluid ounce and a half of camphor mixture, this spirit of Ether allays pain and operates as a gentle soporific. It is considerably less exciting than simple Ether.

B. INDIRECT NARCOTICS.

TINCTURES OF NARCOTICS.—All the narcotic substances which have been described may be administered in solution in alcohol, more or less diluted, or in the form of tinctures. In many instances, the quantity of a narcotic tincture is too small for any influence to be attributed to the spirituous vehicle; but this is not always the case; and the custom of prescribing large doses of tinctures in hysterical and hypochondriacal attacks has too frequently produced a propensity for drinking in females—a pernicious habit which is rarely overcome in the softer sex. Independent of this objection to the use of alcoholic tinctures, a question may arise, namely, does the alcohol augment the power of the narcotic dissolved in it? There can be no doubt that the alcohol employed aids the introduction of the narcotic principle into the system, and enables it to be more directly applied to the nervous centres. Nor is this opinion at variance with the doctrine which I maintain of narcotics acting through the nerves; for the impression must, in either case, be communicated to the nervous centres before it can be extended to the whole system. Where the narcotic possesses decided stimulant as well as sedative principles, the addition of diluted alcohol, in the small proportion contained in the dose of an active medicine, does not interfere with its operation; but when the sedative principle predominates—as, for example, in henbane—and when we wish for its influence chiefly to be exerted, then undoubtedly the extract is to be preferred to the tincture. On the other hand, where it is necessary to stimulate, and at the same time to produce an anodyne effect; where sleep is not so much the object to be attained as the abatement of pain, under such circumstances, tincture of opium and other narcotic tinctures are well fitted to fulfil the indication. Upon the whole, however, few medicines require more judgment for their proper administration than the narcotic tinctures.

n. VERATRIA.—This is an alkaline principle which was discovered by MM. Pelletier and Caventou* in the seeds of Veratrum *Sabadilla*, the roots of Veratrum *album*, and in the Colchium *autumnale*. It is a white, pulverulent, very acrid, inodorous substance, displaying an alkaline reaction, scarcely soluble in cold water, and requiring even a thousand parts of boiling water for its solution. It is very soluble in alcohol, in ether, and in all the vegetable acids, saturating them and forming neutral and uncrystallizable salts. With sulphuric acid it affords a bisulphate which can be imperfectly crystallized. Nitric acid decomposes it and produces a yellow detonating substance allied to the bitter principle of Welther. Iodine changes its white hue to a tarnished yellow; Brome to a pale yellow. According to Pelletier and Dumas, it consists of Carbon 66.75, + Oxygen 19.67, + Hydrogen 8.54, + Nitrogen 5.04, in 100 parts. Veratria fuses at a temperature of 122° Faht., and, on cooling, assumes the appearance of pale amber. A higher temperature decomposes it, producing the same results as on the other alkaloids.

In minute doses, Veratria stimulates powerfully the mucous membrane in whatever manner it is applied to it: thus, if taken into the mouth, it excites salivation; if snuffed up the nostrils, the most violent sneezing; if taken into the stomach, it stimulates both the orifices of the gall-ducts and the intestinal nerves, causing the most abundant discharge of bilious, watery stools; and if the dose exceed a quarter of a grain, violent vomiting is induced. It has lately been externally used, as an ointment or liniment, in combination with twenty-three parts of lard; but I have not found that it is more useful than many other counter-irritants. Veratria is chiefly used in the form in which Nature has produced it in Colchicum.

Colchicum *autumnale*†, Meadow Saffron, is a bulbiferous plant, found in moist meadows, in many parts throughout southern and temperate Europe, and very abundantly in England: it belongs to the natural order Colchicaceæ. The *bulb* is at its perfection, in this country, in June and July; but locality and climate modify this greatly. Thus Maranta and Haller state that it is sweet or tasteless and inert in the autumn, and may then be eaten: Krapf says that it is eaten in the autumn in Carniola and Istria. The perfect bulb, when cut transversely, exudes a white juice, which has a sweetish, biting, acrid taste, and exhales an odour that irritates the mucous membrane of the nostrils. The juice is often so acrid, that Stoërck asserts that on rubbing some of it on his tongue, it swelled, became rigid, and continued as if benumbed for six hours. It is very poison-

* Ann. de Chimie et Phys. t. xiv, p. 69.

† Woodville's Med. Bot. third ed. p. 759, pl. 258. London Dispensatory, art. Colchicum. Richard, Hist. Nat. Med. t. i, p. 353.

ous to dogs; thence the Dutch name *Hundes hoden*, and the French name *Tue-chien*. The Swiss peasants tie the bulbs round the necks of their children, as amulets. When the bulb is good, it is heavy, firm, and when cut transversely, is nearly an entire oval; when it is bad and shrunk, the slices are panduriform. According to the analysis of Pelletier and Caventou, it contains—1. a fatty matter, formed of stearine, elaine, and a peculiar volatile acid; 2. Veratria combined with gallic acid; 3. a yellow colouring matter; 4. gum; 5. starch; and 6. inulin in abundance, besides ligneous matter. Veratria is probably contained, in combination with an unknown acid, in the bulbs, the flowers, and the seeds of the Meadow Saffron; for although Pelletier and Caventou state this to be the gallic, yet this is doubtful.

If the flowers be macerated in wine, the salt of veratria which they contain is taken up, and a preparation equal in efficacy to the wine of the bulb is produced. In a similar manner the seeds also yield the veratria to wine, and yield a very active preparation. The veratria resides in the testa of the seeds, which, therefore, do not require to be bruised when put into the wine.

Notwithstanding what is recorded regarding the impunity with which the bulbs of Colchicum *autumnale* have been occasionally eaten*, there is no doubt that the whole plant is a very active poison. Garidel, in his work, "Les Plantes d'Aix," relates that a man having eaten the flowers of Colchicum, as a remedy against ague, was affected with violent pains of the bowels and other pains for several days. John Agricola Ammonius has recorded a case of two boys who were killed by eating the flowers, whilst playing with them in a field; and several cases are recorded in which children have fallen victims to the poisonous properties of the seeds. I have seen two cases of poisoning from an overdose of the wine of the bulb; and in the 14th vol. of the Edinburgh Journal, a case of this kind is detailed: a man took f℥iss of the tincture by mistake, and died in forty-eight hours, after suffering much from vomiting, acute pain of the stomach, colic, purging, and delirium. Dr. Schobel, in a thesis published at Tubinjin, in 1817, has accumulated much authentic information on this subject. He states that Colchicum is poisonous to animals of all classes—horses, dogs, cats, rabbits, jackdaws, starlings, frogs, snails, and even flies; and that it acts in whatever way it is introduced into the

* All the species of Colchicum yield veratria; but, from comparative experiments on four different species, I found that the *Autumnale* yields the largest proportion, and consequently is the most active as a medicine; and the *Byzantium* yields the smallest quantity, one fourth only of that in the Autumnale: thence I am inclined to think that the bulbs of Colchicum which have been eaten with impunity, belong to the species *Byzantium*

system, whether taken into the stomach, injected into the windpipe, or applied to an external wound. Instinct leads quadrupeds to avoid the foliage in the fields; but when it is eaten mixed with other food, it powerfully affects them, causing purging of blood, inflammation, and sometimes gangrene of the intestines. In the cases of poisoning with the solution of the bulb in wine, which came under my notice, the symptoms were great anxiety, violent agitation, tremors of the extremities, vomiting, bloody diarrhœa, cold clammy sweats, and such prostration of strength as soon terminated fatally. In some of the recorded cases, it appears to have acted locally on the gullet and stomach, producing a sensation of burning in those parts; with giddiness, blindness, and dilated pupils. Post-mortem examinations display appearances of violent inflammation in the gullet, stomach, and colon; and, in some instances, through the whole mucous membrane of the intestinal canal. Some idiosyncracies resist the poisonous effect of Colchicum in an extraordinary degree.

Notwithstanding these violent effects of Colchicum, it is a very efficacious and valuable medicine. It was employed by the ancients under the name of Hermodactyllus; and as such, it was sold in the druggists' shops in this country in the time of Turner, the herbalist. Alexander Trallianus, a Greek physician, first recommended it in gout. Paulus Ægineta extols it as a *purgative* in pains of the joints; and it was, after this period, very generally employed, until some circumstances again threw it out of use, when it was only occasionally resorted to as a diuretic. The surprising effects of an empirical French remedy, the eau medicinale, again brought Colchicum into notice, and few medicines are now so generally employed.

Colchicum, consequently Veratria, exerts a double action on the living system—a local stimulant influence and a narcotic sedative effect; which is probably the result of the prior stimulant action. It operates chiefly on the duodenum; exciting powerfully the excretory ducts of the liver and pancreas, producing copious bilious stools, diminishing febrile action, and allaying pain. It is chiefly from its operation on the bowels, that its beneficial effects in gout and rheumatism result. Colchicum, nevertheless, is generally supposed to exert some specific influence in gout and rheumatism. This is a doctrine which I cannot understand; but I can fully comprehend how gout and rheumatism are relieved, by emptying the gall ducts and carrying a large quantity of vitiated secretions out of the habit. Its local influence on mucous surfaces generally, when it is applied to them, throws considerable light upon the rationale of its action: by causing a determination of blood to so great an extent of surface as the mucous lining of the intestines, the inflammatory action going on in the joints will necessarily be

lessened, on the principle of counterirritation; at least, it is only in this manner that its influence can be satisfactorily explained. Its primary action is purgative; its secondary indirectly narcotic. Much of its efficacy depends on the mode of preserving the parts of the plant employed: if the bulb be the part, it should be sliced very thin, and the slices dried in an obscure place at a temperature of 70° Faht. During the drying, each slice should be placed separately, on clean, colourless, bibulous paper, and turned twice: as soon as they are dry, they should be put into a well-stopped bottle. The *flowers* gathered when they are fully blown, in dry weather, and gently pressed between bibulous paper, may be reduced to powder, and preserved in a well-stopped bottle. The *seeds* should be gathered when fully ripe: as they undergo no change, even when exposed to the atmosphere, little care is required to preserve them in a state for fit use.

The preparations of Colchicum are made with alcohol, wine, and vinegar. Sir C. Scudamore prefers the tincture, and states that proof spirit is the best solvent of the active principles; but its only advantage is, that the starch, gum, and inulin are not taken up by the alcohol; and, therefore, it may be regarded as an alcoholic solution of the salt of veratria*. With regard to its superiority, experience only can determine whether a gallate, a tartrate, or an acetate of veratria be the best medicine. As far as my own experience authorizes me to decide, the wine is the preferable medicine. This is ordered to be prepared with the recent bulb, by the London College, without wine! But even if wine were the vehicle, the fresh bulb is highly objectionable, from circumstances which we cannot controul; namely, soil, climate, season, and other accidental occurrences: as the quantity of fluid contained in the bulb must vary and necessarily alter the strength of the preparation. If the bulb be taken at a proper time and carefully dried, the dry sliced bulb is to be preferred for making the wine. Sherry wine contains free tartaric and malic acids; but it has not yet been determined whether the salt of veratria contained in the wine of Colchicum be a tartrate or an acetate. The wine formed with the seeds is milder in its operation than that made with the bulb. It is prepared by digesting ℥ii of the unbruised seeds in two pints of sherry, for eight days. As I have said, the seeds should remain entire; for if these are bruised, the preparation is less clear and more liable to spoil, from the admixture of the feculaceous matter of the cotyledons. The oxymel and vinegar shall be noticed under the head of Diuretics.

The powder of Colchicum may be employed instead of any

* This salt, as I have already stated, is asserted to be a gallate; but this is questionable.

of the preparations which I have mentioned; and in the diseases of infancy and childhood it is the best form of giving the remedy. The dose of the powder is from gr. iii to gr. ix; that of the tincture and the wine from m. xv to f3i; repeated every eight hours. Neither acetate nor subacetate of lead can be administered with the wine, insoluble compounds being thrown down, independent of the veratria, thus defeating the purpose for which the salts of lead are administered. In gouty affections, the tincture and wine are usually combined with magnesia, on account of the acescent state of the stomach in gout, independent of any influence it has on the Colchicum: but I am inclined to think that the magnesia acts an important part in the operation of the medicine, by preventing the decomposition of the gallate or salt of veratria, whatever that may be, and the formation of the acetate, which, instead of operating on the gall-ducts, and as a secondary sedative, would act solely on the kidneys. It may, however, be contended, that this diuretic influence is beneficial: in the decline of every gouty paroxysm, a large excretion of uric acid takes place as a critical discharge; and Chelius ascertained that one of the effects of Colchicum on the kidneys is to augment the quantity of this excretion. Thus, he found that, on the fourth day after taking Colchicum, the quantity of uric acid excreted was 0.069 parts: after four days more using it, the quantity was 0.076 per cent.: in eight days, 0.091: in twelve, 0.112, or nearly double. We may nevertheless conclude that Colchicum in gout exerts only a secondary narcotic influence: the unloading the biliary system, by diminishing morbid excitement, effects the same result in painful inflammatory diseases, as if it were a direct Narcotic, with this superior advantage, that the benefit is more permanent.

C. MENTAL NARCOTICS.

Our passions, medically considered, are phenomena which produce decided effects on our corporeal frame—frequently causing diseases, sometimes curing them. Those persons who are endowed with great nervous sensibility are for the most part powerfully effected by mental pleasures and pains: and therefore, when the higher orders of society, and men of intellectual acquirements, are affected by mental diseases, it is sometimes necessary to employ Mental Narcotics, if the material fail in procuring repose. Let us examine briefly the manner in which these operate.

Mental impressions act upon the nervous system in general, and rouse or depress according to circumstances. If we select *Music* as illustrative of the manner in which Mental Narcotics operate, we find that the first effect of its impression is that of

an excitant; it rouses the attention: but the repetition of the impression at length exhausts, in the same manner as follows the repetition of any series of stimulant impressions of the same kind, and sleep is induced. It may be supposed that the Music, operating upon the auditory nerves, can scarcely be regarded as a Mental Narcotic: and, assuredly, simple sounds, unless so combined as to produce agreeable emotions, sufficiently powerful to withdraw the attention of the sufferer from the train of morbid associations which characterize his disease, are followed by no anodyne nor soporific effect. In this respect, therefore, although the primary impression be made upon a corporeal organ, yet the secondary influence is mental. It must, however, be recollected that it is not mere succession of sounds that causes this effect, but the repetition of the same combination of sounds or impressions. Were they much varied, the opposite effect would result; for it is a well-known law of the system, that a variation of a stimulant impression renews the excitement in such a manner as to be much less likely to be followed by collapse than when there is a repetition of the same impression. To illustrate this, I need only refer to the effect of listening to the gurgle of the mimic cataract of some mountain rill; or to that of any small waterfall: how decidedly is felt the influence of the monotony of the sound gradually disposing to sleep. It is a common observation that a dull sermon is a good soporific: but I am of opinion that it is less the dulness of the matter of the sermon, than the monotonous manner in which it is read, which produces this effect. Now, Music operates in the first instance on this: in the second, by the associations which it engenders. If it be slow and plaintive, the impressions are longer continued, less varied, and therefore more soporific; and along with this we must also take into account the sedative influence of all depressing passions; and the melancholy, which is the effect of plaintive music, is one of these. This power of Music is much increased, also, by the period of the day and the situation in which the listeners are placed. In some peculiar cases of insanity, therefore, where Music is advisable as a soporific, the evening is the best period for trying its effects; and this period is chosen, also, for the further reason, that when sleep is induced, there is much less likelihood of its being disturbed than if it occurred in the day. In the application of this Narcotic, the chief difficulty arises in determining the character of the individuals, the nature of the attack, and the kind of Music best fitted for the occasion. In some, it should be such as may withdraw the mind of the patient from old associations, and turn his ideas into an entirely new channel: in others, it will prove most salutary if it recall his mind to former habits, and spread before the imagination the scene of past hours, in which domestic happiness reigned

undisturbed in the bosom of the sufferer. Under such circumstances, the cloud which has settled upon the mind may be happily dispersed, and Reason restored to her seat.

The effects of gentle and slow friction in producing a narcotic result are referrible to the same principle, the repetition of an agreeable impression on the nervous system. I have witnessed the powerful influence of gentle friction, in producing sleep, in many instances. In cases of pain, in particular, gentle friction produces a considerably soothing effect, by transferring the attention from the seat of the pain to the mild and agreeable impression of the friction: and this is still more powerful, if to this impression be joined sound, which, although operating on a distinct sense, yet, by the combination, is powerfully soporific: thus, the patting of an infant on the back, whilst at the same time the nurse hums a monotonous tune, is almost sure to procure sleep. I could adduce many instances of the excellent therapeutical effect of such Narcotics.

SECTION VI.

ANTISPASMODICS.—MEDICAMENTA ANTISPASMODICA.

ANTISPASMODICS are usually defined "substances that allay irregular muscular contraction."

Whatever be the nature of the ultimate fibrils of muscles, it may be affirmed that muscular contraction is solely attributable to the nervous system. The extremities of the nerves are so intimately connected with the muscular fibrils, that we have no reason for supposing the existence of the one independent of the other; and it is now fully acknowledged, that the absence of sensation is no proof that a muscular, or contractile organ, is not amply supplied with nerves. In stating this opinion, however, I must also declare that I do not hesitate to accord with the assertion of Prevost and Dumas, that the nervous fibrils are not lost by amalgamation in the muscular fibres, but return or anastomose with other nerves: but, notwithstanding the correctness of this opinion, we acquire little light from it on our investigation. What does anatomy teach us respecting muscles? That they are fasciculi of many filaments of muscular fibres, attached to parts intended to be moved; that these fibres are united to one another by the medium of cellular matter: and that they are supplied with ar-

teries, veins, lymphatics, and nerves, which ramify through this tissue. Whatever may be the impulse given to the muscle in moving a part, it contracts or shortens its length between the extremities. The physiologists whom I have mentioned, Prevost and Dumas, assert that muscular contraction is an electrical phenomenon; and they suppose the approximation of the nervous filaments to one another, drawing the muscular fibres into angles, is the cause of muscular contraction. How very imperfect is this explanation! how very imperfect all that has yet been attempted! The rationale is incompatible with, and far beyond, the highest powers in physics; it leaves at an immeasurable distance those of chemistry; and we must acknowledge, that it is a *vital phenomenon* of which we know nothing.

Whatever may be the immediate cause of the contraction of a muscle, therefore, we can only affirm that it is an action attributable to the motor nerves connected with the muscle; whether the stimulus or exciting power be mental or corporeal. The motion which is induced is transitory, and always followed by a state of rest: and it is this alternation of action and quietude, under due regulation, that constitutes the distinction between *regular* and *inordinate* muscular motion. If, after a muscle or any set of muscles have contracted, the contraction remains when the exciting cause has ceased to operate, this constitutes *spasm;* or, if motions occur in the voluntary muscles, independent of the will, this constitutes *convulsion.* Now, these states are frequently the result of irritation communicated to the origin of the nerves, or to their sentient extremities. In some instances, also, inordinate action in the muscles is the consequence of too great susceptibility of impression, owing to a want of tone. Whatever, therefore, removes the irritating substance which has produced the spasmodic contraction, whatever resolves this state, whatever prevents its recurrence, by giving tone, is an Antispasmodic.

If narcotics allay irritability and sooth pain, and if tonics diminish the morbid susceptibility of impression, it may be reasonably demanded in what do they differ from Antispasmodics? The chief circumstance in which Antispasmodics differ from narcotics and tonics is, that the former is not followed by the insensibility to impressions and the collapse which invariably follow the use of narcotics; and that they operate more quickly than tonics: they are more powerful than narcotics, more rapid than tonics, in repressing inordinate muscular motion.

In explaining the difference between a narcotic and an Antispasmodic, I may hazard the opinion, that it is probable that the impression in the extreme nerves made by a narcotic must be communicated to the brain before the effect is produced; whereas that of the Antispasmodic produces an immediate and

more permanent result by some change produced in the state of the motor nerves, independent of any communication with the sensorium. But, whatever may be their mode of action, the distinct nature of an Antispasmodic, acting simply as such, is very obvious; and Antispasmodics may be regarded as holding an intermediate place between *Narcotics* and *Tonics;* less diffusible, but more durable in their effects than the former; more immediate, but less permanent than the latter. Another point requires consideration—are Antispasmodics stimulants or sedatives? If my hypothesis be correct, it might be supposed necessary that they should operate by a sedative influence; for, if the irregular or inordinate action which they overcome be the consequence of irritation, either mental or corporeal, it follows that, in resolving spasm, the susceptibility of impression in the extreme motor nerves must be diminished; and this, it may be said, can only be the result of a sedative power. It may, however, be either immediate or consecutive of a previous stimulant operation; thence we can explain the reason why some of those medicines, which can only be regarded as direct Antispasmodics, stimulate the general system, and, consequently, first quicken the pulse; since, like narcotics, this action may be primarily stimulant, and be quickly followed by collapse. According to this mode of reasoning, the same results may follow from Antispasmodics operating exclusively on the motor nerves, as from narcotics operating on those of sensation.

The effects of Antispasmodics are generally perceptible very soon after their administration; but this must necessarily depend on the cause of the spasm. If, for example, in blood-letting, the quantity of the vital fluid abstracted is more than the condition of the system can support, nothing is more common than the syncope to be attended with convulsions: on the other hand, if fulness of the vessels of the brain, sufficient to produce epilepsy, or some degree of inflammation, as in phrenitis, is attended with convulsions, the influence of Antispasmodics is soon perceived. It should, however, be remembered, that although Antispasmodics are indicated and proper in the second state, just described, yet, this class of medicines is positively injurious when the spasmodic action is the consequence of inflammation of the brain or spinal marrow, or their coverings: under such circumstances, blood-letting and measures calculated to subdue the primary disease are the means to be adopted. It is also necessary to recollect, that the operation of Antispasmodics is transient, and that by frequent repetition their influence on the nervous system is much impaired: the dose, therefore, requires to be greatly modified, according as the patient has or has not been accustomed to their influence.

Antispasmodics, as far as regards their mode of operating,

may be divided into *Direct*, or those which exert their influence on the nervous energy, but neither as narcotics nor tonics: and *Indirect*, or those which, being narcotics and tonics, produce an antispasmodic effect.

TABLE OF ANTISPASMODICS.

A. DIRECT ANTISPASMODICS.

* *Organic Products.*

a.—ANIMAL RESIN—
combined with Volatile Oil, in
Musk.
Var. α.—Chinese Musk;
β.—East India Musk.
Castor,
Var. α.—Russian Castor;
β.—Canadian Castor.

b.—EMPYREUMATIC OIL:—contained in
Dippel's Oil;
Oil of Amber.

c.—VOLATILE OIL—in

Valeriana *officinalis.*	3.	1. Valerianeæ.

d.—GUM-RESIN—in

Ferula *Assafœtida.*	5.	2. Umbelliferæ.
——— *Communis.*	–.	–. ———
Bubon *Galbanum.*	–.	–. ———
Pastinaca *Opopanax.*	–.	–. ———

* * *Inorganic Substances.*

e.—BITUMENS:—
Naphtha;
Petroleum;
Asphaltum.

B. INDIRECT ANTISPASMODICS.

* *Material.*

f.—TONICS and NARCOTICS.

* * *Mental.*

g.—FEAR.
h.—ABSTRACTION.

ORGANIC ANIMAL AND VEGETABLE PRODUCTS WHICH OPERATE AS DIRECT ANTISPASMODICS.

1. MOSCHUS, MUSK, L. E. D.—This is the secretion of an animal having a near affinity to the deer tribe, the Moschus *moschiferus*, a native of Thibet, China, and Siberia; belonging to the order Ruminantia of Cuvier*. The Musk is contained in a bag, which lies close to the skin of the lower part of the belly of the animal, immediately before the prepuce; it is an appendage only of the male. This bag is flat, oval, covered on the convex surface with stiff hairs, and lined by an irregularly plaited membrane: it has a small orifice. It is always full of Musk in the adult, and empty in the young deer; the quantity is greater, and the quality of the Musk better, if the animal be taken during the rutting season. The skin which covers the musk bag has few vessels, but the cellular matter contains a great many; and the bag, internally, presents small, unequal valves. The Musk Deer is a timid animal: it rarely appears during the day; consequently, the Musk collectors watch and surprise it at night.

Two kinds of Musk are found in the market: one variety, the Tonquin or Chinese, has the bag covered with reddish or cinnamon-coloured hairs: in the other, called Kaburetin, or East Indian, it is covered with coarse white hair. The Tonquin is the best: it should always be bought in the bag or *pod*. The Bengal Musk is inferior to it in every respect; and a still baser sort is brought from Russia, the production of Siberia. The Musk itself is in concreted, brown, granular masses, slightly unctuous, and free from grittiness when rubbed between the fingers. It is bitter and somewhat acrid to the taste; its odour is powerful and astonishingly durable. In many individuals the odour of Musk causes headache; and, in some instances, when it is strong, convulsions. It burns readily, and leaves a light, spongy charcoal. Boiling water takes up about eighty parts in one hundred of Musk; the infusion affords precipitates with sulphate of iron, bichloride of mercury, nitrate of silver, and infusions of astringent vegetables. Alcohol dissolves fifty parts in one hundred: and forms a tincture of a reddish-brown colour, giving scarcely any odour of the Musk, unless water be added to it, which instantly developes the odour. Ether takes up nearly the whole of the Musk.

According to the analysis of Blondeau and Guibourt, Musk consists of — *stearine; elaine; cholesterine; a volatile oil; an acid oil* combined with ammonia; *free ammonia; muriates of*

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* Règne Animale, t. i, p. 251. London Dispensatory, 6th edit. p. 444.

ammonia, *potassa*, and *lime;* an undetermined *acid*, combined with *ammonia*, *potassa*, and *lime; gelatin; albumen; fibrin; carbonized matter*, soluble in water; *carbonate* and *phosphate of lime; water**. In this long list no mention is made of resin; which, however, can be readily separated by ether, from which it is deposited on the surface of the water.

Musk, in moderate doses, operates on the nerves of the stomach; causing, when this organ is in an irritable state, nausea, and a sensation of heat at the epigastrium. If the dose be repeated at short intervals, it acts as a general excitant, increasing the force and quickness of the circulation, and exciting perspiration. It is taken into the circulation, and the odour of the drug becomes evident in the urine, the sweat, and other excretions: and, in post-mortem dissections of persons under a course of Musk, every cavity and tissue is found to be penetrated by it.

Musk is more employed as an Antispasmodic on the Continent than in Britain, which is partly attributable to the high price of the drug. It has been found useful in hiccough, palpitation of the heart, and in spasms of the stomach and intestines, depending on some sympathetic irritation of the spinal and ganglionic nerves, when administered in doses of a scruple, repeated every four hours†; and, at the same time, it acts as a cordial and diaphoretic. In epilepsy, Musk has been highly extolled: but the causes of this disease are so various, that the remedy which is valuable in one case, is perfectly useless in other instances. When the disease is periodical, and apparently connected with some derangement of the nervous system, then Musk may prove beneficial: but if it arise from any organic affection of the encephalon, or from any mechanical irritation within the cranium; from hypertrophy of the left ventricle of the heart; or from any cause of a similar kind, then Musk is of no value. When the epileptic attacks are idiopathic, if no causes such as I have enumerated are very obvious, we may anticipate some benefit from the administration of Musk, provided the dose be carried to its full extent. Thus, in one very severe case which came under my care, the dose was carried to the extent of ʒi, and repeated every sixth hour. The intervals between the paroxysms were strikingly lengthening; so that, instead of occurring three times a day, they were protracted to once in six weeks. In judging, however, of the value of Musk as an Antispasmodic, we must take into account both the genuine character of the medicine and the condition of the patient at the time of prescribing it: when the medicine is good, and given in large doses, and the circumstances are such as fairly indicate its employment, Musk may be regarded as a useful antispasmodic; but less so than many others.

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* Guibourt's Hist. de Drogues Simples. † Clark on Diseases of Long Voyages.

b. CASTOREUM, Castor, L. E. D.—This is also an animal secretion, peculiar to the beaver, Castor *Fiber*. It is deposited in sacs, of a pear shape, situated beneath the skin of the abdomen, in an opening common to the parts of generation and the anus of the animal. The beaver is an amphibious animal, inhabiting rivers and lakes in the North of Europe, Asia, and America; belonging to the order Rodentia of Cuvier*. The best Castor is that which comes from Russia; but it has been very rare of late years; and almost all now found in the market is imported from Canada: the former is in roundish, solid pods, smooth on the outside, and, when cut, presenting an orange-coloured surface: the latter is oblong, thin, and corrugated on the outside, and deeper coloured than Russian Castor. The Russian, when treated with ammonia, affords a whitish, the Canadian an orange-coloured product. Castor has a strong, peculiar, somewhat aromatic odour; and a bitter, sub-acrid taste. The odorous principle is dissipated in forming the decoction, which displays an alkaline reaction. Both alcohol and ether take up all the active principles of Castor, and retain its odour and taste. According to Bonn, Castor contains an etherial oil, cholesterine, resin, lime, iron, and some salts: Bouillon Lagrange and Laugier found a volatile oil, benzoic acid, resin, adipocire, a colouring principle, mucus, subcarbonate of potassa, lime, ammonia, and iron. M. Bizio obtained from it a peculiar crystalline matter, which he called *Castorine;* having the odour of the Castor, and a styptic taste.

Castor is supposed to operate chiefly on the cerebro-spinal nerves. In moderate doses, it causes a sensation of heat in the stomach, and accelerates the pulse; it enters the circulation, and displays the presence of its odorous principle in the urine. Its influence in hysteria and other spasmodic affections was at one time conceived to be considerable: but recent experience has not confirmed this opinion. The dose of Castor is from gr. x to ℈i; but it may be given to almost any extent.

c. ANIMAL OIL OF DIPPEL.—This is a volatile oil, procured by the distillation of bones, albumen, and gelatin, in close vessels. It floats on the water which passes over; and is easily separated. It is the result of the process. According to the degree of heat employed, it is more or less coloured, transparent, and thick: its odour is strong and unpleasant, yet somewhat aromatic: it is very volatile, partially soluble in water, and greens the vegetable blues. The ammonia to which this is owing may be separated by means of hydrochloric acid. All the acids dissolve it, forming imperfect soaps. Strong nitric acid sets it on fire. It combines with alkalies, oil, alcohol, and ether; and is much deepened in colour by exposure to the air and light. It

* Règne Animal, t. i, p. 189. London Dispensatory, art. Castor.

possesses the singular property of burning well in an atmosphere containing only eighteen per cent. of oxygen.

This oil, which received its name from Dippel, a German chemist, who first procured it, was at one time regarded as a powerful Antispasmodic, and employed in epilepsy by Boerhaave, Juncker, and Hoffman. Dippel's oil has, nevertheless, deservedly fallen into disuse, although it is still prescribed on the Continent in symptomatic cases of epilepsy. Alibert made some experiments with it at the Hospital of Saint Louis, and found that it prolonged the intervals between the epileptic fits; but it did not appear to diminish the violence of the disease.

d. SUCCINI OLEUM, *Oil of Amber*, L. E. D. is a pyrogenous oil, procured by destructive distillation from Amber.

Amber, Succinum, has been regarded as a gum-resin; but a recent analysis of Berzelius has separated it from the gum-resins. It may, however, be regarded as a modification of resin, as it has more analogy to resin than to any other substance. Berzelius found it to contain—a small quantity of volatile oil; a yellow resin intimately combined with this oil; another resin little soluble in cold alcohol, but soluble in boiling alcohol, ether, and alkalies; and a principle closely resembling *lac*. Amber is found in various parts of the world, but in greatest quantity in coal strata, on the shores of the Baltic. As the strata containing it run under the shores of the Baltic, it is thrown up by storms, and is found floating on the banks of Samland near Pillaw. There are two subspecies:—1. White Amber, which has a pale straw colour; 2. Yellow, which has the colour of yellow wax, passing into yellowish-brown and hyacinth-red. It is a brittle, transparent, light, inflammable substance, insipid, with a slightly fragrant odour when it is pulverized; possessing considerable lustre, and a sp. gr. 1.065: it is scarcely soluble in water at any temperature; slightly so in alcohol; it dissolves in boiling liquor potassæ, and forms a saponaceous solution not decomposed by water. Sulphuric acid acts upon it in the cold, converting it into a dark-coloured, resinous mass: nitric acid does not decompose it, but, by long boiling, dissolves it. Muriatic acid and the weaker acids do not act upon it.

When Amber is distilled, an oil and succinic acid come over. This oil, redistilled, has a strong ungrateful odour and a hot, acrid taste; is light, volatile, and inflammable; insoluble in water, and only partially soluble in alcohol. It resembles naphtha more than oil.

Oil of Amber possesses antispasmodic powers, and was formerly administered, internally, in hysteria, and other convulsive diseases, in doses of from five to twenty minims, diffused in aqueous fluids by means of mucilage. It is now scarcely ever used, except externally; as the active ingredient in some empirical embrocations: one of these, Roche's, which M. Brande

informs us is a compound of equal parts of Amber and oil of cloves, dissolved in two parts of olive oil, has obtained much celebrity for curing hooping-cough. It is, however, greatly inferior to Belladonna and Conium, in this disease.

e. VOLATILE OILS.—All volatile oils possess more or less antispasmodic powers; but that immediately before us is a component in the root of the Valeriana *Officinalis*, a plant which is a native of Greece and the temperate parts of Europe, the type of the natural order Valerianeæ*. In high situations, Valerian roots contain not only more volatile oil, but that which they possess is of a more stimulant nature than when the plant grows in low and moist situations; and those plants only ought to be employed which are grown on elevated spots. The strong peculiar odour of Valerian is due to its volatile oil of the roots; its odour in a confined situation affects strongly the brain, and produces symptoms of intoxication in some quadrupeds, more especially the cat, who is powerfully attracted by it. Tromsdorff analysed Valerian, and obtained—a peculiar principle soluble in water, but insoluble in alcohol; a dark-coloured resin; a volatile liquid oil, camphor, fecula, a gummy extract, and lignin†. Valerian is administered in the form of powder, infusion, extract, and tincture. The extract is a useless form of preparation; and, although the infusion possesses some of the active properties of the plant, yet it is undoubtedly less powerful than either the alcoholic or ammoniated tincture. Where there is much nervous irritability, accompanying a weak and languid circulation, and more especially in hysterical habits, the ammoniated tincture of Valerian has been found very beneficial. It seems to act chiefly by soothing the nervous turbulence. With regard to its general antispasmodic powers, there is much diversity of opinion. In epilepsy, it proves useful only when the disease is symptomatic, in which case it both shortens and weakens the force of the paroxysm and lengthens the intervals. It has also been employed in chorea and catalepsy, but with little advantage. In asthma, its influence is considerable in relieving the paroxysm; and, in conjunction with sulphate of zinc, in the intervals, it tends to ward off the attacks, if no inflammation be present. Tissot was of opinion that much of the apparent diversity of its action depends on the condition of the patient; and he found that it often afforded much relief after the use of the lancet, when it had previously failed to produce any benefit.

It may be given in the form of powder, in doses of ʒi to ʒii; but the tincture is preferable, especially the ammoniated, when circumstances permit it to be used.

f. GUM-RESIN.—All the antispasmodic Gum-resins are se-

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* Woodville's Med. Bot. 3d edit. p. 77, pl. 32. London Dispensatory, art. Valeriana Richard, Hist. Nat. Med. t. ii, p. 270. † Bulletin de Pharmacie, tome i.

cretions of plants belonging to the natural order Umbelliferæ. They are combinations of resin, gum, extractive matter, volatile oil, and some other substances. The resins and oil are soluble in alcohol; the gum and extractive in water: thence proof spirit is the proper solvent of Gum-resins. They are soluble also in the alkalies; but not in sulphuric ether. The following table displays, at one view, the composition of the antispasmodic Gum-resins.

Components in 100 parts.	Assafœtida according to Pelletier.	Galbanum according to Pelletier.	Sagapenum according to Pelletier.	Opopanax according to Pelletier.
Resin	65.00	66.86	54.26	42.0
Gum	13.60	19.80	33.34	33.4
Volatile oil	3.60	——	10.20	5.9
Wax	——	——	——	.3
Extractive	——	——	——	1.6
Fecula	——	——	——	4.2
Lignin	——	——	——	9.8
Bassorine	11.66	——	——	——
Malate of lime . . .	0.30	——	——	——
Malic acid	——	——	——	2.8
Loss	5.04	4.34	2.20	——

1. *Assafœtida.* L. E. D.—This is the concrete proper juice of the root of the Ferula *Assafœtida*, a native of Persia*. In the recent root, this secretion is in the form of a thick, milky-looking, fœtid juice, which, when inspissated by spontaneous evaporation, is the Assafœtida of the shops. It is collected at that season of the year when the stem of the plant, which is annual, is beginning to wither. This is separated, or rather torn from the root, which is then laid bare by digging the earth from it, and sliced transversely. The milky juice instantly exudes, and, after being left for forty-eight hours to inspissate, is scraped off, and a fresh surface exposed by another transverse slice: and in this manner the root is exhausted.

Assafœtida is in irregular masses, adhering to one another, externally of a brownish-yellow colour, interspersed with shining tears of a whitish, or reddish, or violet hue. The clearer the mass, the paler the redness, and the more numerous the tears are, the better is the Assafœtida. It is sometimes, but very rarely, seen in the form of tears, or distinct, small, granular masses, of a dull white and pink colour, a most fœtid powerful odour, bitter and subacrid taste. This is the finest kind of Assafœtida. By exposure to the air it becomes brittle; but,

* Woodville's Med. Bot. third ed. p. 10, pl. 43. London Dispensatory, art. Assafœtida. Richard, Hist Nat. Med. t. ii, p. 385.

even in this state, it cannot be pulverized unless it be triturated with carbonate of ammonia. It is heavier than water, its specific gravity being 1.327. Assafœtida, when triturated with water, forms a milky-loking emulsion, which gradually lets fall the resin. Alcohol, digested on it, dissolves about sixty-five per cent. which is nearly pure resin: the addition of water renders the tincture milky; but it is not precipitated by that fluid. Its odour, and probably much of its medicinal power, depends on the volatile oil, which can be separated by distillation with water: it amounts to scarcely four per cent. Brugnatelli says that what has been termed gum is extractive; but when the watery emulsion is shaken in chlorine, no extractive is separated; and no precipitate is produced by muriate of tin dropped into the aqueous solution. Assafœtida, according to Brandes, contains also traces of phosphorus, and several earthy salts, with sulphate of iron. Besides forming an emulsion with water, Assafœtida is soluble in vinegar, proof-spirit, and in the yolk of egg*.

Assafœtida owes its medicinal powers to its volatile oil; it is a stimulant Antispasmodic, and, as such, has been much administered in asthma, hooping-cough, and other spasmodic diseases. Cullen regarded it as the best of the expectorants in spasmodic asthma; but much is due to its power of resolving spasm. It has been found serviceable as an Antispasmodic, even when applied externally; and, for this purpose, it is easily formed into a plaster by triturating it with camphor, which promotes its softening.

Assafœtida appears to operate chiefly on the spinal nerves, in a manner not well understood: it is equally serviceable whether taken into the stomach or injected into the rectum. When it disturbs the action of the stomach, the heart, the diaphragm, or the respiratory muscles, there is reason to suspect some organic affection, either of the brain, or of the spinal marrow; in which case, it should not be employed. The usual dose is from five grains to half a drachm: the best form of administering it is that of pill, as the resin separates in the emulsion. The alcoholic solution is also a good form: it contains both the oil and the resin: and, as no precipitation takes place when water is added, the diluted tincture may be regarded as containing all the active properties of the gum-resin.

2. *Galbanum*, L. E. D. is the secreted juice of the Bubon

* The ancients used Assafœtida as a condiment, under the name of Silphion and Laserpitium. In Persia it is still esteemed as a condiment, and mixed with almost all their dishes. Gastronomes, as the French term those who delight in the pleasures of the palate, among the moderns, employ it for the same purposes; having the hot plates on which they eat beef-steaks rubbed with it. The Hindoos use it also as a condiment, and the Arabians consider it as an aphrodisiac. Dioscorides states that the best in his time came from Cyrene. From its smell, it was called Stercor Diaboli.

Galbanum, a native of Asia and Africa*. This juice is obtained by wounding the stem of the plant a few inches above the root: it flows freely, soon concretes, and in this state is scraped off the stem. It is in masses, composed of whitish tears, interspersed in pale brown or yellowish mass: its odour is terebinthinate; its taste bitter, warm, and acrid; its specific gravity 1.212. Water dissolves about one fourth of its weight, forming a white opaqe emulsion, from which the resin is gradually deposited. Alcohol takes up one fifth of its weight. Its proper solvent is proof spirit. The tincture is of a pale yellow hue, and possesses all the active properties of the gum-resin. Ether takes up the resinous part. By distillation, it yields a volatile oil, of an indigo-blue colour; on which the active properties of the Galbanum appears chiefly to depend. Besides the analysis of Pelletier, M. Meisner has given the following as his view of its constituents: Resin 65.8, Gum 22.6, Cerasin 1.8, Malic Acid 0.2, Volatile Oil 3.4, Impurities 6.2, in 100 parts. Galbanum possesses antispasmodic properties in a slight degree. It enters into the composition of several pills and other compounds. It may be given in doses of gr. x to ʒss, either in the form of pill or that of emulsion. It was formerly much prescribed in hysteria and convulsive affections; but the moderns justly regard it as much less active than assafœtida, which it resembles. It is now seldom employed.

3. *Sagapenum*, L. E. D. This gum-resin is of obscure origin, although it was described by Dioscorides, and stated by him to be the produce of a ferula growing in Media. Wildenow refers it to the Ferula *Persica*, whilst others regard it as the proper juice of the Ferula *communis*. It is a question of little interest, as the powers of Sagapenum, as an Antispasmodic, are very inferior to assafœtida.

Opopanax, L.D. The plant which yields this gum-resin is also a Ferula, according to Sprengel; but according to Wildenow, whose authority is followed by the British Colleges, it is the production of the Pastinaca *Opopanax;* a native of Greece, Italy, and the South of France†. It is procured both from the stem and the root. When inspissated, it is of a reddish-yellow colour, variegated with large white pieces. It forms a milky solution with water; but one half of the opopanax only is taken up, and the emulsion gradually deposites resin. Proof spirit is its proper solvent. As an antispasmodic, it is inferior to assafœtida; and is seldom prescribed.

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* Woodville's Med. Bot. third edit. p. 98, pl. 40. London Dispensatory, art. Bubon. Richard, Hist. Nat. Med. ii, 379.

† Woodville's Med. Bot. third edit. p. 122, pl. 47. London Dispensatory, sixth edit. art. Pastinaca. Richard, Hist. Nat. Med.

* * INORGANIC SUBSTANCES OPERATING AS DIRECT ANTISPASMODICS.

BITUMENS.—These are inflammable substances, found either in the earth or issuing from its surface. The medicinal Bitumens are Naphtha, Petroleum, Mineral Tar, and Asphaltum.

1. *Naphtha* is found in various parts of the world. In the year 1802 a considerable spring of it was discovered at Amiano, in the state of Parma. It is used in Genoa to feed lamps, instead of oil. In Persia, Naphtha is found so pure, that, without rectification, it is fit for preserving potassium and sodium from the action of the air. When in this state, it is a fluid of great limpidity; its odour is agreeable to most persons; it is very volatile and considerably lighter than water, having a specific gravity of 0.80; and, when highly rectified, of 0.758. It expands greatly in the air; and, like ether, forms an atmosphere which inflames on the approach of any ignited body. In burning, it exhales a thick smoke, and leaves no residue. When kept exposed to the light and air, it becomes thick, brown, and approaches in character to Petroleum. In truth, these three substances, Asphaltum, Petroleum, and Naphtha, are modifications of one another. We can trace the transition from Naphtha to Petroleum, from Petroleum to Maltha, and from Maltha to Asphaltum: but Naphtha contains no oxygen, and is therefore used to preserve the highly oxidizable metals. It consists of six prop. of Carbon = 36, + five of Hydrogen = 5, making the equivalent 41.

Naphtha was formerly much employed as a therapeutical agent; it is an excitant, operating on the mucous membrane of the intestinal canal, the kidney (the secreting powers of which it augments), and on the urinary organs. In large doses, it seems to suddenly exhaust the nervous irritability, in which and many other respects it resembles the volatile oils, particularly oil of turpentine, in its physical influence on the habit; and, like turpentine, it has been advantageously administered in tape worm. The West Indian practitioners extol it as an external application in hooping cough, and other spasmodic diseases. I have never employed it.

2. *Petroleum* is more opaque and more unctuous to the touch than Naphtha. The substance called Barbadoes tar is Petroleum. It is of a dark greenish colour, and combines with fat, resins, volatile oil, and camphor. It acts on the habit like Naphtha.

3. *Asphaltum* is a solid bitumen, of a black colour and a vitreous lustre: it has a conchoidal fracture, and is very inflammable. It is a more general production than Naphtha: is found in many parts of the world; but especially in the Dead Sea, in

Judea, whence it is procured in great abundance. There are extensive mines of it in Switzerland, in France, and in Germany. Naturalists are divided in opinion respecting the origin of Asphaltum; some asserting that it is of vegetable origin, others deriving it from the mineral kingdom. By distilling Asphaltum, artificial Naphtha is procured. Asphaltum dissolves, or rather melts, in heated oil, and forms a varnish: it was also, formerly, an ingredient in the compound employed for embalming the dead.

Asphaltum has been prescribed as an Antispasmodic; but with very little advantage, and, therefore, it is now almost wholly rejected from practice in this country.

B. INDIRECT ANTISPASMODICS.

* *Material.*

f. TONICS AND NARCOTICS.—With respect to Indirect Antispasmodics, I have little to say: they consist chiefly of tonics and narcotics. In selecting them, we must be guided by the condition of the patient and the nature of the exciting causes of the spasms which they are intended to relieve: if these be the result of local irritation, kept up by habit after the irritating cause is removed, then *narcotics*, by allaying this irritation, and breaking the habit, are undoubtedly the best Antispasmodics; but, if the spasms are maintained, not so much by habit as by a peculiar susceptibility of impression, which is always more or less connected with debility, then *tonics* are to be preferred; and the sooner the body can be brought under their influence, the better.

* * *Mental Antispasmodics.*

FEAR.—In no instance is the remedial influence of mind more strikingly illustrated than in spasmodic diseases. I have already endeavoured to explain in what manner elevating passions, such as *Joy* and *Impetuosity*, operate upon the nervous energy as material stimulants; and, if we admit this to be true, we can have little difficulty in comprehending that the depressing passions may operate as direct sedatives. In order to understand how *Fear* produces an Antispasmodic effect, it is necessary that we should clearly comprehend the meaning of the term, as it is sometimes confounded with *Apprehension* and *Terror*. Apprehension implies a dread of something which hangs over the future, but is not immediate: Terror, the dread of some danger so immediate as to threaten instant destruction, but which, nevertheless, is of a nature to rouse a voluntary effort for self-preservation; or it may be of a kind which pre-

sents no prospect of hope, and which, consequently, paralyzes the nervous energy to such a degree, that an instantaneous cessation of every vital function may result, and death follow. *Fear* is an intermediate state—one which contemplates the cause, and in which, as no immediate effort of muscular energy is necessary to be exerted on the voluntary muscles, these share the general torpor of the rest of the body, evidenced in the corporeal effects of this passion.

When a person is suddenly alarmed, the blood recedes from the surface, which instantly becomes pale, the respiration ceases, the action of the heart is so much weakened that it does not expel half its contents; the pulse becomes small and quick; and a sensation of chilliness is felt over the whole of the skin. But, during this period, the muscular power, in several parts, is exerting a kind of temporary spasmodic contraction; the abdomen is drawn inwards, whilst the breath is suspended; the arms and the limbs are fixed in the position they assumed at the moment of the alarm; and, whilst this continues, spasm, instead of being relaxed, is confirmed. Such a state, however, cannot long continue; and the natural consequence of so powerful an excitement is a corresponding state of collapse: every muscle is relaxed, and those which were previously in a state of spasmodic contraction necessarily share in the change which has taken place. Two queries arise upon this explanation—has the resolution of a morbid contraction of muscles ever resulted from the influence of Fear? Can we employ this agent as an Antispasmodic? In replying to the first query, I say that we see its effects in resolving spasm by its influence on the sphincter of the bladder, so that a smaller than usual stimulus of the urinary secretion is required to cause this muscle to yield; a well-known effect of Fear being a frequent and involuntary discharge of urine; and, perhaps, the diarrhœa which also commonly attends Fear may be explained on the same principles. If, therefore, few direct cases of Fear having actually relaxed morbid spasm can be brought forward, still what is known of its effects is sufficient to prove that it exhausts the nervous energy and produces a state of collapse, so sudden that the relaxation of spasm cannot fail to follow; and there is certainly no reason why so powerful an agent should not be employed when other and more ordinary means fail. I recollect a striking instance of its sanative influence in hooping-cough kept up by the habit. The patient, a young boy, was threatened with the application of a large blister: it was not applied, but merely placed within his view; nevertheless, the dread of it completely removed the cough. Boerhaave also cured epilepsy in a whole school, by displaying, at the moment of the expected attack, a red-hot poker, which he threatened to push down the throats of

those who should have a fit. It is the duty of the physician to take advantage of every means likely to destroy diseased action; and it is wonderful that, in some spasmodic affections, Fear has not been more employed as a remedy.

h. ABSTRACTION.—If there are few cases to illustrate the influence of Fear as an Antispasmodic, many might be brought forward to demonstrate the powerful effect of abstracting the attention in cases of spasm. The explanation of this is not difficult. We can have no sensation of any kind without a perception of the mind, connected with the impression which originates the sensation. Thus, a part of the body is touched with a hot iron: the pain is the consequence of the attention being roused, and the mind receiving a perception of the injury; and the continuance of the pain is chiefly the result of an effort of the mind detaining this perception, to the exclusion of every other object that solicits its notice. Now, if any more powerful impression can be made, so as to abstract the mind from this perception, while the effect thus produced continues, the pain is not felt; and it is only when this quickly ceases to occupy the attention that memory operates in again directing the mind to the seat of pain, and renewing the sensation. That this is a purely mental operation will not appear extraordinary, if we reflect on the evanescent nature of many impressions which are the causes of distinct efforts of the mind and yet cannot be recollected—nay, even appear never to have been present to the mind. Thus, if we are reading aloud, every letter and every combination of letters must produce a distinct impression; yet, the attention being directed to the meaning of the pages, and not to the letters and words, there is no consciousness, or rather no memory, of the impressions ever having been made, although it is possible that two thousand letters may have been objects of perception in the space of every minute. Now, in the case of spasmodic action, the mind is directed solely to the seat of the spasm; and, as long as this exists, no corporeal agents that do not cause an impression greater than that which has been produced by the spasm can in any degree relieve it; but, abstract attention from the seat of the spasm, and the spasm is instantaneously resolved. This is beautifully illustrated in the reduction of luxations. A man has his shoulder luxated; various ineffectual attempts are made to reduce it, owing to the spasm which has supervened, and which is maintained by the attention of the patient being directed solely to the part; abstract the attention by any means, the spasm instantly yields, and the head of the humerus slips into its socket. It is unnecessary to pursue the subject farther: there is no doubt that both Fear and sudden Abstraction of Attention may be successfully employed as Antispasmodics; but, in admitting

this, we must, at the same time, confess that great discrimination and judgment are requisite to determine the circumstances under which their employment is applicable.

Practical Employment of Antispasmodics.

Antispasmodics exert their remedial influence only in one order of diseases, the Spasmi. *Tetanus*, one of the most striking of these, displays spastic action, attended with spasm in many muscles, both voluntary and involuntary: and although a certain degree of relaxation takes place after each exacerbation of spasm, yet, the spastic action prevails so considerably, even during the intervals, that every voluntary muscle may be said to be literally on the rack. In such a case, the narcotic Antispasmodics—for example, opium, musk, and camphor—have been given in the amplest doses with little effect; nor has their influence been much augmented by the additional aid of the warm bath and other relaxant measures. If any Antispasmodic, however, can prove useful, it must be a narcotic; and it is almost incredible in what doses opium can be borne in this disease. Cases are recorded in which fifteen and twenty grains of opium were administered every three hours, for eight and ten days successively, with little effect upon the habit or the disease. When opium has proved beneficial, its effects have been rarely perceived until after the tenth or twelfth day. But although opium has occasionally succeeded, yet little reliance is to be placed upon the influence of other, the most powerful, Antispasmodics in tetanic affections.

In chorea, the spasms are of a very distinct character from those of tetanus: the disease displays itself by sudden jirking movements of some of the voluntary muscles, especially when called into action by the power of the will. It is a disease of debility, and generally attacks young people under the age of puberty; but, after it has made its attack, the disease may run on to an advanced period of life. Under the idea that the spasmodic action depends on some source of irritation in the intestinal canal, the use of purgatives has been assiduously resorted to; and some of the most drastic have been administered in large doses. When purgatives fail to produce relief, Antispasmodics, such as belladonna, musk, and opium, have been largely administered. More decided benefit, however, has been obtained from tonics than from any other Antispasmodics. They operate by supporting the habit under the debilitating influence of the spasms. Oxide of zinc, the sulphates of copper and of zinc, and many of the vegetable Antispasmodics, have failed in granting any relief; but I have seen much benefit and many cures effected by the use of nitrate of silver, carbonate of iron, and arsenious acid; all of which come under the title of tonics, and consequently are *indirect* Antispasmodics.

Cases indeed have occurred in which the disease has yielded to the antispasmodic influence of musk and camphor, after those powerful tonics have failed; but, in general, we may conclude that in this disease, as in tetanus, less benefit has followed the employment of direct Antispasmodics than, from the nature of the disease, might have been reasonably anticipated.

Antispasmodics have effected little benefit in idiopathic epilepsy. This disease may arise from various causes: it is not an unfrequent attendant on mania; sometimes it is connected with some irritation of the uterine organs, and occasionally it follows the improper repulsion of exanthematous eruptions. When arising from such causes, it may either cease of itself or yield to remedies of a nature adapted to that of the exciting cause; but sometimes it is the consequence of mechanical irritation in the brain, or of other causes, which cannot be discovered till after death. I have seen every kind of Antispasmodics, both direct and indirect, employed in this intractable disease, with very various advantage. The narcotic which has had most reputation is the Stramonium; but, like all other narcotic Antispasmodics, it as frequently fails as it succeeds. Among the metallic tonics, the preparations of zinc, mercury, copper, and arsenic, have each had its share of transitory reputation. Of these my own experience would induce me to give the preference to those of zinc; but the metallic tonic on which the most confidence may be placed, as an Antispasmodic, in this disease, is nitrate of silver. Many cases of its efficacy might be cited; and it is remarkable that it always proves most beneficial in those cases in which it opens the bowels. The manner in which these salts operate as Antispasmodics is by diminishing the susceptibility of the habit to irregular action, which is always in proportion to the degree of debility present. In this disease the direct Antispasmodics may be regarded as useless.

In asthma, the direct Antispasmodics have been found highly beneficial, particularly in that variety of the disease in which the muscular coat of the bronchi is thrown into spasmodic action. This often depends on a peculiar predisposition connected with original conformation, in which it is not very probable that the disease will be cured; but much may be done to alleviate the urgency of the symptoms. Among the direct Antispasmodics, assafœtida is most to be depended on, taking care that no inflammatory state of habit exists at the time of prescribing it. Among the indirect Antispasmodics, every thing to be expected from this set of remedies may be obtained from opium and stramonium. The paroxysm of genuine spasmodic asthma will seldom resist a full dose of opium; but it must be given in that form in which its effects will be most rapidly induced: I have found from thirty to sixty drops of Sydenham's

liquid laudanum relieve the paroxysm sooner than any other form of the remedy. I am rather surprised that opium, in the manner in which the Chinese employ it, has not been smoked for the relief of asthma, in this country: as stramonium proves serviceable when used in this manner, opium is more likely to do so; at least, the experiment is worthy of being tried.

In hooping-cough, the direct Antispasmodics have been little employed; but some of the indirect among the narcotics —for example, belladonna and conium—are the chief remedies to be relied upon. When the spasmodic cough is kept up by habit, I have seen much advantage result from the use of indirect Antispasmodics, particularly oxide of zinc, in an alkaline solution.

In colic, the benefit to be expected from Antispasmodics depends much upon the exciting causes of the attack. In simple constriction the narcotics will answer every indication; but when flatulence is the exciting cause, assafœtida and other direct Antispasmodics will be found serviceable.

In no disease have Antispasmodics more satisfied the anticipations of the practitioner than in hysteria. This is a disease depending on an irritable state of the nervous system, in which inordinate and irregular muscular contractions occur with alternate remissions and exacerbations. Being a disease of females, and occurring at that period of life when irritability is in excess, and every impression, both corporeal and mental, produces much effect upon the excitability of the nerves, the character of the disease is greatly modified by the degree of relaxation or of tone in which the individual is at the time of the attack. The convulsions are often of the most frightful description; every muscle seems to share in the inordinate action, even the heart and diaphragm, if we may judge from the hiccough and palpitation which frequently accompany the paroxysm, and the extreme exhaustion which supervenes, and the apparently lifeless state in which the patient appears when the fit ceases. During the paroxysm, the direct Antispasmodics, especially assafœtida and valerian, have been found very serviceable, when prescribed in sufficient doses, which is rarely the case. It is the custom to order from gr. v to gr. x of the gum-resin in the solid state, or from m. xxx to ʒi of the tincture, in these cases; but I am satisfied that little benefit can be expected unless the doses be large. In the intervals, the indirect Antispasmodics, especially the metallic tonics, should be chiefly relied upon; and, indeed, it is only by endeavouring to correct the morbid predisposition, at this time, that any permanent benefit can be expected from medicines in hysteria.

From what has been said, it is evident that the range of this class of medicines is extremely limited; and, in fact, that

every thing which the substances placed in it can effect, even as direct Antispasmodics, may be accomplished by other orders of medicines—purgatives, diaphoretics, narcotics, and tonics. At best, Antispasmodics can be regarded only as auxiliaries; and the spasm and convulsions are less to be considered than the causes which induce them: remove the cause, and the effect will cease.

SECTION VII.

TONICS.—MEDICAMENTA TONICA*.

Syn.—*Corroborants.*

By the term Tonics, we are to understand those medicinal agents that restore the strength and the vigour of the body when it is weakened and relaxed. To comprehend this definition aright, we must take a view of these two opposite states.

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, whether they are involuntary muscles or those under the controul 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 muscles 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 these 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 state. Thence, to a certain extent, *tone* implies a difference in the mechanical condition of muscles; a greater degree of density and cohesion of their component fibres; but this must be also joined with *elasticity*, that is, the power of resisting extension, and of restoring itself when the extending cause is removed, before the part can be said to be in the state of perfect

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* From the Greek word τόνος, tension.

tone. That this state is truly the result of vital energy, is evident; for the same muscle loses the power of sustaining the weight which it supported when first cut from the body, and this in proportion to the distance of time from that of its separation.

Medicines, or medicinal agents that produce this condition of healthful tone, and renew the *tension* and vigour of the muscular fibre, are thence denominated *Tonics*. They act on the vital principle through the medium of the nerves; and we may regard them as excitants. But it has been mentioned, that the excitement which is the result of the action of excitants is always followed by proportional languor or collapse: how, then, it may be enquired, 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 the condition of the parts? If not, to what are we to attribute this diversity of effect from causes which are similar? In reply to these questions, 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 agent in this case is a simple *excitant*. But when the nature of the medicine is such that the excitement is slowly produced, the consequent exhaustion is scarcely obvious, and the stimulus being renewed before this is complete, the impression becomes permanent; for the habit which the reiteration of the stimulus induces is less powerfully felt; 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, becomes permanent. The agent which thus operates is a *Tonic*. Still there is merely a modification of the same action in both these cases: if the dose of a stimulant be so reduced that the effect produced is slight, and if it be repeated at short intervals, the ultimate effect will be tonic: on the contrary, if the administration of a *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. But it may be argued, that, according to this definition, any substance which restores the strength and vigour of the body when it is weakened and relaxed, is to be regarded as a Tonic. Now it is undeniable that a state of

relaxation and debility may depend on loaded states of the stomach and intestines, which can be remedied by the action of an emetic or that of a purgative; and, thence, the salutary change which these agents produce, by the removal of the debilitating causes, is equivalent to the effect of a Tonic; but, certainly, these medicines cannot be regarded as *Tonics*. It might with equal truth be asserted that every medicine within the range of excitants produces a relative tonic effect on the habit; but those agents only are to be considered *Tonics*, the invigorating effects of which are not relative, but the direct sequence of their administration.

Having thus, I trust, satisfactorily explained the nature of Tonics, let us now enquire in what manner their effect is extended to the whole system, when their primary impression must be necessarily local.

Tonic agents may be both mental and material. With regard to the first, mental agents, experience has demonstrated that *Confidence* and *Hope* are powerful Tonics. Two physicians employing the same remedies, and in every respect adopting the same line of treatment in the management of a disease, are not equally successful, if the patient repose a greater degree of confidence in one of them than in the other. Every practitioner who has had many years' experience, and has not shut his eyes to the effects of mental impressions on the recovery of his patients, knows well the paramount importance of this agent in the treatment of diseases, and the great advantage derived by gaining this ascendancy over the mind of a patient. Confidence operates by the general impulse which the exhilaration of mind, consequent on the Confidence, inspires in a patient, stimulating the heart to vigorous action, diffusing the blood more equally over the system, throwing it into the capillaries, and thus restoring the general balance of the circulation. With the increased vigour of the arterial action, the secerning system necessarily sympathizes, and, consequently, every function is properly fulfilled; a certain determination of blood to every part of the body being absolutely requisite for the support and continuance of all its functions. Even during the existence of hæmorrhages, which threaten immediate dissolution, courage and confidence will sustain the action of the heart, and avert that syncope which would otherwise take place: for when the afflux of blood to the brain is diminished, the usual stimulus of distension is removed; thence a loss of sense and of voluntary motion supervenes, and, if this continue to a certain extent, death is the consequence.

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: there can be no solid as-

surance 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.

If these observations be correct, if animating passions operate as tonic powers upon the animal frame, depressed and debilitated by disease, we must ascribe their influence to the connection of the mind with the body, through the medium of the nerves; and if a tonic effect be the result of nervous energy in one case, there is no reason why it should not be referred to the same cause when material agents are employed.

Tonics operate differently upon the different organs of the body.

1. *Action of Tonics upon the Muscular System.*—Tonics act upon the muscular system through the nerves; for every muscle is amply furnished with blood vessels and nerves both of motion and of sensibility. It is true that the nervous threads do not appear "in invisibilem pulpam deliquescere," as Blumenbach expresses himself, and thus to unite intimately with the muscular fibres: nevertheless, any stimulant, acting, even mechanically, on the muscle, must act at the same moment upon the nervous energy; and the discoveries of Bellingeri, confirmed by those of Sir C. Bell, have satisfactorily convinced us that no motion occurs in the human body, at least, without the medium of one set of nerves; and that there is no necessity for the existence of sensibility to prove the presence of nerves. The change which is effected, therefore, upon one set of muscles extends to the rest, all being more or less united by that connection which depends on the communication by nervous sympathy. It is upon the strength or tension only of the muscle that a tonic acts; the contractile power and mobility of the muscular fibres are not increased; thence the employment of Tonics renders a man stronger, but not more active.

2.—*upon the Digestive Organs.*—When a vegetable Tonic is taken into the stomach, it is first partially digested, and the active principle separated. This, 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 become firmer and more resisting, whilst the cavity of the intestine is contracted. The primary action, therefore, is upon the stomach and alimentary canal; but a secondary follows upon the rest of the system. It is scarcely possible to refer the extension of the tonic power to any thing but nervous energy; for, although some Tonics are absorbed and carried into the circulation, yet many others produce their effects so rapidly after they are taken into the stomach, that there is no time to permit their being carried into the blood; nor have any portion of these ever been discovered, by any chemical test, in that fluid.

It is not my province to explain the nature of sympathy. By nervous communication, I do not mean to imply direct nervous connection; for it would appear, from an experiment of Bichat, that the sympathy of animal contractility never takes place unless the nerves connecting the affected muscles with the sensorium be entire: when they are divided, the contractions in the corresponding muscles cease. In whatever manner it is effected, it is by sympathy alone that we can explain the manner in which Tonics, acting primarily upon the stomach, produce their effects upon the rest of the system.

If the stomach be suffering from disease, the action of Tonics produces effects which require to be noticed. Thus, if the organ be in a state of hypertrophy, tonic medicines augment the already too great appetite; they add to the rapidity of the digestive function, and they accelerate the return of hunger, which is always so imperious. When the stomach is suffering from softening or 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 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, 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.

3.—*upon the Circulating and Respiratory Organs.*—Tonics act upon the heart through its sympathy with the stomach, and also by 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 healthy state of the lungs, no appreciable effect on those organs follows the employment of Tonics: but under disease their influence is rapidly made conspicuous. In an irritable state 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. On the other hand, when the lungs have suffered from previous severe disease, when all excitement is over, then Tonics lessen the force and the frequency of the cough, and promote expectoration.

4.—*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 the kidneys, Tonics add to the mischief; but, in a leucophlegmatic condition, they increase the urinary discharge, 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.

5.—*upon the Nervous System.*—From what has been already said, the influence of this class of medicines upon the nerves may be readily understood. It is, therefore, unnecessary to enter more particularly into this part of our enquiry.

The effects of Tonics upon the system are seldom rapidly apparent; but, after they have been taken for some time, their influence becomes obvious, by the increased force of the circulation, the augmented power of the digestive organs, the improvement in the secretions, the abatement of nervous susceptibility, and the increased power, in particular, which is communicated to the muscular system. A Tonic, when it operates favorably, places the system in that state which characterizes health; and, from the mode by which this effect is produced, the character of the diseases in which Tonics are indicated is sufficiently obvious: they are those of depressed power. But the chief use of Tonics, as medicinal agents, is in convalescence, when the habit has been left weak and relaxed after the attacks of acute diseases. In this state, the gentlest Tonics, in combination with aromatics, are to be preferred. This combination exists naturally in many vegetable substances; and those plants which exhibit a bitter principle in conjunction with a volatile oil are the best adapted for producing a tonic effect, in cases such as those to which I have alluded.

Bitterness is a quality of almost all the vegetable Tonics, and indeed has been regarded as essential to Tonics; but those vegetable substances which are purely bitter, such as Quassia, scarcely affect the force of the circulation, and require the addi-

tion of aromatics. Aromatics operate in too transitory a manner, in general, and stimulate too powerfully, to be employed alone; but, in combination, they aid the effect of bitters: and it is a curious fact, that the most powerful vegetable Tonics contain these two qualities conjoined.

It is probable, as I have said, that part of all the vegetable Tonics are digested in the stomach; and the tonic principle, whatever it is, thus separated from the other parts, is enabled to act with more energy upon the nerves of the stomach. Dr. Chapman, and, following him, Dr. Paris, attempt to prove that bitterness is essential to all Tonics; or, in other words, is the *tonic* principle: Dr. Paris also maintains that bitter extractive seems to be as essential to the digestion of the herbivorous as salt is to that of carnivorous animals: a singular comparison; as salt is, in one form or another, essential to both *herbivorous* and *carnivorous* animals. It is true that bitter extractive is a natural stimulus, which is itself not decomposed in the stomach, and passes through the whole course of the intestinal canal unaltered: but there are even vegetable bodies that contain little or none of this principle, and yet possess considerable tonic power. The effect of bitters is well known; they aid digestion, and enable substances—such, for example, as gums—to be acted upon by the stomach; which, without it, would pass through the bowels very little changed. But, although bitter extractive produces a considerable primary tonic action on the stomach, yet, it by no means follows that its presence is essential in all vegetable Tonics; nor is it, in my opinion, by any means a tenable position, that even nitrate of silver is in any degree indebted to its bitterness for the tonic power which it possesses, as the distinguished author of the Pharmacologia has ventured to assert. It does not appear to me requisite to regard bitterness, or any single principle, as alone productive of *tone;* and 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 property, he found, belongs to *ipecacuanha*, *gentian root*, *chamomile flowers*, *Peruvian bark*, *emetic tartar*, and *muriate of ammonia*. And it is remarkable, that cinchona bark and its salts, the most efficacious remedies hitherto discovered for intermittent fever, possess the above-mentioned property in the highest degree. These facts confirm the remark that no single principle can be regarded as solely productive of *tone*.

TABLE OF TONICS.

A. TONICS ACTING PRIMARILY ON THE STOMACH.

* *Organic Products.*

a.	CINCHONIA—			
	combined with Kinic Acid, in			
	Cinchona *lancifolia.*	5.	1.	Cinchonaceæ.
	——— *oblongifolia.*	—	—	———
	combined with Igausuric Acid, in			
	Cusparia *febrifuga.*	5.	1.	Diosmeæ.
	combined with Acids, in			
	Sulphate of Cinchonia:			
	Muriate of Cinchonia:			
	Acetate of Cinchonia.			
b.	QUINIA—			
	combined with Kinic Acid, in			
	Cinchona *cordifolia.*	5.	1.	Cinchonaceæ.
	——— *oblongifolia.*	—	—	———
	combined with Acids, in			
	Sulphate of Quinia:			
	Muriate of Quinia:			
	Acetate of Quinia.			
c.	PIPERINA—			
	combined with Acrid Oil, in			
	Piper *nigrum.*	2.	3.	Piperaceæ.
	—— *longum.*	—	—	———
	Anthemis *nobilis.*	19.	2.	Compositæ.
d.	GENTIANIA—contained in			
	Gentiana *lutea.*	5.	2.	Gentianeæ.
	——— *Chirayita.*	—	—	———
e.	SALICINA—contained in			
	Salix *fragilis.*	22.	2.	Salicineæ.
	—— *Caprea.*	—	—	———
	—— *alba.*	—	—	———
f.	QUASSINA—contained in			
	Quassia *excelsa.*	10.	1.	Simarubaceæ.
	——— *Simaruba.*	—	—	———
	Chironia *centaurium.*	5.	1.	Gentianeæ.
g.	BITTER EXTRACTIVE—contained in the			
Roots of—	Cocculus *palmatum.*	20.	6.	Menispermeæ.
	Geum *urbanum.*	12.	5.	Rosaceæ.
Plant —	Cetraria *Islandica.*	24.	3.	Lichenes.
Leaves —	Menyanthes *trifoliata.*	5.	1.	Gentianeæ.
	Arbutus *Uvæ Ursi.*	10.	1.	Ericeæ.
Flowers —	Cnicus *benedictus.*	19.	3.	Compositæ.

h. VOLATILE OIL—contained in

Croton *Cascarilla.*	21.	8.	Euphorbiaceæ.
Acorus *Calamus.*	6.	1.	Aroideæ.
Balsamidendron *Myrrha.*	—	—	Burceraceæ.

* * *Inorganic Substances.*

i. OXIDES OF METALS *(simple Radicals with Oxygen).*
Lime.
Oxide of Zinc.

k. ARSENIC—*(with Oxygen).*
Arsenious Acid.

l. METALLIC SALTS *(Oxides with Acids).*
Arsenite of Potassa.
Sulphate of Zinc.
Acetate of Zinc.
Sulphate of Copper.
Acetate of Copper.
Subnitrate of Bismuth.
Muriate of Baryta.

B. TONICS ACTING THROUGH THE MEDIUM OF THE BLOOD.

m. OXIDES OF METALS.
Black Oxide of Iron.

n. METALLIC SALTS (*Oxides with Acids*).
Muriate of Lime.
Chlorate of Potassa.
Nitrate of Silver.
Sulphate of Iron.
Hydrochlorate of Iron.
Carbonate of Iron.
Acetate of Iron.
Tartrate of Iron and Potassa.

o. SULPHUR—*(combined with Oxygen).*
Sulphuric Acid.

p. NITROGEN—*(with Oxygen).*
Nitric Acid.

q. CHLORINE—(*combined with a Metal*).
Chloride of Sodium.
——— of Calcium.
(*combined with Hydrogen*).
Muriatic Acid.

C. TONICS ACTING SOLELY ON THE NERVOUS SYSTEM.

* *Material.*

Cold Bathing.

Exercise.
Friction.

* * *Mental.*

Hope.
Confidence.
Travelling.
Amusement.

APPENDIX.

Liriodendri *tulipiferæ Cortex.*
Portlandiæ *grandifloræ Cortex.*
Coffeæ Arabicæ *fructus.*

VEGETABLE PRODUCTS WHICH OPERATE AS TONICS.

a. CINCHONIA.—This is a crystalline salt, white, transparent, in needleform crystals when pure, inodorous, and bitter to the taste, nearly insoluble in cold water, and requiring 2500 times its weight of boiling water for solution. It is slightly soluble in cold, and very soluble in boiling alcohol; and slightly in ether and in fixed and volatile oils. It is unalterable in the air; it displays an alkaline reaction with the blue of vegetable colours reddened by acids; and unites with many acids, forming neutral salts. When submitted to a high temperature, it is decomposed, affording the usual products of azotized substances: its ultimate components are—

	Pelletier and Dumas.	Brandes.	Henry and Plisson.	Liebeg.
Carbon	76.97	79.90	78.88	77.88
Nitrogen	9.02	13.72	9.35	8.87
Hydrogen	6.22	7.17	8.87	7.37
Oxygen	7.79	0.00	2.89	5.93

or 21 Carbon = 126 + 1 Nitrogen = 14 + 11 Hydrogen = 11 + 1 Oxygen = 8; making the equivalent of the salt 159.

Owing to the spare solubility of Cinchonia, it has little taste, and exerts scarcely any action on the animal system: but, in combination with acids, its bitterness is considerable, and it forms a very valuable Tonic. It is procured by boiling a pound of powdered Pale Bark in a gallon of water, acidulated with f℥iii of sulphuric acid, and re-boiling the residue in fresh portions of acidulated water until it cease to yield any thing to the fluid. These decoctions are next to be evaporated and mixed with newly slacked quick-lime, which, forming an insoluble salt with the acid, carries down with it the Cinchonia. This sulphate of lime and Cinchonia is then dried, and treated with boiling alcohol, which takes up the Cinchonia; and, by evaporation, the salt is obtained in the crystalline form.

Cinchonia is the active principle in two officinal Cinchona Barks, in which it is combined with *Kinic acid*, forming a kinate.

1. *Kinic acid* has an acid taste, and reddens the tincture of litmus. Its crystals resemble those of tartaric acid, are unalterable in the air, soluble in water, from which it is precipitated by the nitrates of silver, mercury, and lead, and, when heated, are partially decomposed and converted into a distinct acid, the Pyrokinic, which is characterized by precipitating persalts of iron of a beautiful green. It is procured by evaporating the infusion of pale Cinchona bark, and treating the residue with alcohol: a viscid matter is left, consisting of Kinate of lime and mucilage. Dissolving this in water, the Kinate crystallizes; and by decomposing it with oxalic acid, the Kinic acid is set free, and may be crystallized. It forms kinates with salifiable bases, and is contained, in combination with Cinchonia, in the bark of Cinchona *lancifolia*, and Cinchona *oblongifolia*. This acid possesses no medicinal properties. Its components are, $15\frac{1}{2}$ Carbon $= 97.5 +$ 12 Hydrogen $= 12 +$ 12 Oxygen $= 96$; making the equivalent of the acid 205.5.

Cinchonia, when separated from the kinic acid and combined with sulphuric, or muriatic, or acetic, acids, is very soluble, and eminently displays tonic effects.

The *sulphate of Cinchonia* is readily formed by the direct union of the acid and pure Cinchonia. It crystallizes in short, truncated prisms, sometimes single and irregular, sometimes double. This salt is soluble in $6\frac{1}{2}$ parts of alcohol, of sp. gr. 817°, and $11\frac{1}{2}$ parts of absolute alcohol: it requires 54 parts of water at 65° for its solution. By adding sulphuric acid to a solution of this sulphate and evaporating, a bisulphate is obtained, colourless, permanent in common air, in octohedral rhomboids, soluble in half their weight of water, and in their own weight of alcohol at 817°. The composition of the neutral sulphate is:

	Dry.	Crystallized.
Cinchonia	88.636	84.324
Sulphuric Acid	11.364	10.811
Water	— —	4.865
	100.000	100.000

That of the bisulphate:

Cinchonia	79.592	67.241
Sulphuric Acid	20.408	17.241
Water	— —	15.518
	100.000	100.000

Sulphate of Cinchonia has been little used, owing to the superior power of the sulphate of quinia, formed from an alkali found in Yellow Bark. The cold solutions of sulphate of Cin-

chonia are decomposed and precipitated by infusion of galls, and all astringent vegetable infusions.

As the Cinchonia is contained in the Bark in the form of a kinate, it might be supposed that this salt would be the best substitute for the Bark. This conclusion, however, is more specious, probably, than true: for the artificial combinations of the active principles of the vegetable kingdom frequently produce more useful compounds than the natural. The kinate, however, may be separated in the following manner: evaporate a strong decoction of Pale Bark to the consistence of a syrup; then pour upon it three times the quantity of cold distilled water originally used, and separate the deposite. Evaporate the liquid to one half, and saturate the excess of kinate acid with subcarbonate of lime; then add newly prepared hydrate of oxide of lead; and, when the whole has become of a clear yellow colour and neutral, filter. Pass through the filtered liquor a stream of sulphuretted hydrogen, and, having again filtered, evaporate to the consistence of a syrup: treat this with alcohol at 815°, which throws down the kinate of lime and gum, and also a certain quantity of the kinate of Cinchonia. Solution in water and evaporation afford the salt in the crystalline state. This kinate is soluble in water, but scarcely in alcohol at 815°, is very bitter, and is decomposed by ammonia and lime water. An artificial kinate may be prepared by combining the Cinchonia already prepared with kinic acid: a clear, very bitter, scarcely acid solution is obtained, which, when evaporated in a water bath, furnishes an amber-coloured mass, or, if slowly crystallized, bright papillary crystals.

The medicinal effects of the pure kinates are not yet determined, but are well deserving of examination. The barks that yield Cinchonia are C. *lancifolia* and *oblongifolia*, and Cusparia *febrifuga*.

1. CINCHONÆ LANCIFOLIÆ CORTEX, L.E.D.—This is the Pale Bark of the shops. It was brought to Europe by Condamine, and thence has been named *Condaminea* by Humboldt and Bonpland. The Bark is called Crown Bark in commerce.

The genus Cinchona belongs to the natural order Cinchonaceæ*. It is a very extensive genus, but, as yet, little known. The greater number of the species are natives of South America, particularly of Peru, and to the west of the Andes. A few species have been found in Brazil; and one species, the Cinchona *excelsa*, in the East Indies, in the mountains of the Circars. Cinchona *lancifolia* is found chiefly in Peru, growing at heights of from 6,250 to 8,300 feet, at a mean temperature between 59° and 62° Faht. It is a lofty, handsome *evergreen* tree, rising from 30 to 40 feet high, and seldom found in groups.

* London Dispensatory, art. Cinchona. Richard, Hist. Nat. Med. t. ii, p. 295.

Like other Cinchonas, this species is barked in September; and the bark is known to be in a proper state when, on raising a portion of it, the air gives it a reddish colour.

Although the bark which this tree yields is the original Pale Bark, yet there is reason for thinking that each seronne or package contains the bark of several distinct species. Thus, the C. *lancifolia**, C. *nitida*, C. *hirsuta*, C. *glandulifera* of Ruiz, C. *scrobiculata* of Humboldt, and the C. *glandulifera* of Ruiz and Pavon, also yield Pale Bark. It is generally rolled into small tubes or quills, covered with a rough, cracked epidermis, thickly beset with lichens; on which account it is called, in Peru, *Quinicana*, or hairy Quina. The lichens mark the quality of the bark—thus, those barks bearing *Hypochnus*, *Collemata*, and *Jungermania*, are bad: those bearing *Graphides*, or *Lecanoræ*, are good. The quills vary from the size of a swan's quill to nearly an inch in diameter; this is regulated by the age of the branch, which affords a more quilled bark the younger it is: but the collectors often quill it by heat. Internally, the colour is a pallid fawn, or cinnamon hue, which brightens to pale orange-brown when the bark is moistened. The smaller specimens break with a clean fracture, the larger with a fibrous. The quilled bark comes from Loxa; but some, which is not quilled, from Guanaco. On account of the quantity of lichens on this bark, the first powder should be rejected: or the lichens scraped off before powdering the bark.

Pale Bark, besides being known in commerce by the name of *Crown Bark*, is called Calysaya, with an epithet descriptive of its form: thus, Quilled Bark is called *Calysaya* arollada in cauntillos; flat, *Calysaya* de plancha; and so on. It is also known by the name *Cascarillo fina de Loxa*†. There are four distinct varieties of Pale Bark.

1. The first is the *Quilled Bark of Loxa*, Calysaya ahumada de Loxa, Cascarilla de Loxa, in single and double quills, thin and light, in pieces of from twelve to eighteen inches long. Its epidermis is brown, or iron-grey, covered, when good, with *Graphides*. The taste is astringent and bitter, the odour weak. It is a rare plant.

2. A subvariety of this is the *Grey Bark of Loxa*, which is supposed to be the bark of the Cinchona *Hirsuta* of Ruiz and Pavon. Its epidermis is smoother than the former variety, and covered with a coating of whitish lichens, whence the name. It is thinner than the preceding; indeed, almost as thin as Cin-

* The C. *lancifolia* of Mutis yields an orange-yellow bark, which is now very rare. It grows both in Peru and in Columbia.

† Other appellations are Cascarilla naranjada de Santa Fé, Cascarilla de Hojas Angustus,—poco rolludas,—rugosas,—lampina,—negra, and Palo Blanco. Under the appellation Quina, it is called Quina naranjada, Quina de Bagota, Quina negra de Loxa, Quina tunita, Quina fino; and under that of Quinquina, Q. Royal, Q. Royal batard, Q. orange de Perou.

namon Bark. Its taste is astringent and bitter, with a faint aromatic odour. In Peru it receives the name of Lagartijada, Lizard-like, and Negrillo, Blackish, from the colour of its epidermis.

3. A third variety is the *Bark of Lima*, of which there are two subvarieties known in commerce. 1. The *Grey Bark of Huanaco*, probably that of the Cinchona *glandulifera* of Ruiz and Pavon: it is in flatter, thicker, and coarser pieces than the Grey Loxa Bark, the quills being generally about an inch in diameter, the epidermis thin, easily separated, cracked with transverse fissures, and covered with stringy lichens. Its fracture is compact and ligneous, its colour internally yellow; it has scarcely any odour, and tastes simply bitter and mealy. This is the variety of the Pale Bark most liked in this country. 2. The *Lima Bark*, which closely resembles the Huanaco in every particular.

4. *Havannah Bark*, of which I know nothing. The knowledge of these varieties is of little moment: it is sufficient, for the purposes of medicine, to distinguish the Lima and the Loxa Bark.

In tracing the chemical history of this species of Cinchona Bark, it is unnecessary to offer any account of the early analyses. Dr. Duncan, of Edinburgh, first hinted the existence of a new principle, and named it *Cinchonin*. Gomez (Memoirs of the Lisbon Academy) examined the Cinchonin of Duncan, which he procured in small, white, acicular crystals. His process was to dissolve an alcoholic extract of Cinchona Bark in water, and then to treat it with potassa, which dissolved successively all the extractive, and left the Cinchonin undissolved. This was afterwards dissolved in alcohol, and crystallized by evaporation. The alkaline character of the salt was first pointed out by Pelletier and Caventou. Good Pale Bark should yield 1.4 per cent. of Cinchonia*.

Good Pale Bark, although it has scarcely any odour in substance, gives out an agreeable aromatic odour in decoction, depending on a volatile oil, which Dr. Irving procured in a distinct state. The infusion and decoction are agreeably bitter, slightly acidulous and austere: both are of a pale, brownish-yellow colour: they redden litmus paper and precipitate infusion of galls, the gallic acid and tannin of the galls forming an insoluble tanno-gallate of Cinchonia by decomposing the kinate. Both render a solution of tartar emetic turbid, decomposing the tartar emetic, and rendering it inert; a circumstance which depends on the tannin of the bark: as the solution of pure Cinchonia does not precipitate the tartrate of antimony and potassa. The sulphate of iron produces a slight precipi-

* Voreton, Ann. de Chim. et de Phys. t. xvii.

tate, of an olive-green colour, evidently depending on the formation of a kinate of iron, whilst the sulphuric acid unites with Cinchonia, forming a soluble sulphate. The carbonates of the alkalies also precipitate the infusion and decoction of Pale Bark. The aqueous infusions of many bitter and astringent vegetables, as of Chamomile flowers, Calumba root, Cascarilla bark, Horse radish, Cloves, Catechu, Orange peel, Foxglove, Rhubarb, Valerian, Simaruba bark, and Elm bark, precipitate the infusion and decoction of Pale Cinchona Bark. The tincture of this bark suffers similar decomposition from these reagents; but the colour struck in the tincture with sulphate of iron is deeper and blacker than that in the infusion. Muriate of baryta produces no change either in the decoction or in the tincture; both the muriate of Cinchonia and the kinate of baryta being soluble: thence this salt may be administered in combination with these preparations. The quantity of the precipitate formed with the infusion of gall-nuts demonstrates the goodness of the bark; for, according to the quantity of Cinchonia which it contains, the tanno-gallate will be more or less abundant. All the other precipitates may occur, although no Cinchonia be present in the infusion or decoction. According to the analysis of Pelletier and Caventou, the bark of this species of Cinchona contains—kinate of Cinchonia; a minute portion of kinate of Quinia; a green fatty matter; a red colouring matter, scarcely soluble, convertible into tannin by the alternate action of alkalies and acids; a red soluble colouring matter, tannin; a yellow colouring matter, precipitable by acetate of lead; kinate of lime; gum; starch, and woody fibre*.

When cold water is poured into a decoction of pale Cinchona bark, the red colouring, scarcely soluble matter is copiously precipitated. When this is dried and pulverized, it is of a dull red colour, and its bitterness is slowly perceived on the palate: it is a compound of tannin and kinate of Cinchonia; and it is this which decomposes the solution of Tartar emetic, when it is added to infusion or decoction of Bark.

The pharmaceutical preparations of the Pale Bark are—1. Infusion and Decoction. They should always be made with water acidulated with diluted sulphuric acid, in order to change the kinate of Cinchonia to a sulphate, which is more soluble than the kinate. The evaporation of the decoction forms the watery extract, in which the kinate of Cinchonia is combined with all the other components of the Bark, except the woody fibre. It is now scarcely ever employed. There are three tinctures of Pale Bark ordered in the British Pharmacopœias:—The first is a simple alcoholic solution of the kinate of Cinchonia, the colouring matter and the tannin: it is prepared by mace-

* Journ. de Pharm. t. vii.

rating the powdered Bark in proof spirit. 2. A tincture made with aromatic spirit of ammonia—the Tinctura Cinchonæ Ammoniata; but it is at least a doubtful preparation, in as much as the Cinchonia is thrown down by the ammonia. 3. A compound tincture containing several aromatics, such as orange peel, Virginian snake-root, and saffron, which add to the medicinal power of the kinate of Cinchonia. The cochineal is a useless ingredient.

Cinchonia is also found in another Bark which does not belong to the genus Cinchona; but, in this case, it is not combined with kinic acid.

2. CUSPARIA CORTEX. L. E. D.—This bark is the production of the Cusparia *febrifuga* of Humboldt, the Bonplandia *trifoliata* of Willdenow*, and which St. Hilaire supposed is a species of Galipea. It is a handsome tree, a native of South America, belonging to the natural order Diosmeæ. Cusparia Bark is in pieces from six to twelve inches in length: sometimes quilled. The epidermis is whitish-yellow, unequal, rough, the interior of a fawn colour, hard, firm, breaking with a resinous fracture, and, when pulverized, giving a powder of a brownish-yellow hue, which, triturated with magnesia, exhales ammonia. If the bark be chewed and retained for some time in the mouth, it is bitter, aromatic, and leaves on the palate an acrid *astringent, nauseous* taste. Both cold and hot water take up its active principles: alcohol dissolves the bitter and aromatic. This tincture is decomposed by water: proof spirit is its proper menstruum.

The aqueous infusion and decoction of Cusparia Bark is precipitated by infusion of gall-nuts and other astringent vegetable infusions and decoctions; but neither by solution of gelatine nor tartar emetic. It is also precipitated by the sulphates of iron, of copper, and of zinc. The nitrate of silver throws down a copious white precipitate, which gradually acquires a dull purple hue on being exposed to the light; affording a presumption that this Bark contains a muriate of ammonia. With the salts of lead, bichloride of mercury, the carbonates of potassa and soda, muriate of baryta, and lime water, precipitates are produced, demonstrating that the Cinchonia is not in the state of a kinate, as both the muriate of Cinchonia and the kinate of baryta are soluble salts. Ammoniated-sulphate of copper causes a pea-green precipitate. Nitric acid deepens the colour nearly to a blood-red, and, after some time, causes a precipitate of a lemon-yellow hue: muriatic acid causes no precipitate; but, after it is added, a solution of the ferrocyanate of potassa throws

* Woodville's Med. Bot. third edition, vol. v, p. 120. London Dispensatory, art. Cusparia. Trans. of the Medico-Bot. Soc. of London, vol. i, part i, p. 17. Richard, Hist. Nat. Med. t. ii, p. 777.

down a copious yellow precipitate: sulphuric acid produces no precipitate. If the powdered bark be digested with sulphuric ether, and the solution evaporated on the surface of water, a thin pellicle of pure resin is left. From these facts, we may conclude that the chief components of this Bark are *Cinchonia*, a trace of *brucia*, *muriate of ammonia*, *gum*, *resin*, and *extractive;* that it displays no traces of either tannin or gallic acid; and that the acid with which the Cinchonia is united is the *igausuric*. Its odour depends on an acrid essential oil, which can be procured in a separate state by distillation.

This bark was first brought to this country in 1788; and, as the plant yielding it was then unknown, it was named Angustura Bark, from the Spanish appellation *Corteza del Angustura;* Angustura being the vulgar name of the town of St. Thomas, the place of its export. The native name of the tree is *Cuspare;* thence the appellation *Cusparia*. When the bark is good, the lichens which mark its qualities are the same as those of the Cinchona *lancifolia;* but the Myriotrema is peculiar to the Cusparia, and always distinguishes the true from the false bark.

The false Cusparia was supposed to be the bark of Brucea *ferruginea*, or *anti-dysenterica*, a plant of the natural order Xanthoxyleæ, a native of Africa: but it is now admitted that the plant yielding the *false Cusparia Bark* is still unknown, although it is suspected to be a species of Strychnos. It is in longer pieces than the true Cusparia; is more or less quilled, heavy, compact, and breaks with a brittle, mealy fracture; but it is less fragile than the true Cusparia. The epidermis is covered with distinct, rust-coloured, warty excrescences. Its powder is a lighter yellow than that of the true Bark; it is inodorous; impresses no aromatic flavour nor acrimony on the palate, but the most disgusting, durable bitter. It is distinguished from the true Bark chiefly by the effects of the following reagents on its infusion: 1 Carbonate of potassa deepens the red colour of the infusion of the true Bark, and gradually deposites a clear, citron-yellow, floculent precipitate: in the infusion of the false Bark, the precipitate is greyish-yellow, and the supernatant fluid becomes dark-brown, beginning at the surface. 2. Persulphate of iron causes a dark precipitate, changing, by degrees, to a satin-black, verging to an ash-grey, in the infusion of false Cusparia. 3. Water, acidulated with muriatic acid, shaken with the powder of false Cusparia, takes a beautiful, clear green colour when an alkaline prussiate is poured on it, and in a short time it deposites Prussian blue: this does not occur with the true Cusparia. 4. The bark of false Cusparia contains much brucia—a poisonous alkaloid which strikes a deep crimson colour with nitric acid: causes the sensation of stinging by ants over the skin, and slight tetanic convulsions.

As a medicinal agent, Cusparia Bark possesses all the tonic

properties of Cinchona; and, from containing a larger proportion of acrid volatile oil, is more directly stimulant. It was originally introduced for the cure of intermittent fevers, and was supposed likely to supersede the use of the Cinchona Bark; but, in this respect, its powers were greatly overrated. It is, nevertheless, an excellent aromatic tonic in convalescence from fevers, dysentery, and diarrhœa; and, whilst it increases the appetite and restores tone, it never oppresses the stomach. In dysentery, however, much caution is required not to prescribe Cusparia until all inflammatory action is fairly subdued: as the acrimony of its essential oil renders it injurious in all such conditions of the mucous membrane of the intestinal canal. In cases of dyspepsia which admit of the use of Tonics, Cusparia Bark, owing to the combination of an aromatic with a tonic principle, is to be preferred to all others; it requires no tincture to warm it; an addition which, in my opinion, is always to be avoided in dyspeptic affections, unless the general strength be greatly reduced, and the pulse indicate a sinking state of the habit.

The best form of administering Cusparia Bark is in powder, combined with rhubarb; or, in hypochondriacal affections, in which the extrication of ammonia is useful, with magnesia. The dose is from gr. v. to ℈i. It is also exhibited in the form of infusion and of tincture. In large doses it nauseates*.

QUINIA.—This salt was first procured by M.M. Pelletier and Caventou. It is a white, friable, incrystallizable salt, which, if exposed to heat, melts into a resinous-like substance. It is more bitter than Cinchonia; is scarcely soluble in water, requiring 2000 parts for one part, but is soluble in alcohol and ether; and, in conjunction with acids, furnishes neutral salts: the best known of which is the sulphate. Its free solution in ether distinguishes it from Cinchonia, and separates it from that alkaloid. The composition of Quinia is—

	Liebeg.	Pelletier and Dumas.
Carbon	75.76	75.02
Oxygen	8.61	10.43
Hydrogen	7.52	6.66
Nitrogen	8.11	8.45

or $12\frac{1}{2}$ Carbon = 129 + 2 Oxygen = 16 + 12 Hydrogen = 12 + 1 Nitrogen = 14; making the equivalent 172.

Quinia may be combined with two proportions of sulphuric acid; one forming a salt which is perfectly neutral, the other an acidulous salt. The first, the neutral salt, that in common use, is pure white, in silky needles, little soluble except in boiling

* Evodia *febrifuga*, Ticoria *febrifuga*, and Hortia *Brasiliana*, Brasilian plant, possess properties closely resembling those of Cusparia. See Plantes Usuelles de St. Hilaire, pl. xvi—xvii.

water, but completely soluble in water acidulated with sulphuric acid; and in alcohol. It effloresces in the air, losing ¾ of its weight; is phosphorescent in a temperature of 210° Faht.; and is decomposed by all substances that form salts with sulphuric acid. It is readily distinguished from sulphate of Cinchonia by its crystals, being acicular instead of lamellar.

An acidulous or bisulphate is readily formed of Quinia. The components of these salts are—

NEUTRAL SULPHATE.

	Crystallized.	Effloresced.
Quinia	80.9	88.899
Sulphuric acid	10.0	11.111
Water	9.1	———
	100.0	100.000

ACIDULOUS SULPHATE.

Quinia	63.5	81.819
Sulphuric acid	19.1	18.181
Water	17.4	———
	100.0	100.000

The bisulphate is soluble in eleven parts of water at 60°, and at a temperature of 212° it dissolves in its water of crystallization. It readily dissolves in diluted alcohol, but with difficulty in strong alcohol. It is colourless and permanent in the air; its crystals are rectangular, quadrangular prisms, sometimes compressed, sometimes square and truncated. It would be better, were the acidulous used instead of the neutral sulphate, as it is very soluble; and the neutral sulphate is generally converted into it, in extemporaneous prescriptions, by the addition of sulphuric acid.

Sulphate of Quinia is sometimes adulterated. When the adulteration is white sugar, it is detected by the solution of the suspected salt in as much carbonate of potassa as will saturate the sulphuric acid: if sugar be present, it will then be perceived by the taste. If the adulteration be starch, a portion of the suspected salt will remain insoluble in cold water; and if the mixture be heated to 170 Faht. then cooled, and the tincture of iodine added, the starch will be made evident by the blue colour which iodine strikes with fecula. Boracic acid, with which it is also adulterated, is detected by dissolving the salt in alcohol and setting fire to the solution: if boracic acid be present, the flame will be green. It is more difficult to detect the sulphate of lime, which is manufactured in acicular crystals, expressly for the purpose of adulterating the Sulphate of Quinia: it may, however,

be detected by exposing the suspected salt to a red heat: the S. of Quinia is decomposed, but the S. of Lime merely loses its water of crystallization; and, when mixed with water, it will rapidly absorb the fluid and solidify in a few seconds. If the adulteration be an anhydrous sulphate of lime, it will remain insoluble in water, whilst the S. of Quinia dissolves.

Pure sulphate of Quinia is precipitated from its aqueous solution by acetate of lead; an insoluble sulphate of lead is formed, whilst an acetate of Quinia remains in solution. With the infusion of galls, an insoluble tanno-gallate of Quinia is thrown down: and, by lime-water, both the sulphate of lime and pure Quinia are precipitated. No change is produced by the salts of iron—a great advantage in the treatment of amenorrhœa in a debilitated habit. Acetic acid readily unites with Quinia, and forms a salt, which crystallizes in long, pearl-coloured needles, that are often grouped into stars: it is very soluble, and possesses the same medicinal powers as the sulphate. The precipitate which the infusion of galls forms with the salts of Quinia affords a ready method of ascertaining the value of specimens: of the yellow bark, the greater the precipitate is, when infusion of galls is added to the infusion of the bark, the richer it is in the alkaloid which it contains. The Bark yielding Quinia is the—

CINCHONA CORDIFOLIA. L.E.D.—The Yellow Bark is thicker than the Pale, less quilled, and more woody and fibrous. It is stated in the London Pharmacopœia to be the Bark of the Cinchona *Cordifolia* of Mutis; but it is probable that the Yellow Bark from Lima, the Quina Calysaya of the Spaniards, is not the produce of the C. *Cordifolia;* because the Quina de Santa-Fé, which is well known to be the bark of the C. *Cordifolia*, differs in appearance greatly from the former, the Yellow Bark of the shops. The Santa Fé Bark is known by the name of Hard Carthagena Bark. The Cinchona *Cordifolia* is a handsome tree, growing on the mountains of Loxa in Quito, and on those of Santa Fé, at a height of from 900 to 1440 toises.

Yellow Bark is both quilled and flat. The flat pieces are generally devoid of epidermis; the quilled have a tawny, greyish-brown cuticle, covered with flat and stringy lichens; the thallus of some of which is so thickly extended over the Bark as almost completely to obscure the natural surface. There are two distinct varieties of Yellow Bark known in commerce. The *first* is in pieces of various sizes, from that of the finger to two or three inches in breadth. The smaller pieces have a thin epidermis, are very rugged, transversely cracked, and covered thickly with parasitic lichens. This Bark is of a yellow-fawn colour interiorly, very fibrous in the fracture, and possessing little astringency. The larger pieces have a thicker, rougher, and more deeply cracked epidermis; and, from age, the epidermis consists of various layers; but it is easily detached from the

Bark, and is perfectly inert. The Bark is about two lines in thickness, of a deep fawn colour, and a texture entirely fibrous, but fine and uniform. The fibres are studded with brilliant points, the extremities of fibrils, which are detached with ease; they feel harsh between the teeth, and run into the fingers, occasioning itching. On breaking the bark, a fine yellow fibrous powder falls out. It tastes very bitter and astringent. The *second* variety is known in commerce by the name Orange Yellow Bark: it is less thick, more compact and finer. This is the Bark of the Cinchona *Cordifolia* of Mutis. It occurs both in quills and in flat pieces. In the younger specimens, the internal part is of a pure yellow, the external of a rose colour: but this disappears in the old bark. The mixture of these two colours produces a tint which distinguishes this bark from every other. The flat pieces are a little convex, and entirely devoid of epidermis.

Both varieties of the Yellow Bark have more bitterness, but less astringency, than the Pale Bark. They are more pulverulent, and the powder is of a brighter colour than that of the Pale Bark. The aqueous infusion and decoction deposite, on cooling, a sediment, which is of a brighter colour than the dry powder. The infusion is less turbid than that of the Pale Bark: it reddens litmus paper, and precipitates infusion of galls more slowly than the infusion of the Pale Bark. Gelatin forms a pinkish-yellow precipitate; tartrate of antimony and potassa a yellowish-white and very copious precipitate; and the persulphate of iron throws down slowly a bluish-green precipitate. The other reagents which affect the Pale Bark act upon the yellow.

Yellow Bark owes its tonic properties to the kinate of Quinia, which can be separated in the same manner as the kinate of Cinchonia from the Pale Bark. The kinate in the natural Bark is intimately combined with a red, insoluble matter. When cold water is poured into a strong decoction of Yellow Bark, the red matter is thrown down; and, if magnesia be added, and the compound boiled with alcohol, Quinia will be obtained. There is also a *red, soluble* matter, which is procured by evaporating the decoction to the thickness of a syrup, then treating with cold water and filtering. According to Mutis and Zea, Yellow Bark is only indirectly febrifuge. The sulphate of Quinia is obtained from it by a process similar to that necessary for procuring the sulphate of Cinchonia. The powdered Bark is boiled with water acidulated with sulphuric acid; and the decoction afterwards precipitated by lime, which, at the same time, carries down the Quinia coloured. This combination of sulphate of lime and Quinia is then dried, powdered, and digested in boiling alcohol, until no more soluble matter is taken up, which is known by the alcohol ceasing to acquire bitterness. The alcoholic solutions are then distilled nearly to

dryness, to save the alcohol. The Quinia does not crystallize; and, if deprived of its humidity, by drying, it forms merely a white, porous mass, little soluble in water, but very soluble both in alcohol and in ether. In forming the sulphate, the residue of the alcoholic solution is treated with boiling water acidulated with sulphuric acid: the sulphate precipitates on cooling. The precipitated sulphate is now to be dissolved in water and boiled with a small quantity of pure animal charcoal which has been well washed in muriatic acid: it is then to be filtered whilst it is hot. The crystals form as the solution cools: but, as they retain much water, they must be dried in a stove between folds of colourless blotting-paper. The filtering papers should be kept from one operation to another, as much of the product is lost by using fresh filters.

According to the analysis of Pelletier and Caventou, Yellow Bark contains—an acidulous kinate of Quinia; a minute portion of kinate of Cinchonia; a kinate of lime; a fatty matter; a red, insoluble, colouring matter, which precipitates when the decoction cools; a red, soluble, colouring matter (tannin); a yellow colouring matter; starch; and lignin.

The knowledge of these constituents readily explains the result of reagents on the infusions, decoctions, and tincture of Yellow Bark.

Although the Pale Bark yields chiefly *Cinchonia*, with a small quantity of Quinia, and the Yellow *Quinia*, with a small proportion of *Cinchonia*, yet the quantities of the opposite principles are too small to give a character to the medical properties or the chemical nature of the Barks. In the Red Bark of the Pharmacopœias, these salts exist together in nearly in equal proportions; which distinguishes this bark as much as its colour and other physical properties.

CINCHONA OBLONGIFOLIA of Mutis grows in New Granada, near Maraquita, and yields a Bark known by the terms Quina de flor de Azahar, Cascarilla de Loxa, Cascarilla Azahar, and Cascarilla Maraquita de Loxa. The C. *magnifolia* of Ruiz and Pavon, found in the Andes, also yields the Red Bark, and affords the Quina Amarilla of the Spaniards ,the Quina rouge de Santa Fé, and the Quina rouge orange plât, of the French. Both kinds go by the name of Red Bark in this country. The last species is that best known. The first kind of Red Bark is known by the name of *smooth Red Bark:* the second kind is called *warty Red Bark.*

1. *The smooth Red Bark*, Quina Roxa and colorada of commerce, is imported in both quilled and flat pieces, seldom exceeding ten or twelve inches in length, of a lively red colour, fibrous, very hard, covered with a rough, but not warty, epidermis, transversely cracked, and not much covered with lichens.

The cortical part is about a quarter of an inch in thickness, and breaks with a fibrous fracture. Immediately under the cuticle, there is a dark red, resinous matter deposited in the fibres, in the form of an agglomerated powder, which has a deeper colour than the rest of the bark.

2. *The Red Bark of Santa Fé* is in thick quills, nearly an inch in diameter, very rough and warty on the exterior, cracked in different directions, and exhibiting deep fissures: interiorly, it has a bright red colour, is brittle, and breaks with a fibrous fracture: when moistened, it has a peculiar, not agreeable odour: is unpleasant in the mouth; and, although less bitter and acrid than the barks of the other species, it is more acid, austere, and nauseous. This bark is essentially different from that which is found in the shops. The aqueous infusion of both kinds is of a ruby red hue, and lets fall, in cooling, a large quantity of insoluble red colouring matter, particularly if the decoction be concentrated and poured into a large quantity of cold water. The infusion is slowly precipitated by the infusion of gall-nuts, and of other astringent vegetables; and a very light, floculent precipitate only is thrown down by gelatin. Both protosulphate and persulphate of iron strike a deep bluish colour, but afford little precipitate. It is also precipitated by tartar emetic and bichloride of mercury. The tincture is effected in the same manner as the infusion.

According to the analysis of Pelletier and Caventou, this bark contains—an equal quantity of acidulous kinate of Cinchona and acidulous kinate of Quinia; a red colouring matter; much tannin; a yellow colouring matter; a fatty matter; kinate of lime; starch; and lignin. From the effects of the sulphates of iron in its infusion, it is probable that it also contains traces of gallic acid, in combination with tannin. It is more astringent and stimulant than the other officinal species.

I have stated that there are evidently many varieties of bark in the same package. Formerly, this was of little importance: but, on account of the distinct salts contained in the different species, a knowledge of these has become necessary. The experiments of Pelletier and Caventou have demonstrated that the quantity of the active principle is least in the Pale Bark, the proportion of kinate of Cinchonia being only as two to nine of kinate of Quinia found in the Yellow Bark, whilst the quantity of each, in Red Bark, is in the proportion of eight of the kinate of Cinchonia and seventeen of kinate of Quinia: thence, if the febrifuge powers of the bark depend on these salts, the Red is the most efficacious.

With regard to the medicinal history of Cinchona Bark, numerous fables have been propagated. Humboldt has ascertained that it was unknown to the Peruvians before the Spanish

conquest. It was introduced into Europe in 1640, by the Countess of Cinchon, after whom the genus is named*.

If a drachm of powdered Cinchona Bark, *pale*, *yellow*, or *red*, be swallowed, once in three or four hours, by a healthy person, it causes a dryness of the mouth, a sensation of weight and uneasiness at the stomach, an augmented force in the circulation of the blood, an increase of perspiration, an elevation of temperature, accompanied with redness of the skin, and other symptoms of general excitement, demonstrating the stimulant power of the remedy. These effects, when the dose is small, although weaker, yet are permanent: we feel authorized, therefore, to regard Cinchona as a *Tonic*. With respect to its power in changing diseased into healthful action, and restoring the vigour and energy of the debilitated frame, every day's experience has proved its efficacy and that of its active principle, especially in fevers of an intermittent and remittent character. Much was said, at one time, about the period of fever in which Cinchona Bark ought to be administered. Dr. Clarke of Newcastle, and others, gave it at every period and cured the disease: and Dr. Heberden, in his Commentaries, remarks—"Unde didicimus suspicionem periculi a cortice, etiam sub ipsa febre adhibito, fuisse non minus vanam, quam multas alias suspiciones, quas nostri majores de utilissimo hoc remedio sparserunt." Nevertheless, Cinchona Bark is seldom given during the paroxysm: but, in the intervals, augmenting the dose towards the accession of the next attack. The remedial effects of the Barks depend on their alkaloids: their other principles exert only a secondary influence. Thus the kinic acid increases the solubility and activity of the Cinchonia and the Quinia: but when these are united with mineral acids, especially the sulphuric, they are better Tonics. In their administration, we ought always to direct our attention to the state of the stomach and intestines before prescribing them; and not to administer them if these important organs be in an irritable condition: or if general inflammation be present.

Cinchona Bark, and the salts of its alkaloids, may be prescribed advantageously in all diseases which assume an intermittent type, whether they appear as gout, rheumatism, the exanthemata, eruptive fevers, catarrh, or even phthisis. Whenever a true intermittent character occurs, the Bark proves serviceable, and rarely injures. Even in local affections, this rule holds good. In a case recorded by Mr. Brodie, a gentleman, who had lived long in a tropical climate, became affected with stricture of the urethra, of a spasmodic nature, which recurred every alternate night about twelve o'clock, and continued until five or six o'clock in the morning. Mr. Brodie cured the dis-

* A brief history of its various fortunes is contained in the London Dispensatory.

ease, by anticipating the paroxysm and administering sulphate of Quinia, in large doses, at short intervals of time. In the intermittents of warm climates, Cinchona may be conjoined with calomel and aloës; and, even in this climate, the intestines should, in every instance, be kept rather in a lax state during its exhibition, or that of the sulphates of its alkaloids.

In many chronic diseases, although intermissions do not occur, Cinchona Bark and its alkaloids are beneficially administered. Thus, in chronic pulmonary catarrh, kept up by a weakened habit; in chronic diarrhœa; in passive hæmorrhages; in scrophulous conditions of the system; in dyspepsia; anorexia; and every case of direct debility, they may be prescribed with advantage. I am in the daily habit of prescribing them in cases which are regarded as neuralgia, in which the pain returns at stated intervals. In that peculiar inflammation of the sclerotic coat of the eye that assumes the characteristic of rheumatism, they may be regarded almost in the light of specifics.

But, notwithstanding the substantial benefit resulting from the administration of Cinchona, and the sulphates of Quinia and Cinchonia, in these diseases, some caution is requisite in prescribing them. They are hurtful when hepatic symptoms are present: they should never be ordered until all inflammatory symptoms are subdued by bleeding and other means: and in every case their use should be prefaced by purgatives. Local and topographical circumstances also vary their efficacy. Thus, Mr. Annesley, in his work on the Diseases of India, states that although the bark is the grand remedy in fevers in India, during the cold season, yet it fails in the rainy season, in which calomel and antimony only prove useful.

The British Pharmaceutical preparations of Cinchona are *powder*, *infusion*, *decoction*, *tinctures*, *and extracts*, *sulphates of Cinchonia and of Quinia*. The *powder* was formerly given in doses of gr. x to ʒvi, every second or third hour, during the intermissions in agues: but the bulk, which alone was often such as to nauseate, was always regarded as an objection to this form of the medicine. The best vehicle for administering it is milk, which effectually covers the taste of the bark, if the dose be swallowed the instant it is mixed with the milk. If *decoction* be preferred, care should be taken not to prolong the boiling beyond ten minutes; as long boiling converts the tannin into oxidized extractive, which, precipitating, carries down with it much of the kinates. In the decoction, the precipitates formed on cooling should be suspended by means of mucilage; for these contain a large proportion of the kinates. *Infusion* in boiling water, acidulated with diluted sulphuric acid, is a preferable preparation. Neither decoction nor infusion are useful in agues. They prove very beneficial as topical remedies—

namely, gargles, in combination with the chloro-sodaic solution, or with muriatic acid, in malignant scarlatina; and, also, as lotions in gangrenous sores: the bark changes the morbid action of the part, and aids cicatrization.

The Tinctures contain all the active principles of the bark; the alcohol dissolving the kinates of the alkaloids, and scarcely touching the kinate of lime. A *Wine* is employed on the Continent; and in this country wine is used as a vehicle for the powder. The French Codex orders a syrup; but it is a feeble preparation.

The *Extracts* are prepared both with water and with alcohol: the alcoholic extract contains all the active constituents of the bark: if it be repeatedly washed with distilled water, the whole of the kinates are separated, and the red insoluble matter only remains: thence the natural kinates can be readily obtained.

The best preparations are sulphates of the alkaloids. It may be reasonably demanded, in what do these salts differ? We are already acquainted with their chemical differences. In a medicinal point of view, my experience does not authorize me to assert that either possesses properties not common to both: but M. Bally has stated that the sulphate of Cinchonia is more stimulant than the sulphate of Quinia. To obtain the full effect of the sulphate of Quinia, in ague, the best mode of prescribing it is to dissolve two or three grains in an infusion of the confection of roses, filtered and acidulated with diluted sulphuric acid, and to add f3i of tincture of orange peel, which covers the extreme bitterness of the solution*. This dose of the sulphate thus combined, should be given every second hour, during the interval, so that the last dose may be taken one hour only before the anticipated paroxysm. Dr. Elliotson says, that the preferable mode is to give a large dose—gr. x, for instance—either before or immediately after the paroxysm: but, in my practice, small doses, frequently repeated, have proved more useful than a large dose. I have given it, in appropriate doses, to infants labouring under intermittent fever, with the best effects.

In those conditions of the habit in which catarrh assumes an intermittent type; and in which the periodical attacks depend on a weak and imperfect action of the cutaneous function; and this, again, on a defective action of the heart and arteries; I have found the sulphate of Quinia, administered in the manner I have just described, most beneficial. In strumous affections, particularly when the eye is the obvious seat of disease,

* It is a curious, although not easily explained fact, that the bitterness of the sulphate is completely covered by aromatic bitters, such as gentian root, orange peel, and cascarilla.

as when the cornea is inflamed, with a certain degree of inflammation of the iris also, Mr. Mackenzie has found the sulphate of Quinia most serviceable. In some cases, however, when taken into the stomach, it has produced symptoms almost indicative of inflammation of that organ; to obviate which, Signor Broglia dal Persico proposes to cure agues by dusting the sulphate, in fine powder, on blistered surfaces: he affirms that the salt thus appplied may be detected in the stools. M. Pointe, a physician in Lyons, has also proposed to introduce it into the habit by absorption. His plan is to rub the gums and the inside of the cheeks with the sulphate, very finely powdered, for ten or fifteen minutes, or until all the powder be absorbed; cautioning the patient not to swallow the saliva. He affirms that, thus applied, the sulphate acts with as much energy as when taken into the stomach, without exciting any irritation of the mucous membrane, which, he contends, it is always apt to induce. I can bear testimony to the efficacy of this mode of introducing the salts of Quinia into the habit.

The sulphates of Quinia and Cinchonia may be also administered per anum: they cure ague, but cause violent colic.

d. PIPERINA.—This is a peculiar principle, which was discovered by M. Oerstadt, of Copenhagen, in Black Pepper. Its discoverer regarded it as an alkaloid; but M. Pelletier disproved this opinion. It is procured in pale, yellow, semi-transparent, flattish quadrilateral prisms, with two parallel large and two small sides, terminated by an inclined plane; these are insoluble in cold, scarcely soluble in boiling water, and precipitate as the water cools: but they are soluble in alcohol, in ether, and in acetic acid. The alcoholic solution is rendered milky on the addition of water, like resinous spirituous solutions. The diluted mineral acids do not act upon it; but the strong acids alter its properties: thus, sulphuric acid gives it a *blood*-red colour; the nitric first produces a *greenish-yellow*, then an *orange*, and, lastly, a *red* colour; and the muriatic changes its natural yellow to a deep *yellow* hue.

The process for procuring the Piperina is very simple. Two pounds of pulverized Black Pepper are boiled in three pounds of alcohol at 36° Beaumé, and the tincture left at rest until it is cold, and decanted: this operation is repeated with fresh alcohol: two pounds of distilled water, containing f℥iii of hydrochloric acid, are next poured on the alcoholic solution; the fluid becomes turbid, and deposites a precipitate of a deep grey colour, which consists partly of fatty matter, on removing which, beautiful crystals of Piperina appear upon the sides of the vessel, and on the filter. By adding fresh water to the liquid as long as it becomes turbid, fresh crystals are procured. The concrete oil, which is separated, is of a dark green colour, excessively acrid, and very soluble in alcohol. Pepper, also,

contains a volatile balsamic oil, extractive, a large quantity of starch, bassorine, and malic and uric acids. The acrid oil resides chiefly in the skin of the fruit; when this is denuded, as in White Pepper, scarcely any acrid oil is procured, but a smaller quantity also of Piperina is procured. Piperina is procured by a similar process from Long Pepper, and I have succeeded in obtaining it also from chamomile flowers. The effect of impure Piperina, such as it is usually prescribed, resembles closely that of the acrid oil of Pepper. In some habits, it acts upon the bowels, causing gripings and watery stools; and in others, it seems to have produced a fistular eruption, with severe itching and exfoliation of the cuticle. In this case, it is difficult to say whether the acrid oil or the Piperina should be regarded as causing these symptoms.

If we enquire into the value of Piperina as a Tonic medicine, we find that Pepper entered into many of the prescriptions of the ancients; but it does not appear that it was employed by them for the cure of agues: it is not easy, therefore, to determine the origin of the popular opinion* in its favour as a remedy in these diseases: and it was not until after the discovery of *Piperina* that any idea could be formed of the cause of its beneficial effects. The first satisfactory account of the medicinal properties of Pepper was published by Dr. Meli of Ravenna, in a work entitled "Nuove Esperienze ed Observazioni sul modo ottenerve dal Pepe nero il Peperino e l'Olio acre." Piperina has been successfully employed as a tonic on the Continent; but it is rarely used in this country; thence farther experience is requisite to determine its value. Dr. Gordini, of Leghorn, asserts that in periodical fevers he has found it prove successful when sulphate of Quinia has failed. He gave it in doses of from gr. viii to gr. x every fourth hour during the apyrexia†. If it be

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* A mixture, or rather tincture, of Black Pepper in gin or rum, has long been regarded as a specific for ague among sailors.

† *The following extract of a letter from J. Adamson, Esq. of Rye, to Charles Knight, Esq., at the date of the letter one of my pupils, is illustrative of this point.*

Dear Sir, Rye, April 14, 1829.

The cases in which I have used the Piperine, in its *crystallized state*, have been most satisfactory. The first person upon whom I tried it was a man of the name of George Avery. I visited him during the third paroxysm, and ordered one grain of Piperine to be taken every two hours between the paroxysms. The next day he had a most terrible fit of the "vulgar gripes," which, however, was speedily removed by an aperient. The ague did not return, and he has been free from it to this day. Another man, Henry Heath, had two paroxysms. He took gr. i every two hours, and had no return. The pain in the bowels also appearing in this man, I determined, in future, to give an aperient at first starting, which has completely prevented, in other cases, any griping. Hodges, of the Staff Corps; Catt, Winchelsea Marsh; Jarratt, near the Bank; Mrs. Watson's cook; Mrs. Wood, of the workhouse; Mrs. Peedle, and many others; have experienced equal benefit: and, I think, afford sufficient evidence of the efficacy of Piperine in intermittents. There is one case to which I wish particularly to direct your attention and recollection—Crowhurst, Vidler's foreman. This man has suffered from ague for, I think, nine months; it could be moved by nothing. He, as you may remember, wished to try

found to realize the anticipations of those who have introduced it, some method of procuring it at a more reasonable rate should be discovered; and the re-introduction of the use of some of our indigenous plants, such as chamomile flowers, in agues, may be attended with beneficial effects.

CHAMOMILE FLOWERS, Anthemis *nobilis**, were formerly celebrated for curing agues†. With some degree of aromatic flavour and warmth, their taste is intensely bitter. Both water and alcohol extract their medicinal properties. The oil which gives them their aromatic quality can be separated by distillation. Boiling in alcohol separates from them a concrete fat oil, which is deposited as the solution cools; and in it the Piperina exists, and separates when it is treated as that of pepper. The infusion and tincture of chamomile flowers are copiously precipitated by subacetate of lead: sulphates of iron strike a deep blue-black; they are also precipitated by decoction of yellow cinchona, the precipitate being a tannate of quinia. From these results, we may conclude that, besides Piperina, chamomile flowers contain a fat concrete matter, a volatile oil, bitter extractive, tannin, and perhaps gallic acid.

The tonic properties of Anthemis *nobilis*, when given in moderate doses, has been long known; and before the introduction of the cinchonas, the pulverized flowers were successfully administered in intermittent fevers. In strong decoction or infusion, or in large doses of the powder, they prove emetic; but in a light infusion, made at a temperature under 120°, they are very excellent tonics, in convalescence from acute diseases, dyspepsia, gout, and chronic debility. The dose of the infusion and decoction is from ʒiv to fʒiss. They are administered, also, in the form of an extract; but the heat necessary to be employed in preparing the extract dissipates much of the volatile oil; and, consequently, the value of the remedy, as far as regards its aromatic qualities, is deteriorated.

e. GENTIANIA.—This is a yellow, inodorous, bitter principle, in the form of acicular crystals. It is not very soluble in cold

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the Piperine. He took the usual dose with decided effect; for the paroxysm was evidently weakened; but, the stomach having got accustomed to the action of Piperine, whether stimulant or tonic I will not determine, the enemy returned, and there remained, in spite of the doses of Piperine, and small or large doses of sulphate of quinia, or any thing else which was given. I mention this case to shew, that, where the Piperine has failed, the sulphate of quinia has had no better effect. But I dare say you will ask—How does it answer now? To be candid, I have discontinued the use of it; not from doubting its power, but from the four following reasons:—1st, the expense of preparing it in comparison with the price of sulphate of quinia; 2dly, want of time and opportunity to prepare it; 3dly, its inconvenient form of exhibition, only in the form of pills; and, 4thly, the spirituous extract, which you remember you prepared before you left, I find to be perfectly useless; you may as well give so many pepper-corns.

* Woodville's Med. Bot. 3d edit. p. 47, pl. 19. London Dispensatory, art. Anthemis. Richard, Hist. Nat. Med. t. ii, p. 218.

† Morton, Exer. 1 de febr. intermit. cap. 6. Pringle, Diseases of the Army, p. 216. Cullen, Mat. Med. vol. ii, p. 79.

water; but communicates to it a powerful bitter: it is soluble in boiling water, alcohol, ether, and the alkalies: dissolved in acid, it loses its colour; but, on the addition of an alkali in excess, its colour is deepened. Gentiania was discovered by MM. Henry and Caventou, who regard it as an acid; but M. Richard considers it an alkaloid.* It does not, however, appear to possess either acid or alkaline properties. Exposed to the action of heat in a tube, it is partly sublimed, partly decomposed. It may be procured from the roots of the Gentiana *lutea* and other species of the natural order Gentianeæ, by macerating the roots in alcohol, and evaporating to dryness: then dissolving the residue in distilled water, adding a small quantity of magnesia, boiling, and evaporating to dryness. The magnesian residue thus procured, when boiled in ether, yields the Gentiania. The solution, filtered while hot, affords crystals on cooling. A small quantity of Gentiania is left with the magnesia on the filter, and may be procured by treating this residue with oxalic acid, which, uniting with the magnesia, leaves the Gentiania in a state to be taken up by fresh ether.

M. Majendie tried the medicinal properties of Gentiania thus carefully prepared: it proved to be an excellent Tonic, and so little poisonous as to produce no bad consequences even when injected into the veins. It is the active principle of the—

GENTIANA LUTEA.—A plant which grows in great abundance in the Alps of Switzerland and Austria, the Apennines and the Pyrenees, on the mountains of Burgundy, and in North America: it belongs to the natural order Gentianeæ†.

The roots, *Gentianæ luteæ Cortex*, L. E. D. or rather underground stems, are in rough, twisted pieces, nearly inodorous, and having an intensely bitter but not nauseous taste. Their sensible qualities, which are not perfected until they are four years old, may be extracted by ether, alcohol, and water. According to the analysis of MM. Henry and Caventou, besides the Gentiania, they contain—a very fleeting, odorous matter; a substance resembling bird-lime; a green fixed oil; a free vegetable acid in small quantity; uncrystallizable sugar; gum; a yellow-colouring matter; and lignin‡. The fugaceous nature of the colouring matter accounts for the effects of acids and alkalies on the infusion. Neither the salts of iron nor nitrate of silver throw down precipitates in the infusion—a very convenient circumstance in its medicinal administration. It is copiously precipitated by acetate of lead and the decoction of yellow cinchona

* Journ. de Pharm. Avril 1819.

† Woodville's Med. Bot. 3d edit. p. 273, pl. 95. London Dispensatory, art. Gentiana. Richard, Hist. Nat. Med. t. ii, p. 127.

‡ Journ. de Pharm. tome vii, p. 173.

bark. Besides diluting the colour, acids greatly diminish the bitterness of the Gentian root; whilst alkalies increase both colour and bitterness. Owing to the saccharine principle contained in the Gentian, the infusion very rapidly ferments and spoils.

Fabulous history carries the discovery of the medicinal properties of Gentian to high antiquity; assigning it to Gentius, king of Illyria, who lived 167 years before the Christian era, after whom the plant is named*. It possesses considerable tonic powers, exciting appetite and promoting digestion. It is taken into the circulation, and accumulates in the habit. Cullen says that Gentian, combined with galls or tormentil, in equal parts, and given in sufficient quantity, cures intermittents; shewing the advantage of combining astringents with bitters when we desire to extend their influence on the system. This root had formerly a high character as a gout medicine, and was an ingredient of the celebrated Portland powder. It is particularly applicable in such diseases as require a combination of bitters and chalybeates, namely, scrophula, amenorrhœa, worms, and similar affections. The best form for administering it is infusion; and the facility of combining it with acids, or alkalies, or the salts of silver, iron, and zinc, renders it an excellent vehicle for these medicines in all cases of direct debility†. The officinal infusion is a compound of Gentian, orange peel, and lemon peel, and is an excellent vehicle for sulphate of quinia. The tincture is a compound of the same kind with alcohol. The simplest and a good preparation is the extract, which may be given in doses of from ten grains to half a drachm, twice or thrice a day.

The Gentiana *Chirayita* of Roxburgh has long been used as a Tonic, in dyspeptic affections, in India; and has lately been introduced in England as a gout medicine. MM. Lassaigne and Boissel have analyzed it, and found in it—a yellow bitter principle; a brownish colouring matter; resin; gum; malic acid; malate of potassa; silex; and some traces of oxide of iron‡. It does not appear to possess any advantages over Gentian *Lutea*.

f. SALICINA. — This is a resinoid, discovered by MM.

* It formed a part of the celebrated antidote of Mithridates, which, says Celsus, was called most noble: "quod quotidie sumendo rex ille dicitur adversus venenorum pericula tutum corpus suum reddidisse"—an excellent commentary on the state of medicine at that period, and a striking instance of the antiquity of that credulity which still adheres to titled ignorance on the subject of remedies.

† It is said that the root of the Gentiana *acaulis*, a beautiful indigenous mountainous species, with a solitary, large, bell-shaped flower, possesses all the medicinal properties of the yellow Gentian root without the disadvantage of the gum. This deserves a trial.

‡ Journ de Pharm. t. vii, p. 285.

Belke, Buchner, and Leroux, in the bark of some species of the willow tribe*. It is procured in white, acicular, and prismatic crystals, very bitter, inodorous, little soluble in cold, but very soluble in hot water, soluble also in alcohol, but not in ether, nor in volatile oils. Sulphuric acid, at a low temperature, reddens it deeply; muriatic acids dissolve it; and it may be changed into resin by the action of both these acids, and by heat. Duflos prepared it by boiling the bark in three successive waters; evaporating till the decoction is the triple of the bark used (say 1lb. bark, 3lb. decoction): then add litharge in fine powder, and digest twenty-four hours; repeating this two or three times. Evaporate to the consistence of syrup, and purify the chrystals that form, by solution and crystallization.

To ascertain whether willow bark contain Salicina, boil ʒi of it in fʒiv of distilled water; digest in the decoction ʒi of litharge in fine powder; filter and precipitate the lead with sulphuretted hydrogen gas, then evaporate to fʒi. If, in this solution, sulphuric acid produces a bright purple red, Salicina is present†.

Salacina is not precipitated from its solution by infusion of galls, acetate of lead, alum, nor tartar emetic. According to Pelouze and Gay-Lussac, it consists of

Carbon	2 prop.	(2 × 6) =	12,	or 55.491
Hydrogen	2 ——	(1 × 2) =	2	8.184
Oxygen	1	=	8	36.325
		Equivalent	22	100.000

The following species of Salix are officinal.

1. Salix *fragilis*, Crack Willow‡, D., an indigenous species, growing upon the banks of rivers, flowering in April and May. The bark is inodorous, bitter, and austere.

2. Salix *Caprea*. Round-leaved Willow‡. L. D. This is also an indigenous species; the bark is bitter and tonic.

3. *Salix alba*. White Willow‡. D. The bark of this species has been longest known as a medicinal agent: when dry, it is of a brown colour within; is very intensely bitter, acrid, and slightly aromatic. According to the analysis of Pelletier and Caventou, it contains, besides Salicina, a brownish red matter, soluble in alcohol, but little soluble in water; a green fatty matter, soluble in alcohol and ether; tannin, of a peculiar kind, which affords an abundant precipitate with gelatin, but not with tartar emetic; gum; and lignin. The infusion of White

* Journ. de Pharm. 1829. This species of Salix in which it has been found are S. *fissa*, S. *helix*, S. *amydalina*, S. *vitellina*, and S. *incana*: it has also been procured from Populus *tremula*, P. *nigra*, P. *Græca*, P. *angulata*, and P. *alba*.

† Duflos, Schweizzer, Seidel Journ. 1833, p. 25.

‡ Richard, Hist. Nat. Med. t. i, p. 477—8. London Dispensatory, art. Salix. Woodville's Med. Bot. third edit. p. 13, t. 8. Smith's Flora Brit. 1051—1067—1071.

Willow Bark is precipitated by lime water; the carbonates of alkalies; the persalts of iron, and the salts of lead. All these precipitates are tannates of the bases, combined with the colouring principle.

It is evident that these barks possess a tonic power, both on the tissues to which they are applied, and also on the general habit; and experience has fully confirmed their influence as an antiperiodic in intermittents. They require, however, to be prescribed in large doses: they may be administered in powder or infusion, or decoction, or in that of tincture, which contains all the active principles of the bark. But the discovery of Salicina, like quinia, has nearly superseded the use of these barks.

g. QUASSINA. This is not a simple vegetable principle: it is obtained by evaporating a strong decoction of Quassia chips to the consistence of an extract: it is semitransparent and of a brownish-yellow colour, soluble in water and in diluted alcohol, or what is termed proof spirit, but not in strong alcohol and ether. The aqueous solution of Quassina precipitates the persalts of iron and the acetate of lead in yellow flakes, and the nitrate of mercury in white. It does not precipitate tartar emetic, and does not throw down the protosulphate of iron, as it contains no traces of either tannin or gallic acid. Quassina is an active principle of the following substances.

1. QUASSIÆ EXCELSÆ LIGNUM, *Quassia Wood*, L. E. D*. Quasssia *excelsa* is a native of Jamaica and the Caribeean Islands, belonging to the natural order Simarubaceæ.

Quassia wood is brought home in billets, and cut into the chips found in the shops. Water is the best vehicle for taking up its medicinal properties; and the infusion is, in fact, a weak solution of Quassina; so that it is affected by the same reagents as the solution of Quassina.

Quassia was first introduced, as a medicinal agent, from being used as a secret remedy in fever, by a negro in Surinam, called Quassi, after whom the plant is named. It was at one time vaunted as capable of curing intermittents; but it has not maintained that character, although it is still regarded as a powerful Tonic; and, from being of a nature that its infusion admits of admixture with the sulphate of iron, of zinc, and some metallic salts, it is advantageously given in chlorosis and other obstructions of the catamenia. In fevers, it may be administered in every stage of the disease, as it neither quickens the pulse nor augments the animal heat, nor operates on the bowels†. In combination with cretaceous powders, or the alkalies and aromatics, it is useful in atonic gout; but if any irritation exist in the stomach, it is injurious. Its vermifuge

* Woodville's Med. Bot. thrid edit. p. 574, pl. 204. London Dispen. art. Quassia. Richard, Hist. Nat. Med. t. ii, p. 783. † Murray, Apparatus Medicam.

powers have been well ascertained: but all Tonics may be regarded as vermifuges. On the Continent, persons of sedentary habits take a table-spoonful of the infusion of Quassia an hour before dinner, as an aid to digestion. In South America, basins are made out of the wood of the Quassia, which are employed by dyspeptics, the wood communicating its bitter to the beverage which is put into it, and which thence proves Tonic*.

2. QUASSIÆ SIMARUBÆ CORTEX. *Simaruba Bark.* L. E. D. Quassia *simaruba* is a native of Guayana and Jamaica. The bark of the root is the officinal part, being more active than that of the branches. It had been long employed by the inhabitants of Guayana before it was introduced into Europe in 1713. It is brought from Jamaica in pieces folded lengthways. It is very fibrous, thin, light, greyish or whitish, and warty exteriorly, and interiorly of a light reddish-brown hue. It is inodorous, and impresses a very bitter taste on the palate, but without any acrimony.

According to the analysis of M. Morin, of Rouen, Simaruba contains a resinous matter, a volatile oil having the smell of benzoin, malic acid, traces of gallic acid, Quassina, ulmin and lignin, acetate of potassa, an ammoniacal salt, malate of potassa, and an oxide of iron†. Its active principles are taken up both by water and by alcohol.

The infusion contains all the virtues of the bark. It is precipitated by infusion of yellow bark and some other reagents, which do not affect the infusion of Quassia; but more particularly by the bichloride of mercury and the alkaline carbonates. It is distinguished by the volatile oil, with which the bitter principle is combined, and which, undoubtedly, adds to its powers as a Tonic. The tannin which it contains is too small to prevent the sulphates of iron from being combined with it; thence they may be exhibited with the decoction in the same manner as with that of Quassia. The decoction deposites a copious resinous precipitate on cooling. In medicinal properties, the Simaruba Bark has not maintained the high character which introduced it into notice. It is now little employed, although it is a Tonic of considerable power, and has been justly regarded as the best remedy of the class in the treatment of dysentery; in which, however, it ought not to be given until the inflammatory and febrile symptoms have abated. At this period, when the tenesmus continues, with a weak, sinking pulse, it allays this uncomfortable symptom, and any griping with which it may be accompanied; favours the secretions of the skin, and restores the tone of the intestinal canal.

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* I am informed that the wood of the Quassia *amara* is that which is used in South America, where the *excelsa* is altogether disregarded.

† Journ. de Pharm. Feb. 1812.

Simaruba Bark is sometimes given in substance, in the form of powder, in doses of gr. xv to ʒss, combined with opium and aromatics; but it is an inconvenient form of the medicine.

CHIRONEA CENTAURIUM. *Lesser Century.* L. E. D.—Is a beautiful indigenous plant, belonging to the natural order Gentianeæ, which enlivens the fields with its pink corymbs of flowers in July and August*.

The infusion and decoction of the Lesser Century form a precipitate of an olive green with the sulphates of iron, and the alcoholic solution leaves a resin when evaporated. Vauquelin found that it produces no precipitate with tartar emetic, nor with gelatine. M. Moretti analyzed the summits of Lesser Century, and obtained a free acid, mucus, bitter extractive, lime, and hydrochloric acid, which was probably united to the lime. M. Chevallier procured from these summits a bitter crystallized matter†, probably Gentiana.

As a medicinal agent, the Lesser Century does not possess any properties different from those of Gentian and many other bitters; and, therefore, it might be advantageously rejected from the list of the Materia Medica.

g. BITTER EXTRACTIVE.

Extractive is found in many tonic vegetables, in combination with *fecula*, *gallic acid*, *tannin*, and *volatile oil*. In most works on chemistry which treat of vegetable bodies, it is mentioned as if it were a well-defined substance. Schrader is said to have obtained it pure from the bark of the Cinchona *lancifolia*. It is, nevertheless, difficult to say what Extractive is, in a strictly chemical point of view. The term is applied to that solid transparent residue which remains, in combination with other principles, when a vegetable infusion is slowly evaporated; which is insoluble in pure alcohol; is oxidized and rendered insoluble in water, when the solution containing it is long boiled; which forms an insoluble yellow precipitate when acted on by chlorine; is rapidly precipitated by muriate of tin; and is fixed as a dye, of a fawn-brown hue, by any substance yielding oxygen. Bitter Extractive is contained, in considerable quantity, in many roots, herbs, barks, and leaves, which possess tonic powers.

Extractive is inodorous; but it differs in taste according to the plant which yields it; thence it is probably never obtained in perfect purity. When the solution of Extractive is evaporated slowly, the residue is transparent; when rapidly, the oxidizement which occurs renders the Extractive opaque, and it

* Woodville's Med. Bot. third edition, p. 275, pl. 96. London Dispensatory, art. Chironea. Richard, Hist. Nat. Med. t. ii, p. 131.

† Journ. de Pharm. t. v, p. 98.

ultimately loses its insolubility in water. This effect of boiling, or that of rapid evaporation on Extractive, explains the reason why long decoction of some of the medicinal barks renders them nearly inert; why extracts, not slowly prepared in a water bath, are seldom active medicines; and, also, why extracts prepared in vacuo are preferable to all others. The effect of alum, alkalies, and many of the metallic salts and the oxides, on vegetable infusions and decoctions, is explained by the result of these reagents on pure Extractive. Insoluble, nearly inert precipitates are thrown down; and, therefore, these reagents are incompatible in all vegetable infusions containing Extractive. Its presence is always easily ascertained by muriate of tin, and the power of the infusion or decoction to fix a permanent fawn colour on cotton soaked in alum. When submitted to destructive distillation, Extractive yields carbonic acid gas, carburetted hydrogen gas, and, if the heat be great, ammonia: thence, we conclude that its ultimate components are—carbon, hydrogen, oxygen, and nitrogen.

* *Roots containing Bitter Extractive.*

1. CALUMBÆ RADIX. *Calumba Root.* L. E. D.—This root was used long before the plant which yields it was known: it was named from Calumbo, the place of its export in Ceylon. By the careful examination of a plant, reared from a root brought from Africa and planted in the Botanic Garden at Madras, De Candolle discovered it to be a Coculus, and named it Coculus *palmatum*. It belongs to the natural order Menispermeæ*. It grows in great abundance in the forests of Mozambique, where it is dug up in March by the natives, and transported to Tranquebar, whence it is shipped for Europe.

This root is in transverse sections, of rather more than the third of an inch in thickness, and from an inch to two inches in diameter. The centre, which is spongy and of a pale brown colour, is covered by a thick, easily detached bark, the interior of which is of a bright yellow hue; and the epidermis or cuticle olive-brown and much wrinkled. The disks or pieces are generally concave on both sides, owing to the shrinking of the spongy interior part in drying. The best specimens of the root are those slices which are least worm-eaten, solid, and heavy.

Calumba root has a slight aromatic odour, and a bitter taste; it is brittle, breaks with a starchy fracture, and is easily powdered. Boiling water and alcohol extract its virtues; but proof spirit is its best menstruum. The aqueous infusion strikes a beautiful blue with tincture of iodine; and this is the test for distinguishing the true root from a *false Calumba*, which has

* Woodville's Med. Bot. third edition, vol. v, p. 22. London Dispensatory, art. Calumba.

lately been sent from the Barbary states*. The aqueous infusion of true Calumba 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. According to the chemical analysis of M. Planché, Calumba root contains—starch, about one-third of its weight; a yellow azotized matter; a bitter yellow principle, not precipitated by the metallic salts; traces of a volatile oil; woody fibre; salts, consisting of bases of lime and of potassa; oxide of iron, and silex†. A new crystallized principle, *Calumbina*, has been procured. from Calumba, by digesting the powdered root in ether, filtering and evaporating. It possesses the bitter taste of the root: its properties require examination. Dr. Duncan supposed that Calumba root contains cinchonia; and certainly the action of reagents on its aqueous decoction apparently confirms his opinion: but the examination of the root by M. Planché and M. Guibourt, has not detected this principle in Calumba. The central part, or pith, contains little or no bitter extractive; and should, therefore, be separated before making an infusion or decoction of the root. The tonic properties of Calumba have been known since 1685: and, as it possesses no astringency, and is little stimulant, it is perhaps the best Tonic in phthisical cases. It has a considerable power in allaying the irritability of the stomach accompanying pregnancy and dyspepsia: and, occasionally, attending dentition. Dr. Denman recommended it in the low stage of puerperal fever: and, as a Tonic, in combination with rhubarb and sulphate of potassa, I have found it extremely useful in the mesenteric affections of infancy and childhood. The dose of Calumba root in powder is from gr. xv to ʒi. When taken alone, in the form of powder, it is said to exert a purgative effect, according to the experiments of Dr. John Davy. The infusion and decoction soon spoil, and are, so far, objectionable preparations: but it is one of the few vegetable medicines which should be given in the form of tincture; the alcohol taking up the active principles only of the root. One great advantage of the Calumba is the facility with which it can be combined with the salts of iron. The dose of the tincture is from fʒi to fʒiii, and even more if the patient have been accustomed to the use of ardent spirits.

2. Gei Urbani Radix. *Common Avens.* L. E. D.—This is the root of an indigenous plant, belonging to the natural

* This false Calumba 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 precipitates its infusion black; and ether, digested on it, acquires a bright, yellow colour; none of which effects are presented by true Calumba.

† Bull. de Pharm. t. iii, p. 289.

order Rosaceæ*, growing very abundantly in woods and thickets, flowering in June, July, and August.

The roots, which are the parts employed, should be dug up in spring; they have a fragrant odour, not unlike that of cloves; the taste is austere and bitter. In distillation they yield an aromatic oil in small quantity. According to the analysis of Melandri and Moretti, they contain resin, tannin, gallic acid, oxygenizable extractive, soapy extractive, muriates of potassa and magnesia, nitrate of potassa, malate of lime, mucus, lignin, and volatile oil†. Tromsdorff, also, analyzed the roots of Geum, and procured tannin, resin, volatile oil, tragacanth, gummy matter, lignin, and a trace of sulphur‡.

Avens has been little employed as a Tonic in this country; but, on the Continent, it is much used in intermittents; and in convalescences from acute diseases. Augsburg beer, which is considered as an excellent preventive of ague, in the fenny parts of Germany, owes its properties to the Geum Urbanum, a small bag of the bruised root of which is put into cask. It is also regarded as a useful corroborant in chronic diarrhœa and in scurvy. The best mode of administering Avens is in powder; but it is also administered in the form of decoction, one ounce of the bruised root being boiled in one pint of water and strained. The dose of this decoction is from f℥i to f℥iss, three or four times in the day.

** *Entire Plants.*

1. CETRARIA ISLANDICA. *Physica Islandica, Iceland Liverwort, or Moss.* L. E. D.—This is a lichen, not a moss; it is found not only in Iceland, and other parts within the Arctic circle, but on the mountains of central Europe, the Alps, and the Pyrenees, Jura, and many of the mountains in the northern parts of our Island. It grows in tufts, sometimes on the rocks and arid places, but not unfrequently on the pasturage on mountains. It holds a place among the *Cellulares*, in the order Lichenes of the natural arrangement§. It is more generally employed as an article of diet for the convalescent, than as a Tonic.

This Cetraria has no sensible odour, but a very bitter, somewhat astringent taste. It has been analyzed by several chemists: the analysis of Berzelius is that most to be depended on: he ascertained that it contained, in 100 parts—saccharine matter 3.6; bitter principle 3; bitartrate of potassa 1.9; green wax 1.6;

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* Woodville's Med. Bot. third ed. p. 502, pl. 181. London Dispensatory, art. Geum.

† Bulletin de Pharm. t. ii, p. 358. ‡ Journ. de Pharm. t. v, p. 310.

§ Woodville's Med. Bot. third edition, p. 804, pl. 271. London Dispensatory, art. Lichen. Richard, Hist. Nat. Med. t. i, p. 282.

extractive 7; gum 3.7; fecula 44.6; woody fibre 34.6. Its astringency is stated to depend on traces of gallic acid: this, however, is doubtful, as the salts of iron do not indicate it when added to the decoction. On the contrary, the sulphates of iron produce a reddish or port-wine colour with the decoction, which is probably owing to the action of the free tartaric acid of the bitartrate of potassa. The extractive is developed by muriate of tin; the gum by subacetate of lead; and the fecula by the tincture of iodine. The tonic powers of Iceland lichen depend on the bitter principle; and, therefore, when it is employed as a Tonic, which has been the case for some years past, to a considerable extent, in the latter 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. In this state, combined with milk, it forms an excellent article of diet in convalescence from the remittent of childhood, and in dentition. The addition of five or six minims of diluted sulphuric acid, and f℥i of syrup of white poppies, to f℥iss 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.

* * * *Leaves.*

1. Menyanthis Trifoliatæ Folia. *Leaves of Marsh Trifoil.* L. E. D.—Marsh Trifoil, or Buckbean, is an indigenous plant, growing in marshes; belonging to the natural order Gentianeæ*. According to Tromsdorff, it loses 75 parts in 100 of its weight in drying; what remains consists of bitter extractive; a peculiar substance approaching to the character of animal matter; a brown gum; malic acid; acetate of potassa; and fecula. The leaves are the parts medicinally employed; they yield to boiling water an intensely bitter, nauseous taste. The infusion strikes a deep black with persulphate of iron, shewing the presence of gallic acid; throws down a copious precipitate with alum and muriate of tin; and also precipitates infusion of yellow cinchona bark. It is acted upon by chlorine, which separates the extractive, rendering it insoluble.

Buck-bean or Marsh Trifoil is an admirable Tonic, and

* Woodville's Med. Bot. third edit. p. 177, pl. 97. London Dispensatory, art. Menyanthes. Richard, Hist. Nat. Med. t. ii, p. 132.

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 stops intermittents, and is peculiarly useful in rheumatism when it assumes an intermittent character. It may be given either in substance, in doses of from ℈i to ʒi of the powder; or in infusion. On account of its nauseating properties, it is useful to combine it with aromatics.

2. ARBUTUS UVA URSI. *Bear's Whortleberry.* L. E. D.—This is also an indigenous plant, a native of most of the mountainous districts of Europe. It belongs to the natural order Ericeæ*. Like its congeners, it is an evergreen shrub, low, and trailing on the ground. Its leaves are obvate, nearly obtuse, firm, and glossy, of a deep green on the upper disk, and paler on the under. Their entire edge, and their thick, firm texture, distinguish them from those of the Vaccinium Vitis Idea, Cowberry, with which they are often mixed. They have no sensible odour; their taste is extremely acerb and astringent. When triturated with cold water, the infusion strikes a beautiful deep blue with persulphate of iron, from the large proportion of gallic acid which they contain.

Uva Ursi possesses tonic powers; and has been employed in convalescence from diarrhœas, and in leucorrhœa. It displays considerable action on the urinary organs. It has been 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 was to lower the pulse without adding to its force: it palliated the symptoms, and, in some cases, appears to have effected a cure. Uva Ursi may be given in the form of infusion; but as little more than the gallic acid is taken up by the water, the powder is preferable when the tonic influence of the leaves is required. The dose of the powder is from ten grains to half a drachm.

CNICI BENEDICTI FOLIA. D. *Centauræ Benedictæ Herba.* E. *Leaves of the Blessed Thistle.*—Cnicus *Benedictus* is a native of Spain and the South of Europe, belonging to the natural order Compositæ†. The leaves have scarcely any odour, but an intensely bitter taste. They have been analyzed by M. Morin, of Rouen, and found to contain—*a bitter principle*, more soluble in hot than in cold water, and very soluble in alcohol and ether; a *resinous substance*; a *green fatty matter*; *liquid sugar*; *gum*;

* Woodville's Med. Bot. 3d edit. p. 288, pl. 100. London Dispensatory, art. Uva. Ursi. Richard, Hist. Nat. Med. t. ii, p. 167.

† Woodville's Med. Bot. third edition, p. 34, pl. 14. London Dispensatory, art. Centauria. Richard, Hist. Nat. Med. t. ii, p. 430.

albumen; a *volatile oil; nitrate of potassa; malate of lime;* several *mineral salts;* some *oxides;* and *traces of sulphur.* This analysis throws no light on the active principle of the plant.

The infusion of Cnicus *benedictus* acts powerfully upon the stomach, and, in large doses, operates as an emetic, and sometimes purges. In small doses, its influence is directly tonic; and this is accompanied with a marked action on the cutaneous capillaries. It has been successfully administered at the moment of the expected accession in intermittents, and has arrested the course of the paroxysm. In the intervals, the infusion may be taken to the extent of a small cupful, three times a day, with advantage; or from ten grains to half a drachm of the powdered leaves may be given in wine. It is also prescribed in gout and in chronic rheumatism; and very successfully as a worm medicine, its influence as which may be attributed to its bitter and tonic properties. On the Continent, where this Tonic is more frequently employed than in this country, both the powder and the infusion are ordered. The dose of the powder is from ten grains to half a drachm, when its tonic influence only is required; that of the infusion, which is made with half an ounce of the dried plant and a quart of water, is a fluid ounce and a half twice or three times a day.

h. VOLATILE OIL.

Volatile oil can be regarded as a Tonic only when it is in combination with other vegetable principles. In the following substances it is peculiarly adapted to exert a tonic influence.

1. CASCARILLÆ CORTEX. *Cascarilla Bark.* L. E. D.—Croton *Cascarilla* is a native of South America, particularly Peru, the Bahama Island, and Virginia. It belongs to the natural order Euphorbeaceæ*. This bark is generally brought home in quilled pieces, thin, compact, and breaking with a resinous fracture. The epidermis is whitish, rough, cracked, and covered, like the cinchona bark, with various lichens, some of which are very elegant, and belong chiefly to the Graphideæ. It has a bitter and slightly acrid taste, and an agreeable, aromatic odour, which is communicated to the infusion and decoction. This odour, which depends on the volatile oil which the bark contains, is exhaled when the bark is burnt; on which account it is used in India to diffuse an agreeable smell, resembling musk, in the houses of the natives. Its active properties are taken up both by alcohol and water. According to Tromsdorff, the analysis yields mucilage, bitter extractive, resin, volatile oil, water, and woody fibre; but, from the effect of various reagents, it evidently contains also gallic acid. Its infusion yields precipitates with sulphate of iron, acetate of lead, lime water, and infusion of yellow cinchona bark.

* Woodville's Med. Bot. third edit. p. 629, pl. 222. London Dispensatory, art. Croton. Richard, Hist. Nat. Med. t. i, p. 582.

Cascarilla is a very valuable Tonic; its aromatic qualities greatly aiding its tonic powers in dyspeptic affections. It was introduced into practice in 1690 by Professor Stisser*, and was employed as a substitute for cinchona bark in the cure of intermittent and remittent fevers; but its powers in these diseases were greatly overrated. It is usually said to be an excellent addition to cinchona; but this refers to the pale cinchona only, as it precipitates the infusion and decoction of the yellow bark. It is advantageously administered in asthma, flatulent colic, the latter stage of dysentery, and in diarrhœa; indeed, in every affection in which the combination of a Tonic and an aromatic is indicated. In the gangrenous thrush of infancy it is peculiarly serviceable; and no less so in that state of languor and emaciation, accompanied with a tumid, tense abdomen, which depends on obstruction of the mesenteric glands. The volatile oil of Cascarilla, whilst it is useful in some cases, excites too powerfully to permit this bark to be employed where there is the least tendency to inflammatory action. It has also been supposed to favour a determination of blood to the hæmorrhoidal vessels.

The powder of the bark may be administered in doses of twelve grains to a scruple; but it is most frequently prescribed in the form of infusion, to which the compound tincture of cinchona is an admirable addition.

2. Acori Calami Radix. *Root of Sweet Flag.* L. E.—The physical characters of this root, or rhizome, and the chemical properties of the volatile oil on which its excitement depends, have been already described (p. 146); what share this oil has in its tonic power is not so obvious. In the fenny counties, and in Holland, its influence in curing agues is well known; and I have had sufficient experience of its powers to authorize me to regard it as one of the best additions which can be made to any of the more decided Tonics in the treatment of intermittent fever. I have seen both the bark and the sulphate of quinia succeed in curing the disease when combined with the Acorus Calamus, in powder, although they had previously failed when administered alone. Whether the volatile oil of the Acorus, which is now procured in a separate state, if administered in the form of an oleo-saccharum, in combination with sulphate of quinia, would be productive of the same beneficial effects as the powdered rhizome, I have not yet ascertained. It is rather remarkable that all the volatile oils, in this mode of combining them with infusions and decoctions of simple bitters and with solutions of tonic salts, are not employed instead of the substances from which they are extracted. The former often contain substances which decompose the salts and render them inert; whereas, no such effect would follow the combination of the

* Art. Laborat. Chym. Spec. c. 9.

volatile oils with these powerful Tonics; whilst their efficacy would be greatly augmented by the addition of the aromatic. To illustrate this remark by an example, let us suppose that sulphate of quinia is administered with the aromatic powder of the Pharmacopœia, the salt would be decomposed and an inert tannate of quinia formed; but, were the volatile oils only of any of the aromatics separated and combined with the salt, much advantage would be derived from the combination, without the smallest risk of decomposition. Although, in some instances, a simple Tonic, devoid of any exciting property, is desirable, yet, in the greater number of cases requiring the aid of Tonics, the addition of an aromatic is rather beneficial than injurious.

MYRRH. L. E. D.—Balsamidendron *Myrrha* is supposed to be the plant from which Myrrh is procured; but whether it is a spontaneous exudation, or obtained artificially in the same manner as some other gum-resins, are circumstances still involved in mystery. This is remarkable, when we consider the early notice of Myrrh in Scriptural history*. The probability, however, is, that it is a spontaneous exudation. It is imported into this country from the Levant and the East Indies; but, in both instances, it is the same substance, the produce of Arabia†.

Myrrh is in irregular masses, and sometimes in tears; of a reddish-yellow colour; nearly opaque; brittle; breaking with a vitreous fracture; and easily powdered: its taste is bitter and slightly aromatic, especially when fresh pulverized, and not disagreeable. It feels fat and greasy under the pestle, owing to the volatile oil adhering to its resin. It is not fusible, and not easily inflamed. It is heavier than water, its sp. gr. being 1.360. When the masses are dark-coloured, and have an unpleasant odour, the drug is bad. The best Myrrh adheres to the teeth when chewed, and renders the saliva milky. It is partially soluble in water, forming with it an opaque, yellow solution; but nearly one third of the suspended matter is deposited by rest. Alcohol takes up the portion insoluble in water, and forms a tincture, which water renders opaque and whitish, but does not precipitate. The other portion, soluble in water, resembles Acacia gum, except that it is slowly precipitated by bichloride of mercury and superacetate of lead, and combines with the oxides of these salts: it also acquires cohesion, and becomes nearly insoluble when evaporated to dryness. Myrrh is soluble in the alkalies; when it is distilled, a heavy fixed oil is

* "And they lift up their eyes and looked and beheld a company of Ishmaelites came from Gilead with their camels, bearing spicerie, and balm, and Myrrh, going to carry it down to Egypt."—Genesis, chap. xxvi, v. 25.

† "Vauquelin, the distinguished French chemist, when treating the root of a species of grass from Arabia, the Anthropogon *Schœnanthus*, obtained an oil from it of a sharp taste and a peculiar odour, not unlike that of Myrrh. He ascertained that, when this oil is united to gum or mucilage, it forms a compound closely resembling natural Myrrh.

procured: nitric acid changes it into oxalic acid. According to the analysis of Pelletier, Myrrh is composed of—

Resin, combined with volatile oil. .	34.68
Gum.	65.32
	100.00

The resin, deprived of the volatile oil, is tasteless and inert*.

Myrrh is a stimulant Tonic, well adapted, when exhibited in the entire state, for the relief of humid asthma and chronic catarrh. The watery solution, in combination with nitrate of potassa, foxglove, opium, and camphor, or sulphates of zinc, or of iron, is often administered in pulmonary consumption; but it is only by the use of the entire gum-resin, in the latter stages of that intractable disease, that it can, in any way, prove beneficial. Myrrh, in this case, acts as a Tonic, and arrests, in some degree, the progress of that exhaustion which always accompanies purulent expectoration. For the same reason, it proves beneficial in chlorosis, and defective excretion of the menstrual discharge, in pale, leuco-phlegmatic, languid girls. In combination with oxide of zinc, it has been found an extremely beneficial Tonic in a peculiar cough which occasionally accompanies pregnancy, and continues after abortion. Upon the whole, I may assert that Myrrh possesses tonic powers; but that these can be taken advantage of only in cases where stimulants are required. It may be administered in the form of powder; or in pills, in combination with other Tonics; or in the form of watery infusion; or in that of tincture, if properly diluted. The oil, mixed with sugar as an oleo-saccharum, possesses all the properties of the entire drug. The dose of Myrrh in substance is from gr. x to ℈i; that of the tincture, from m. xxx to ʒi in ʒii of water; and that of the oil, from m. ii to m. xii. The watery emulsion is useless; being merely a solution of gum, slightly impregnated with a bitter.

INORGANIC SUBSTANCES WHICH OPERATE AS TONICS.

OXIDES OF METALS.

These are metals combined with certain proportions of oxygen, forming compounds that possess properties different from those of either the metal or the oxygen. They are for the most part insoluble in water: those which are soluble display an alka-

* Myrrh was used for various purposes by the ancients. According to Plutarch, in his Dissertation de Isse et Osire, it entered into the composition of the famous *Zulphi*, which, it is stated, inflamed every night to the setting sun, in the Temple of Vulcan, at Memphis. Its medicinal use, both externally and internally, is mentioned by Celsus and other early authors; and the *Vytians*, the native practitioners of India, order it as a cordial, and externally, mixed with lime juice, as a repellent.

line reaction: they unite with each other, and enter into combination with acids, forming that class of substances termed salts; all of which, except those into which ammonia and the vegetable alkaloids enter, are composed of metallic oxides and an acid. Oxides of metals are arranged into two classes: the *first* class contains those oxides which are regarded as alkalies and earths; of which those medicinally used are *potassa*, *soda*, *lime*, *baryta*, and *magnesia:* the second, those which are neither alkalies nor earths; among which, the *oxides of zinc*, *iron*, *antimony*, *bismuth*, *lead*, and *mercury*, are medicinal agents. The metals forming these oxides are all capable of combining with oxygen in more than one proportion: thence the terms *protoxide*, *deutoxide*, and *peroxide*. The oxgyen gives the efficiency to the preparation; for pure metals are inert. It also renders the resulting compound soluble in the animal fluids, and enables it to enter into the circulation and be there decomposed, or to exert a primary stimulant influence on the nerves of the part to which it is applied. In both cases it operates as a Tonic.

1. CALX. *Lime.* L. E. D.—This is a compound of calcium and oxygen: it is found most abundantly in combination with acids, forming mineral salts, in many parts of the world. It also forms a part of many vegetable and almost all animal bodies, constituting the solid part of bones, teeth, shells, crusts, horns, nails, hair and feathers, in muscles, and even in the medullary part of the brain. When calcareous spars, marble, and all limestones, are exposed to a red heat, carbonic acid is expelled, and pure lime remains.

Lime, thus procured, is of a white colour, moderately hard, brittle, and porous. Its sp. gr. is 2.3. Lime has been ascertained to be a compound of—

Calcium .	71.42	or	1 prop. =	20.5
Oxygen .	28.58	–	1 prop. =	8
	100.00		Equivalent	28.5

It is therefore a protoxide of the metal. It is inodorous, extremely acrid to the taste, displays distinct alkaline properties, and, when applied to the living body, enters into chemical union with its components, and corrodes and destroys the vitality of the part. It is one of the most infusible of known bodies, and has a powerful affinity for water. When newly burnt, water causes it to swell, become hot, and fall into powder; a large portion of the water is converted into vapour, whilst the rest disappears, having become an integrant part of the lime, which has acquired weight and is now a *hydrate*, or a compound of Lime and water. When the operation is performed on large quantities of Lime, in a dark place, light as well as heat is given out. Hydrate of Lime, or slacked Lime, is a compound of—

Lime	75.68	or	1 prop.	= 28.5
Water	24.32	–	1 prop.	= 9
	100.00		Equivalent	37.5

In this state it is soluble in water; and it is a curious fact, that cold water dissolves more of it than hot water. One pint of water, at 32° Faht. dissolves eleven grains of pure slacked Lime; at 60°, 9.7 grains; and at 212°, 5.6 grains only. It is in solution that Lime produces a tonic effect when taken into the stomach.

The solution of lime, or *lime water*, is prepared by agitating slacked Lime with water; then setting the mixture aside in a well-stopped bottle until the undissolved Lime subside, and carefully decanting the clear fluid. Lime water is limpid, inodorous, and has an alkaline, harsh, but sweetish taste. It converts vegetable blues to green; unites with oil, forming an imperfect soap; and, when exposed to the air, rapidly absorbs carbonic acid, and is converted into Carbonate of Lime. It precipitates many of the astringent vegetable infusions and decoctions, is precipitated by oxalates, citrates, and tartrartes, by the alkaline carbonates and borates, and by almost all the metallic salts. These substances, therefore, are incompatible in prescriptions with lime water. But although lime water is precipitated by carbonic acid and substances yielding it, yet carbonate of Lime is soluble in an excess of carbonic acid. For the same reason, although sulphuric acid precipitates lime from a strong solution, yet, in a dilute solution, no precipitation is produced.

Lime, in its state of solution in water, is a Tonic of very moderate power; and it is probable that even this is due to its exerting a sedative influence on the nerves of the stomach, by which the irritability of the viscus is allayed; and the gastric juice, being more slowly secreted, is consequently more perfectly formed, and chymification thus aided. It is employed in those cases of dyspepsia in which there is a superabundant acidity of the stomach: in these instances its operation is not, as generally supposed, chemical, but such as has been just described. The old custom of combining bark with Lime water was founded on erroneous principles; and it is questionable whether the combination of Lime water with sarsaparilla be consistent with sound practice. Lime water may be administered in doses of from two to four fluid ounces, twice or three times a day.

2. ZINCI OXYDUM. *Oxide of Zinc.* L. E. D.—Metallic Zinc is rapidly oxidized when it is thrown into a crucible exposed to a white heat: the metal burns with a brilliant bluish-green flame, and emits white flakes, which, collected in a crucible inverted over the former, are Oxide of Zinc. The London College orders it to be prepared by decomposing sulphate of Zinc by ammonia; but much attention is required in precipitat-

ing the sulphate, as the Oxide is soluble in an excess of the solution. The Oxide, in whatever manner it is prepared, is a white, inodorous, tasteless substance, insoluble in water, but partially soluble in the pure alkalies, although not in their carbonates, and soluble also in almost every acid, forming regular salts. It consists of—

1 prop. of Zinc	= 32.3,	or	81
1 prop. of Oxygen	= 8		19
Equivalent	40.3		100

Oxide of Zinc (Zn. + O), prepared in either way, is a protoxide of the metal. It was introduced into practice by Gaubius; and, although it has not fully realized all which that distinguished physician anticipated, yet it is a Tonic of much value. By the tonic influence which it exerts, it has been found beneficial in the decline of acute diseases of a spasmodic character; for example, in hooping-cough, when the cough is kept up by custom, acting on a debilitated, irritable habit of body. The solubility of the Oxide, in an excess of the pure alkalies in solution, is of advantage in prescribing it in psoriasis and some other cutaneous eruptions. In these cases, whilst the alkali allays the morbid irritability of the stomach, the Oxide of Zinc restores its tone.

Mr. Phillips recommends a carbonate of Zinc to be prepared by precipitating the solution of the sulphate by means of the carbonate of potassa. This, although a more œconomical preparation, is probably less active than the Oxide: it is, however, worthy of a trial.

k. ARSENICUM. *Metallic Arsenic.*—Arsenic, like all other metals, exerts no influence on the animal œconomy in its metallic state. It is one of those metals which is capable of forming with oxygen compounds possessing acid properties. The following is one of these:—

ARSENICUM ALBUM SUBLIMATUM. *Sublimed White Arsenic.* L. E. D. Syn. *Arsenious Acid.*—When metallic Arsenic is heated, with free exposure to air, it is changed into Arsenious Acid; and the same substance is produced by digesting it in nitric acid, which is decomposed and yields its oxygen to the Arsenic. On a large scale, Arsenious Acid is obtained during the roasting of the native arseniurets of cobalt for the preparation of zaffre, and from the reduction of the arseniurets of copper. It undergoes a second sublimation to purify it, and is thus formed into white cakes, which are generally transparent within, white and opaque on the outside, and break with a conchoidal fracture. In this state it is sufficiently pure for medicinal purposes.

Arsenious Acid, the oxide of Arsenic, or white Arsenic, as it is commonly called, is volatile at a temperature of 380°: in this state it is inodorous; but, if it be placed on red-hot coals, it exhales the odour of garlic, owing to its partial reduction to the

lowest state of oxidizement. It requires nearly 400 parts of cold water to dissolve one part of Arsenious Acid; but the solubility of the acid, in its transparent and opaque state, is different: 1000 parts of boiling water take up 97 parts of the transparent acid, and retain 18 parts when cold; it takes up 115 parts of the opaque variety, and retains 29 on cooling. The transparent acid becomes opaque when exposed to the air. This is an important practical fact. Its solution, when evaporated, yields the Arsenious Acid in regular tetrahædrons. It feebly reddens the vegetable blues. It is soluble in small quantity, in alcohol and in oil, and readily unites with salifiable bases.

Arsenious Acid is a compound of 2 prop. of Arsenic = 75.4 +3 prop. of Oxygen = 24, making the equivalent 99.4. For medicinal use, the white Arsenic sold in powder should never be employed, as it is generally adulterated with sulphate of lime—a fraud easily detected by exposing the powder to a heat sufficient to volatilize the arsenious acid.

Arsenious Acid is decomposed by various reagents. It is precipitated from its aqueous solution by lime water in the form of a white powder, which is an arsenite of lime; by sulphuretted hydrogen as a sulphuret of Arsenic; by ammoniacal nitrate of silver, which throws down a yellow arsenite of silver; by the solution of cuprum ammoniatum, which throws down arsenite of copper, or *Scheële's green;* and, lastly, by metallic copper, in which case an alloy of the copper and the metallic Arsenic is formed.

It has been asserted that Arsenious Acid was known to the ancients, as the word *Arsenikon* is mentioned by Dioscorides; but whether this was Arsenious Acid is not easy to determine*. The first process for obtaining it is detailed in the Pharmacopœia of Schroeder, published in 1649; but it was not until the beginning of the eighteenth century, when Mr. Brandt, a German chemist, examined the metal and ascertained its affinities, that the nature of Arsenious Acid was well understood.

Arsenious Acid, or oxide of Arsenic, as it is called, has a most powerful action on the animal œconomy; but, when the dose is properly apportioned, it is a valuable and sufficiently manageable Tonic in intermittents and other diseases requiring the aid of this class of remedies. It has long been employed in the fenny districts under the name of "tasteless ague drop;" but there are objections to it which have almost superseded its employment; and it should be recollected, that, if arsenical oxides or salts are to be employed, those forms of administering them ought to be preferred which are attended with the least risk, and the dose of which is most easily apportioned. Now,

* The word *Arsenic* first occurs in the writings of Avicenna.

the Arsenious Acid, from the variations in its solubility, cannot be administered in solution without some risk.

l. METALLIC SALTS.—These are combinations of alkalies, or of oxides of metals and acids. They are solids, and assume regular crystalline forms. They vary in colour, are inodorous, more or less sapid when soluble, and insipid when insoluble. They differ greatly in their affinity for water; some being *deliquescent*, or abstracting moisture from apparently dry air; some undergoing this change only in a very humid air; and others suffering nothing even in an atmosphere loaded with aqueous vapour: thence salts differ in solubility. But this depends also, in some degree, on their cohesion; their solubility being in the inverse ratio of this property. Soluble salts crystallize when their solutions are evaporated; the regularity of the crystals is greater the more slowly evaporation is conducted; and these always assume the same definite forms, all circumstances being equal. All salts, in crystallizing chemically, unite with a definite portion of water: when this is lost spontaneously, on exposure to the air, the salt is termed *efflorescent;* when it retains the water of crystallization, *persistent;* when heat is applied, and it dissolves in this water, it is said to undergo the *watery fusion.*

Amongst the salts now under consideration, some are formed from protoxides or oxides containing one equivalent of metal and one of oxygen; others from peroxides: thence *proto*, or *per*, or *bis*, are attached to the names of the salts.

1. ARSENITE OF POTASSA.—This is a compound of Potassa and arsenious acid, in the proportions of one equivalent of each of the components. It is characterized, like other arsenites, by forming a yellow arsenite of silver when mixed with a solution of the nitrate of silver; and by forming orpiment when, after being acidulated with acetic or muriatic acid, sulphuretted hydrogen gas is passed through it. Arsenite of Potassa is the active part of the following preparation.

LIQUOR ARSENICALIS. *Arsenical Solution.* L. D. *Solutio Arsenicalis.* E.—This solution was introduced as a remedy for ague, by Dr. Fowler, of Stafford, in 1786, under the name of Solutio Mineralis. In the preparation of the Pharmacopœias there is scarcely a sufficient quantity of the Potassa to saturate the whole of the arsenious acid. Each fluid drachm of the solution contains a grain of the arsenite, or half a grain of the 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; but it must not be supposed that it will always succeed where other means fail; and, indeed, it is not easy to explain the manner

in which it produces its beneficial effects, as it sometimes induces symptoms at variance with our notions of those which follow the exhibition of a Tonic, and yet it cures the disease. Were I to hazard an opinion as to the mode in which arsenious acid and the arsenite of potassa cure intermittents, I should regard them as acting by their primary effect as stimulating Tonics on the stomach, assisting the digestive powers of that viscus; and, consequently, both by that effect and also by the extension of their tonic influence to the whole system, removing the debility which favours the repetition of the intermittent paroxysm. Their diaphoretic power, also, aids their 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 tic douloureux and cephalalgia. I have had much experience of its efficacy in lepra and some other cutaneous diseases, when given in conjunction with large doses of the pure alkalies and with conium. In the treatment of cancer, arsenious acid has been both internally administered and externally applied; but I must confess that I have never witnessed decided benefit from its administration, although I have seen its deleterious agency manifested in many cases, even where its use was confined to the surface. When applied to an external wound, it sometimes causes almost immediate imflammation in the stomach, accompanied with violent vomiting and purging; and death is as likely to ensue as if it were internally administered. Whether, in this case, the acid is absorbed into the circulation, or the stomach is affected by sympathy, through the medium of the nerves, is still undetermined; but the probability is that it is taken into the circulation, and acts directly on the organ, in the same manner as if it were swallowed. We have only, however, to consider its acrimony as an external application, to be satisfied that it exerts, also, an immediate and direct influence on the nerves of the stomach, when it is taken into that viscus. Upon the whole, therefore, although arsenious acid and its preparations, when properly administered, often afford all the advantages which can be expected from the operation of the most powerful and safe Tonics; yet much caution is requisite in using them, under every circumstance.

When an overdose of arsenious acid or of arsenite of potassa is swallowed, the first symptoms are violent pain in the stomach, and, soon afterwards, in the bowels also, accompanied by a sensation of heat and constriction in the œsophagus and

the mouth, producing nausea with an increased excretion of saliva. These feelings are conjoined to a sense of tightness of the skin of the face, stiffness of the eyelids, inflammation of the conjunctiva, and an itching of the face and neck. Vomiting is sometimes incessant, the fluid brought up is streaked with blood: there is purging, and occasionally a paucity of urine, and even strangury: the pulse, which is at first indicative of high inflammatory action, quickly sinks, and becomes irregular; cold sweats supervene, with convulsions, and death ensues. In those cases in which the poison has either been ejected or removed from the stomach, the wretched sufferer seldom fails to feel its influence during the remainder of his life, which is dragged on in mental and bodily debility.

The post-mortem examination of the body of a person poisoned by arsenic exhibits remains of inflammatory action in the stomach, generally confined to the mucous membrane, which is red, soft, pulpy, and easily detached; sometimes there is only a thinning of the coats: but more frequently there is a highly injected state of the vessels, with spots of extravasated blood. The inflammation of the stomach is often more severe, and the death more sudden, when the acid or arsenite is applied to a wound, than when it has been swallowed: it is, therefore, supposed that the fatal issue is not the result of the local action of the poison on the stomach. Several ingenious experiments of Mr. Brodie seem to confirm this opinion, and to lead to the conclusion, that death from poisoning with Arsenic is to be ascribed to its influence upon the heart and the nervous system: nevertheless, the decided change which it produces upon these is sufficient evidence of the energy of its local influence.

In such cases, undoubtedly, the first object is to free the stomach from the poison as completely and as quickly as possible, by the stomach pump, which should be promptly used; and I am of opinion that, if the nature of the poison be known, and even when subsequent experiments are likely to be instituted on the contents of the stomach, in using the pump, lime water should be employed to wash out the stomach instead of common water. The union of lime and arsenious acid forms a nearly insoluble salt; so that, whilst we are relieving the viscus of its deleterious contents, we are, by using it, also diminishing the virulence of any part of the poison which may remain. When, however, the stomach pump is not at hand, emetics—namely, the sulphates of zinc and of copper, which act directly upon the stomach, and not through the medium of the circulation,—should be administered. In this case, also, lime water should be drunk immediately after the first act of vomiting, to neutralize and diminish the activity of the arsenious acid in the stomach. It might be supposed that lime water, in this instance, should be administered in a tepid

state; but it must be recollected that the solubility of lime is in the inverse ratio of the temperature of the water; and, therefore, by heating the lime-water, a certain quantity of the lime is thrown down, and the influence of the solution in neutralizing the arsenious acid diminished. For although the arsenite of lime be not wholly insoluble, yet it is less so than white arsenic; consequently, its activity being in the direct ratio of its solubility, the formation of this salt in the stomach, by the lime water, is a safeguard, to a certain extent, against the acrimony of the arsenious acid. As there is hazard, should the arsenical salts be absorbed, we must be particularly cautious not to dilute with any fluid that is likely to act as a solvent of arsenious acid; such, for example, as alkaline solutions, which have been recommended in these cases; the alkaline arsenites being very soluble, and as poisonous as arsenious acid itself. Oil may be safely and advantageously administered, and also milk: its effects indeed are so well known that the smelters of metallic ores containing arsenic, in Cornwall, whenever they are infested with more than an ordinary portion of arsenical vapour, have frequent recourse to olive oil.

From what has been said regarding the effect of Arsenious Acid on the stomach, and also regarding the probability of its absorption, little benefit can be expected from the employment of antidotes. It has been recommended to use vinegar; but the solubility of arsenious acid in vinegar renders this a dangerous agent; the sulphuret of potassa merits no better confidence, the sulphurets of arsenic being poisonous; and, indeed, if we except lime water, I know of nothing which has a claim to the title of antidote in cases of poisoning by arsenious acid. Magnesia has been recommended; but magnesia scarcely acts upon arsenious acid. When boiled with magnesia for some time, the acid remains unaltered. Peroxide of iron has been proposed: but I know nothing of its powers*. It is of great importance, after evacuating the stomach, to allay the excitement which has been induced on its coats; this is most effectually done by bloodletting; counter-irritation, as for instance, blistering, by means of boiling water on the scrobiculus cordis; and sheathing the organ itself by the administration of oil and milk. When the inflammatory symptoms are reduced, the case is to be treated as one in which the stomach has been the seat of inflammation, without any reference to the exciting cause.

2. ZINCI SULPHAS. *Sulphate of Zinc.* L. E. D.—This is a compound of sulphuric acid with the protoxide of zinc, and a large proportion of water of crystallization. Sulphate of Zinc was first artificially made in the sixteenth century, by Henkel and Newmann, two German chemists, who prepared it from

* Athenæum, No. 368, p. 845.

calamine and blende, nearly in the same manner as it is now manufactured in some places for commercial purposes. The sulphurets are roasted and thrown, whilst they are hot, into water, which is afterwards evaporated in leaden boilers, and then exposed in wooden cisterns to crystallize. In this process the sulphur is partly converted into sulphuric acid, which aids the metal to decompose the water, the oxygen of which it attaches to itself, so as to change it into an oxide, which, uniting with the sulphuric acid, forms the sulphate. The Sulphate of commerce is unfit for the purposes of medicine; and, therefore, it is ordered to be formed by the direct combination of its constituents. The salt obtained is in its crystalline state.

Pure Sulphate of Zinc, although strictly neutral, yet is an acidulous salt; it has an acrid, styptic taste; is inodorous and in colourless, transparent, flattened, quadrilateral crystals, which effloresce in the air; and, when exposed to heat, first lose their water of crystallization, then their acid, and, if the temperature be much raised, the simple oxide remains. Sulphate of Zinc is soluble in two parts and a half of water at 60°, and in its own weight of boiling water. The solution is precipitated by alkaline carbonates; but the pure alkalies first precipitate and then redissolve the oxide: it is also precipitated by salts of baryta, and acetate of lead; the precipitates being sulphates of baryta and of lead, whilst muriate, nitrate, or acetate of Zinc remains in solution: these substances, therefore, are incompatible in prescriptions with Sulphate of Zinc. With sulphate of potassa it forms a double salt, which crystallizes in flat, rhombic, prisms; a compound salt extremely useful where a tonic influence is required to be conjoined with an aperient. The composition of Sulphate of Zinc, in its crystalline state, is (Z. + S.) + 7 aq.

Oxide of Zinc	30.9	or	1 prop.	= 40.3
Sulphuric Acid	29.4		1 prop.	= 40
Water . . .	39.7		7 prop.	= 63
	100.0		Equiv.	143.3

As a Tonic, Sulphate of Zinc exerts its primary influence on the stomach: the effect produced there being communicated by nervous sympathy to the rest of the system. It is supposed to operate with less general excitement than other metallic salts, and, therefore, is frequently prescribed in phthisis. To its general tonic influence, also, may be ascribed its efficacy in the humid asthma of old men; for, by communicating tone to the exhalant bronchial vessels, it diminishes both the acrimony and the quantity of the bronchial excretion, and renders the expectoration more easy. The same mode of action enables this sulphate to prove useful in protracted hooping-cough, in

which the habit is much debilitated. The dose of the Sulphate of Zinc, when its tonic effect only is desired, should not exceed gr. ii, repeated twice or three times a day. It may be given in combination with all the mineral acids: and also with the pure alkalies in excess; and with such of the bitter infusions as contain little tannin.

3. ZINCI ACETAS. *Acetate of Zinc.* E. D.—This salt may be prepared by the direct combination of its constituents; but it is usually directed to be obtained by mixing the solution of the acetate of lead with a solution of sulphate of zinc; a double decomposition takes place, the oxide of zinc detaches itself from the sulphuric acid and combines with the acetic, leaving the lead in union with the sulphuric acid, as an insoluble sulphate, which precipitates. By filtering and evaporating the liquid, the Acetate of Zinc is procured in talcy crystals, soluble in water, and readily decomposed by heat. The constituents of this salt are (Zn. + Ac.) + 7 aq. or 1 prop. oxide of zinc = 40.3, + 1 prop. acetic acid = 51, + 7 prop. of water (7 × 9) = 63, making its equivalent 154.3.

Acetate of Zinc possesses the same tonic properties as the sulphate. It is seldom prescribed as an internal remedy; but frequently as an astringent collyrium in ophthalmia.

4. CUPRI SULPHAS. *Sulphate of Copper.* L. E. D.—This salt is found abundantly in a state of nature, occasionally solid, massive, or in capillary or cubic crystals, but more generally in solution in water, in the vicinity of copper mines. It is also obtained by roasting the native sulphurets of copper, and treating them in the same manner as the sulphurets of zinc for the preparation of the sulphate of that metal. It is known in commerce by the names of *blue vitriol*, or *blue copperas*, and is a bisulphate. The form of its crystals vary according to the manner in which the process is conducted; but, in general, they are either octahedrons or decahedrons, with the edges truncated at the base; and refracting double.

Sulphate of Copper is inodorous and has a strong styptic taste. It is soluble in four parts of water at 60° Faht., and in two parts of boiling water. It is insoluble in alcohol. When long exposed to the atmosphere, it undergoes slight efflorescence, so that its surface becomes covered with a whitish-green powder. In a moderate heat it loses its water of crystallization, and in a high temperature is decomposed, the acid is driven off, and a black oxide of copper remains behind. According to the analysis of Berzelius, the pure Sulphate consists of—(Cu. + S.) + 5 aq. or

Sulphuric Acid .	31.38	or 1	prop.	= 40
Peroxide of Copper	32.32	1	prop.	= 39.6
Water.	36.30	5	prop. (9 × 5)	= 45
	100.00		Equivalent	124.6

Sulphate of Copper is decomposed by alkaline solutions; by

lime water; the hydrosulphurets; subborate and phosphate of soda; the salts of lead; muriate and acetate of baryta; the nitrates of lime, mercury, and silver; and astringent vegetable decoctions and infusions. It is also precipitated, copiously, of a reddish yellow colour, by ferro cyanate of potassa.

Sulphate of Copper is a powerful but hazardous Tonic and antispasmodic. It has been given in doses of from one sixth of a grain to one grain in spasmodic diseases, in combination with opium, twice or three times a day: but unless the disease be accompanied with severe diarrhœa—as, for instance, Asiatic cholera, in which it has proved successful—it is not to be recommended. In chronic diarrhœa nothing is more likely to check the discharge and to increase the tone of the habit than Sulphate of Copper, in doses of gr. ss, combined with gr. i or gr. ii of opium. It has been supposed to operate in these cases by its astringent powers; but the dose is too minute to support this opinion; and it is more probable that it acts by increasing the tone of the intestinal nerves. It is on this principle that it has lately been advantageously employed in diarrhœa depending on a weakened state of the coats of the intestines. The dose of the sulphate, as a Tonic, may be gradually extended to gr. ii; but it ought not to exceed this quantity.

5. ÆRUGO. *Subacetate of Copper.* L. E. D. CUPRI ACETAS, *Acetate of Copper*, D. Syn. *Verdigris. Distilled Verdigris.*

The first of these substances is prepared at Montpellier in France*, by stratifying plates of copper with the fermenting marc of grapes from the wine presses; the copper is thus first formed into an oxide, and then the uniting with acetic acid of the husks and stalks forms a mass of impure acetates of copper. It is also prepared at Grenoble, by simply moistening copper-plates with distilled vinegar, and, in England, with pyroligneous acid. This preparation is usually obtained in a dry, hard, pulverulent, foliaceous, pea-green mass. Distilled water dissolves 0.56 parts only of the crude Verdigris, which sonsist of soluble binacetate of copper, composed of 1 prop. oxide of copper = 39.6 + 2 acetic acid (51 × 2) = 102, making the equivalent 141.6: the insoluble portion is a diacetate, and consists of 2 prop. of the oxide = 79.2, + 1 of acid = 51, making the equivalent 184.2.

The Acetate of Copper, formed by dissolving Verdigris in diluted pyroligneous acid, decanting off the solution and crystallizing by evaporation, is obtained in very deep-green rhomboidal crystals, efflorescent in the air, and, when exposed to it, becoming of a light bluish-green hue; they are entirely soluble in water, but not in alcohol or ether. They are the principal ingredients in the blue variety of Verdigris.

* London Dispensatory, 6th edition, art. Cuprum.

These salts of copper possess the same tonic powers as the sulphate. When any salt of copper has been taken in poisonous doses, violent vomitings and pains of the stomach and intestines follow: there is a distinct coppery taste in the mouth, and a sensation of strangulation in the throat, colic pains, sometimes purging, with severe tenesmus, and occasionally the alvine discharges are bloody: these symptoms are followed by violent headache, vertigo, cramps, and convulsions; and, if the poison be not wholly expelled from the stomach, inflammation of the mucous membrane supervenes, and death rapidly follows. To relieve these symptoms, the stomach must be emptied by means of the stomach pump, and the excitement reduced by bleeding. Orfila and others advise to give as much albumen and *sugar* as the patient can swallow. The sugar and albumen, in this case, are supposed to reduce the salts of copper; but this is doubtful: they may alter them so much that they lose their poisonous qualities. If sulphate of copper be boiled in a solution of sugar, it is reduced to the metallic state; but it requires to be boiled. These substances, however, are usually employed in cases of poisoning by salts of copper.

BISMUTHI SUBNITRAS. *Subnitrate of Bismuth.* L.—This tonic salt is a compound of the oxide of Bismuth, water, and a small proportion of nitric acid. It is never found in a natural state. Bismuth dissolves readily in nitric acid moderately diluted with water; and when this solution is poured into a large quantity of water, a snow-white precipitate subsides, which, separated by the filter and dried, is Subnitrate of Bismuth. It is a white, inodorous, tasteless, flaky substance, soluble in the acids and the pure alkalies. It is blackened by sulphuretted hydrogen and its compounds. It consists of 3 prop. of protoxide of Bismuth (79×3) $= 237 +$ 1 prop. nitric acid $= 54$, making the equivalent 291.

This preparation is a powerful Tonic, particularly useful in that state of stomach which produces *pyrosis*. In this complaint, the paroxysms commence with a sense of constriction and pain at the stomach, gradually subsiding after the eructation of a large quantity of either insipid or acidulous watery fluid. The Subnitrate, in doses of from gr. iii to gr. x, in combination with gr. i of opium, gives almost immediate relief, and affords a more decisive evidence of the primary action of tonics on the stomach than any medicine of this class. It has been erroneously stated to prove beneficial in cholera.

BARYTÆ MURIAS. *Muriate of Baryta.* E. D.—In strict chemical language, this salt is a muriate only when in solution, or in crystallization with much water. It is prepared by dissolving the carbonate in muriatic acid, diluted with three parts of water, and crystallizing the solution. The carbonate was first found native in 1783, by Dr. Withering, after whom it was

named Witherite. Its crystals assume different forms: in general they are in hexagonal prisms: they have neither taste nor odour. The muriate of Baryta generally crystallizes in flat rectangular plates with bevelled edges, which are permanent in the air: it has a peculiar, pungent, nauseous taste, and is soluble in two and a half times its weight of water at 60° Faht. According to Berzelius, the muriate consists of 1 prop. of Muriate of Baryta (Ba. + 0) + (H. + Cl.) = 113.15 + 2 prop. of water (9 × 2) = 18, making the equivalent 131.15. It is decomposed by alkaline phosphates, and sulphates which form insoluble phosphates, and sulphates that exert no influence on the animal body; and by the citric acid, which forms with the Baryta a flaky precipitate, that gradually assumes the character of a beautiful and brilliant vegetation: this is partially soluble, and therefore is poisonous. This Muriate cannot be administered with any of these salts; nor astringent vegetable infusions, insoluble tannates being produced.

The solution of the Muriate, in three parts of water, is employed as a Tonic. It is chiefly administered in scrophula, in doses of three to six minims, in a glass of water or an infusion of Quassia: it is not a powerful Tonic. It has been, also, used in asthma, particularly in those cases in which there is a tendency to hydrothorax; in which the diuretic influence of the Muriate, aiding its tonic power, is likely to be useful; but I cannot state any opinion, either favorable or adverse to its employment.

In large doses, the Muriate of Baryta is an acrid poison, destroying not only the powers of the stomach, but extending its action to the heart, rendering that organ insensible to the stimulus of the blood. As the salt is decomposed, and insoluble compounds are formed by sulphuric acid and the alkaline sulphates, the soluble phosphates and tannin, these are the proper antidotes in cases of poisoning by Muriate of Baryta.

B. SUBSTANCES OPERATING AS TONICS THROUGH THE MEDIUM OF THE BLOOD.

All the tonic substances which have been noticed exert a primary action on the stomach, and a secondary influence on the system through the nerves: those next to be examined enter the circulation, and can be detected in the secretions. This division of the class, besides containing substances which owe their influence on the animal œconomy to oxygen, contain others which derive it from chlorine. Both are deserving of attention.

m. FERRI OXYDUM NIGRUM. *Black Oxide of Iron.* E. D. Syn. *Æthiops Martialis.*—There are two Oxides of Iron—a protoxide (Fe. + 0), consisting of 28 parts, or 1 prop. of iron, + 8 parts, or 1 prop. of oxygen, making the equivalent 36; and a peroxide (Fe. +, $\frac{3}{2}$0), consisting of 28 parts or 1 prop. of iron, + 12 parts, or 1½ prop. of oxygen, making the equivalent 40.

The substance under consideration is a mixture of both these oxides, united in irregular proportion. It is formed when iron is heated to redness in the air, as in the operations of the anvil, and when it is brought into contact with aqueous vapour at a high temperature. The small scales from the anvil are ordered, in the Pharmacopœias, to be separated by the magnet and powdered: these form the preparation under notice.

The Black Oxide soils the hands; and is insoluble in water, but soluble in acids, without exciting effervescence. The reason why it is an irregular, mixed oxide, has been thus explained by M. Mosander: a bar of iron, when heated in the air, affords a layer of oxide on the surface, which contains more oxygen than the layer beneath it; the former is supposed to contain one proportion of peroxide and four proportions of protoxide: the latter, one of peroxide and six of protoxide. The outer layer is always variable in its composition; the inner is generally uniform.

As a Tonic, this mixed oxide has been at one time highly extolled, at another altogether neglected. In the state of a protoxide, Iron dissolves in the gastric juice, acts upon the nerves of the stomach, and through them upon the general system. The influence of this oxide as a Tonic is less quickly obvious than that of the saline preparations of Iron; therefore it is well adapted for the treatment of those cases of general debility, in which the tonic effect is not required to be quickly produced, but to be permanent. This oxide is a better preparation than the filings of Iron, which gain their activity from meeting with acid in the stomach; thence the inconvenience that follows their use, the oxidizement of the metal in the stomach producing a decomposition of the water of its aqueous contents, and the evolving much hydrogen gas. The utility of the black oxide is, also, increased by its meeting with acid in the stomach, so as to favour its solution, and consequently its absorption into the circulating mass. The dose of the Black Oxide is from gr. v to ℈i: it may be combined with any aromatic. Its operation is characterized by the black colour of the alvine discharges.

n. METALLIC SALTS.

1. CALCIS MURIAS. *Muriate or Hydrochlorate of Lime.* L. D. —This is a combination of the hydrochloric or muriatic acid and lime. It can be readily procured by the direct union of its components; but it is generally obtained as the residue of the operation for the production of liquor ammoniæ. It crystallizes in long six-sided prisms, terminated by hexædral prisms. Its taste is acrid, sharp, bitter, and very disagreeable. It is inodorous; extremely deliquescent; and, when exposed to a high temperature, is decomposod and converted into chloride of calcium.

Muriate of Lime, in this view of the salt, is a compound of—

Muriatic Acid .	48.10	or	1 prop.	= 36.45
Lime, Oxide of Calcium	51.90		1 prop.	= 28.5
Water . .	00.00		6 prop.	= 54
	100.00		Equiv.	118.95

This muriate, when exposed to a strong red heat, is converted into *Chloride of Calcium:* which consists of—

Calcium	1 prop.	= 20.5	or	35.71
Chlorine	1 prop.	= 35.45		64.39
	Equivalent	55.95		100.00

It returns to the state of Muriate when it is dissolved in water.

As a medicinal agent, Muriate of Lime is a Tonic of some power. It is taken into the circulation. It is given in cases of scrofula and enlarged glands, as a deobstruent; but its effects undoubtedly depend on its tonic influence, in which the glandular system shares. It is said to have succeeded in bronchocele when iodine failed*. Its use in these diseases was first suggested by Fourcroy, in 1782; and, afterwards, its powers were investigated by Dr. Beddoes and Dr. Pearson; and my own experience has enabled me to recommend it with confidence. As it can be combined with the permuriate of iron, it is advantageously prescribed with that salt, in languid states of the female habit, with a tendency to bronchocele or other glandular swellings. I have advantageously applied the iodine ointment externally, whilst the patient was taking the Muriate of Lime. It may be administered, also, in conjunction with *pure* ammonia. It cannot be combined in prescriptions with the protosulphate of iron, or the carbonates of the alkalies: in the one case an insoluble sulphate of lime, in the other a carbonate of lime, is formed; both of which are useless. The dose of the saturated solution is from m. xii to f℥ii, given twice or three times a day, in infusion of gentian root, or any other simple bitter. In large doses it excites nausea and vomiting; and this sometimes follows small doses. This effect is relieved by opium. Lisfranc asserts that he has found it highly serviceable as an ointment in ulcerated chilblains, in which it also acts as a stimulant Tonic†.

2. POTASSÆ CHLORAS. *Chlorate of Potassa.*—This salt is prepared by passing Chlorine, extricated from a mixture of eleven parts of muriatic acid and five of black or peroxide of manganese, through a concentrated solution of subcarbonate of potassa in a Wolf's apparatus. In this operation, the hydrochloric or muriatic acid is decomposed: the chlorine passes over in a gaseous state, whilst the hydrogen, uniting with 1 prop. of the oxygen of the peroxide of manganese, reduces it to the state of a protoxide, and forms water. The Chlorine thus given over passes into the solution of the alkali, decomposes a por-

* Med. Rep. vol. ii, p. 383, New Series. † See Revue Med. Feb. 1826.

tion of the water, the elements of which, the hydrogen and the oxygen, unite to separate portions of the Chlorine, the former producing muriatic, the latter, chloric acid. Both these acids combine with the alkaline base of the Carbonate of Potassa, and expel the carbonic acid; thus forming two distinct salts—a chloride and a chlorate. This latter salt is produced in white, pearly, hexædral plates, soluble in fifteen parts of water at 60° Faht. and two parts and a half of boiling water, from which it is deposited in cooling. The Chlorate of Potassa is inodorous, has a cool, austere taste, not unlike that of nitre; and, when heated to redness, gives out more than a third of its weight of oxygen gas, leaving in the retort a simple chloride of potassium. According to Robiquet, the whole of this oxygen is not abstracted from the decomposition of the *Chloric* acid; but one fifth is from the *Potassa*, which is reduced to the metallic state, in order to unite with the chlorine and form the chloride.

Chlorate of Potassa contains no water of crystallization: it is a compound of—

Chloric Acid	1 prop. = 75.45	or	61.228
Potassa .	1 prop. = 48		38.772
	Equivalent 123.45		100.000

As a remedial agent, the *Chlorate* of Potassa operates as a stimulant Tonic, by imparting oxygen to the system from the decomposition of the salt in the body; and thence it was, at one time, employed in the treatment of syphilis and sea-scurvy. In what part of the system the decomposition is effected is not easily ascertained: but as the Chloride of Potassium itself is a Tonic, the influence of the Chlorate is not altogether dependent on the extrication of the oxygen: its use, therefore, is chiefly indicated in those states of the habit in which the powers of the system require to be roused, and, at the same time, a permanent tonic effect to be obtained; as, for instance, in the sinking stage of typhoid fever; particularly in that attended with eruptions, as, for instance, malignant smallpox and scarlatina. As a remedy in syphilis, it has fallen into disrepute. The dose is from gr. vi to ℈i in solution, three or four times a day.

3. Argenti Nitras. *Nitrate of Silver*. L. E. D. Syn. *Lunar Caustic*.—This Nitrate is readily prepared by acting upon silver by means of nitric acid diluted with three times its weight of water: the metal is oxidized at the expense of a portion of the acid, and then dissolved in the remainder.

Nitrate of Silver, in its crystallized state, is in brilliant plates, in general very irregular in their forms. They are colourless, inodorous, have an extremely bitter, caustic taste; stain the cuticle black; and dissolve in their own weight of water at 60°, and in alcohol. The crystals of Nitrate of Silver are permanent in the air; and, when the Nitrate is pure, and the water also

pure distilled water, no decomposition takes place: but the smallest portion of animal or vegetable matter causes it to become dark-coloured when exposed to light. When these crystals are heated to 426°, they melt, and in this state the salt is run into moulds or *Lingotures*, as the French term them, and is thus formed into cylinders, for the convenience of using it as an escharotic in surgery. These cylinders, or *lunar caustic*, when pure, are whitish; but, like the crystals, they become dark when the moulds are oiled.

Nitrate of Silver is precipitated from its solution by lime water, and the muriates and carbonates of alkalies. Water, therefore, containing these, which is the case with all hard waters, should never be employed in prescriptions with Nitrate of Silver. It is also decomposed and precipitated by sulphuretted hydrogen and the alkaline sulphurets; by borate and phosphate of soda; and by tincture of iodine: all of which are, therefore, incompatible in formula with Nitrate of Silver.

Nitrate of Silver is a compound of—

Nitric Acid	1 prop. =	54	or 68.61
Oxide of Silver	1 prop. =	116	31.39
	Equivalent	170	100.00

Nitrate of Silver communicates general tone to the habit, through the medium of the nerves of the stomach, upon which its primary action is exerted; 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 the 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 salted food, nor much salt, should be used by persons taking the Nitrate; as these form an inert chloride of silver in the stomach.

When Nitrate of Silver has been overdosed, its injurious effect on the stomach may be counteracted by diluting freely with salt and water, so as to decompose the Nitrate and render it inert: but if there be time for inflammation to be induced, then the case must be treated in the same manner as inflammation of 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 reintroduced by Dr. Simms, of London; who em-

ployed it in the treatment of epilepsy; and from his success it became much used. In looking at its value in this disease, truth obliges me 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 is taken into the circulation, stimulates moderately, and increases the general tone of the habit; lessening thereby the inordinate irritability and mobility of the system. I have given it also, with great advantage, in angina pectoris.

The dose at first should not exceed one sixth of a grain; but it may be gradually augmented to four or five grains.

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, in some habits, to give an indelible leaden or saturnine hue to the whole skin. This effect does not appear to depend on the quantity of the medicine which is given; nor does it occur frequently: two questions, therefore, arise—what is the cause of this change of colour of the skin? and is there any probability of a remedy for it being discovered? In reply to the first of these queries, 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, we know, acquires a grey, leaden colour whenever it remains in contact with animal matter; and, as it is insoluble, and incapable of being reabsorbed, it is fixed in the rete mucosum, 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. With respect to the second query, is there any remedy for this inconvenient effect of Nitrate of Silver? it must be admitted that none has yet been suggested; and what I have to propose being totally unsupported by experience, I offer the suggestion merely as matter of experiment. I 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, in great part, may be ascribed its utility in affections 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 I am inclined to believe that something is also due to its tonic power. On the same principle, it cures that inflammation of the cervix uteri depending on increased irritability of the part.

4. FERRI SULPHAS. *Sulphate of Iron.* L. E. D.—This salt is prepared by dissolving soft iron in diluted sulphuric acid: the water is partially decomposed by the iron, aided by the sulphuric acid, the hydrogen escapes, whilst the oxygen is united with the iron, forming a protoxide, which combines with the sulphuric acid, and constitutes the sulphate. By evaporating the solution immediately, crystals of protosulphate of Iron are obtained; but if it be permitted to remain for some time exposed to the air, it attracts oxygen, and the salt is converted into a persulphate. There are two varieties of the Sulphate of Iron: both are employed as medicinal agents. Protosulphate of Iron has a fine emerald green colour; is transparent, owing to its containing a large quantity of water; and is crystallized in rhomboidal prisms: but the crystals are very irregular. The taste is styptic and nauseous; although neutral, yet, it reddens vegetable blues: is soluble in two parts of cold water and in three quarters of its weight of boiling water; but is again deposited as the water cools. When exposed to the air, it gradually loses its water of crystallization, becomes opaque, and is covered with a yellowish powder, which is a persulphate of the salt: an effect produced by the absorption of the oxygen of the atmosphere. In solution, this absorption of oxygen proceeds more rapidly than when the salt is in the solid state. The Sulphate of Iron of commerce should not be used for medicinal purposes, as it sometimes contains copper.

The protosulphate of Iron cannot be preserved without changing into the persulphate, unless the bottle be filled with alcohol, in which the salt is insoluble. According to the analysis of Berzelius, it consists of—

Sulphuric Acid	28.9	or	1 prop.	=	40
Protoxide of Iron	25.7		1 prop.	=	36
Water . .	45.4		6 prop.	=	54
	100.0		Equivalent		130

Both Sulphates, when heated, first lose their water of crystallization, then suffer decomposition; and, if the heat be considerably augmented, are converted into a red powder, called *colcothar;* which is a mixture of red oxide of Iron and the persulphate: a substance formerly employed as a Tonic.

Both Sulphates of Iron are decomposed by the phosphates and the borates, the alkalies and their carbonates, and all the

vegetable infusions and decoctions containing tannin. Owing to this great susceptibility of decomposition, the sulphate is generally prescribed in the form of pills, in preference to that of solution. The dose of Sulphate of Iron is from gr. i to gr. x. It acts better in small doses frequently repeated, than in large doses. In large doses, it excites nausea. In the dose of ℈i, it acts as an emetic.

5. MURIATIS FERRI TINCTURA. *Tincture of Muriate of Iron.* L. E. *Muriatis Ferri Liquor.* D.—The salt of iron in this preparation is both a protomuriate and a permuriate, which crystallize with difficulty, and deliquesce on exposure to the air. They dissolve readily in alcohol, forming a permanent reddish brown solution, or tincture, which has a strong styptic taste; and, owing to the superabundance of muriatic acid ordered in the preparation of the Pharmacopœias, the alcohol forms an imperfect muriatic ether: it has an etherial odour. Each drachm of the Tincture contains four grains of the muriates of Iron. It is decomposed by the alkalies and their carbonates, lime water, and the alkaline earths. It strikes a deep olive-green colour with infusions of astringent vegetables; and is thrown down in coagula, when mixed with mucilage of Acacia *gum:* but it may be prescribed in conjunction with infusions of quassia, gentian, and orange peel; and with tincture of Calumba. The dose is from ten to thirty minims, twice or three times a day.

Besides possessing the usual tonic properties of salts of Iron, this solution of the muriates has the advantage of admitting of combination with the muriates of lime and of Baryta. It displays almost a specific effect in dysury, from spasm of the sphincter muscle of the neck of the bladder, when it is administered in doses of ten minims, repeated every ten minutes, until the spasm is resolved. Its ordinary dose is from m. x to m. xxx.

6. FERRI SUBCARBONAS. *Subcarbonate of Iron.* L. E. D. The preparation to which this name is attached in the Pharmacopœias is a mixture of the peroxide and the carbonate of Iron. The Protoxide of Iron only forms a definite compound with carbonic acid; and such a salt is found in nature, under the name of *sparry iron ore*, which contains upwards of forty-two per cent. of carbonic acid; and, also, in many mineral waters, held in solution by carbonic acid. 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 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.

To render the preparation as perfect as possible, the sulphate

of iron should be recently prepared, and in the state of a pure protosulphate. The precipitate should be washed with hot water, and it should be speedily dried between folds of blotting paper.

An imperfect native carbonate of Iron, or rather protocarbonate, is also naturally formed in every instance when Iron is exposed to a moist atmosphere. The metal is first oxidized, partly by the oxygen of the air, partly by the decomposition of the moisture—a fact which is demonstrated by the formation of ammonia during the oxidizement, arising from the union of the hydrogen of the water and the azote of the atmospherical air: the oxide thus formed attracts carbonic acid, which is always present in the air, and becomes a subcarbonate or *rust*. In this manner the subcarbonate is ordered to be prepared in the Dublin and Edinburgh Pharmacopœias.

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. It is to the improper manner in which it is prepared that such discordant accounts of its tonic powers are to be attributed.

Subcarbonate of Iron is of a reddish-brown colour, and dissolves with effervescence in acids, yielding up its carbonic acid, which it also parts with at a high temperature. 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 it 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.

Besides the artificial preparations of the carbonate and the sulphates of Iron, these salts are found in a state of natural solution in mineral waters in many parts of the world. The springs of Scarborough, Tunbridge, Peterhead in Scotland, Bourbon l'Archambault, Passy, Pongues de Chateau-Gentier, Pyrmont, Spa, Vichi, and many others, contain carbonate of Iron. Those of Sand-rock in the Isle of Wight, of Hartfel in Scotland, and Wals in France, contain sulphate. All these waters are readily distinguished by striking a black or deep violet colour with tincture of galls, and a green, which becomes

deep blue on exposure to the air, with ferro-cyanate of potassa. When the water which holds the iron in solution suspends it by means of carbonic acid, a yellow or ochery sediment is precipitated by boiling the water; and, after this operation, it ceases to give evidence of its chalybeate nature by the usual tests. When the mineral water contains the sulphate, it deposites no ochery sediment, and answers to the tests as well after it has been boiled as it did before. Both kinds of water may redden the tincture of litmus before being boiled, owing to some free acid being present; but the water containing carbonate of iron ceases to do this after it has been boiled. If the chalybeate be a sulphate, a precipitate will be formed by nitrate of baryta; if the sulphate be conjoined with alum as well as iron, this will be indicated by ammonia. By such means these two chalybeates are distinguished.

7. Ferri Acetas. *Acetate of Iron.* D.—This is a preparation of little value, although the Dublin College have ordered it to be prepared in two different modes, and to be kept both in a solid form and in that of tincture. It is a mild chalybeate, and may be administered in doses of from eight to fifteen grains to children labouring under scrofulous affections.

Tartras Potassæ et Ferri. *Tartrate of Potassa and Iron.* L. E. D.—This preparation, which is formed by exposing equal parts of bitartrate of potassa and filings of soft Iron, mixed together and moistened with water, to the action of the air, is a mixed salt, containing Tartrate of Potassa and a Tartrate of the peroxide of Iron. In this process, the Iron is oxidized at the expense of the water; as a protoxide, which, attracting the oxygen of the air, is changed into the peroxide, and unites with the excess of tartaric acid of the bitartrate.

This mixed salt is of a greyish-green colour, inodorous, and, although styptic, yet not unpleasant to the taste, and is consequently a chalybeate well adapted for children. It is soluble in water, and its solution does not soon undergo decomposition. It has the great advantage of not suffering any change when combined with the alkalies and their subcarbonates; but it is precipitated by the infusions and decoctions of astringent vegetable substances. It attracts moisture from the air, and therefore cannot be prescribed in the form of powder. The dose is from ten grains to half a drachm.

The preparations of Iron, whether those formed by the hand of Nature, or those contrived by the artifice of Man, exert a powerfully tonic effect upon the living system. They increase the digestive powers of the stomach, stimulate the intestines, and, being dissolved also in the gastric and intestinal juices, they are taken up by the absorbents, enter the blood, and stimulate the whole of the 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. Forty dogs were fed with food mixed with Iron in different states: on killing them, more Iron was found in their blood than in that of the same number of dogs fed in the usual manner; and the quantity varied according to the nature of the Iron employed. Thus, those fed with Iron ore had three times more Iron in their blood than those who took no Iron with their food: those fed with Iron filings had the next greatest quantity: and those who took the peroxide the least. The cause of these differences is obvious: in the ore, the Iron was in the state of a sulphuret, and easily convertible into a salt in the juices of the stomach, owing to the oxide containing the minimum of oxygen: the Iron filings were not so rapidly rendered soluble; as they had first to suffer oxidizement—a process which could not always be completed before they passed from the bowels: whilst the insolubility of the peroxide readily explains why so little of it is taken into the habit. A very striking proof of the absorption of the salts of Iron is detailed by Dr. Home, Professor of the Practice of Medicine in the University of Edinburgh. On testing the urine of a man to whom he had given a large quantity of the muriated tincture of Iron, with tincture of galls and ferrocyanate of potassa, it afforded evident proofs that it contained a considerable quantity of Iron. But the absorption is slowly effected; and neither the black colour of the fecal discharges, nor the results of testing the excretions, indicates the presence of the Iron for some days after the use of any of the preparations has commenced.

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 to the circumstances connected with drinking mineral waters at their source;—when the cares and anxieties of life have been left behind, in the smoky alley and the crowded street, when Hope and Confidence and Amusement lend their invigorating aid to the tonic influence of the salutary fountain. But tone follows the use of Iron in all its forms, and therefore its preparations are employed in every disease connected with relax-

ation or debility, particularly of a chronic kind: dyspepsia, hysteria, amenorrhœa, leucorrhœa, scrofula, and chronic catarrh, are a few of the catalogue 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, I have never found it necessary, if the preparation be good, to exceed a drachm for a dose; and, in chorea, I 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 hæmorrhage, and similar affections.

n. ACIDUM SULPHURICUM. *Sulphuric Acid.* L. E. D. Syn. *Oil of Vitriol.*—This is a compound of sulphur, oxygen, and water. The dry acid, or anhydrous acid, which it contains is a combination of Sulphur 1 prop. = 16 + Oxygen 3 prop. (8 × 3) = 24; making the equivalent 40. The liquid acid, of a specific gravity of 1.847, which is the usual gravity of what is termed the concentrated acid, contains—

Anhydrous Acid	1 prop. =	40	or 81.6
Water . . .	1 prop. =	9	18.4
	Equiv.	49	100.0

It is a colourless, transparent, heavy fluid, with the consistence of oil. It is inodorous, and has an intensely acid taste; but it is so acrid that it cannot be applied to the tongue with safety in the undiluted state. In the concentrated state, it speedily chars all animal and vegetable bodies, and has so great an affinity for water that it imbibes one third of its weight from the air in twenty-four hours. When it is suddenly combined with water, in the proportion of one part to four of the acid by weight, the density of the mixture is considerably less than that of the mean of the two components; therefore much latent caloric is disengaged in a sensible form, raising the thermometer from

50° to 300° of Fahr. and a great condensation takes place in cooling. Sulphuric Acid unites readily with the alkalies, earths, and most of the metallic oxides, forming the salts called *sulphates*.

Free Sulphuric Acid is probably never found in nature, although M. Baldassari has published an account of his having discovered it, in a solid, crystallized state, in a grotto of Mount Amiata, below the baths of Saint Philip. It is, however, found in an impure state near the craters of volcanoes. Humboldt says that it is contained, in conjunction with hydrochloric acid, in the waters of the *Rio Vinagre:* Vauquelin, also, has detected it in the water of a mountain lake in the island of Java.

Sulphuric Acid may be artificially prepared by the direct combination of its components. Thus, if sulphur be burnt in oxygen gas, *over water*, this acid is formed, and is taken up by the water; but nearly all the liquid Sulphuric Acid, employed both in trade and in medicine, is manufactured by burning a mixture of eight parts of sulphur and one of nitre in leaden chambers containing water. In this process the nitre is decomposed and aids the acidification of the sulphur. The process is carried on until the water is highly charged with the acid; after which it is concentrated by evaporation, and forms the Sulphuric Acid of commerce. This generally contains sulphates of lead and of potassa; but, as the acid is purified by diluting it for medicinal use, the sulphate of lead is thrown down, in the form of a white powder, on the addition of the water.

Sulphuric Acid, when properly diluted, is a Tonic of very considerable power. Its influence is extended, through the circulation, to every part of the system. It is much used in continued fevers, especially those in which the debility is so great as to admit of the escape of blood from the intestinal vessels; and it is the only remedy, in conjunction with wine, on which we can rely in the confluent smallpox, when the pustules are filled with a bloody sanies and the urine is coloured by broken-down particles of blood. In a general point of view, we may safely consider it proper to be administered in all those fevers accompanied with extreme debility, and what has been termed a putrid tendency in the habit. In cases of immoderate perspiration—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 it 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 fact illustrated by the following quotation from a case, extracted from a German Journal, which appeared in the Medical Gazette of May the 10th, 1828. 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, in its diluted state, consists of a fluid ounce and a half of the strong acid and four fluid ounces and a half of distilled water; thence, each fluid drachm contains ten minims of the strong acid. It is given in combination with vegetable infusions and decoctions, in doses of from eight to thirty minims to produce its tonic influence. It 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.

If the strong acid be taken into the stomach, it operates as a corrosive poison; producing violent pains of the stomach and chest, and a burning sensation in the mouth and throat, at the same time that an icy coldness is felt all over the body. In this case, no time must be lost, but magnesia, dissolved in water, freely and repeatedly administered; using the stomach-pump in the intervals between each dose. If magnesia be not at hand, any alkaline carbonate will answer equally well. It often happens that the poison is vomited almost as soon as it is taken; but the patient is not on this account secure, for he may still die of the corrosive effects of the acid. In a case which occurred at the Hotel Dieu, although the poison was instantly vomited, yet the stomach could not afterwards retain either solid or fluid aliment, however mucilaginous or mild; and the man died sixty days after having taken the poison. The stomach was contracted in an extraordinary degree: it was perforated on the anterior parietes; and the edges of the perforation had contracted adhesions with the concave surface of the liver: no extravasation had taken place; and the interior of the viscus presented numerous cicatrices of very recent date, but all completely formed.

Acidum Nitricum. *Nitric Acid.* L. E. D.—Liquid Nitric Acid is a heavy, colourless fluid, emitting, when exposed to the air, dense, disagreeable fumes: its taste is intensely acid and corrosive; and, when applied to the skin, it tinges it of an indelible yellow colour, destroying the cuticle, which, in a few days, peels off. Its specific gravity is 1.513 to water as 1.000. It has a great affinity for water, and attracts it from the air; and,

when water and the acid are suddenly mixed, heat is evolved. It frequently contains a little Nitrous Acid, which gives it a yellowish tinge; but, by heating the acid, this is driven off, and it remains colourless, unless it be exposed to the direct rays of the sun, when it is partially decomposed, oxygen is evolved, and Nitrous Acid being formed, a yellowish tinge is communicated to the whole fluid. It is decomposed with great rapidity by some combustible bodies. It unites with oxides of metals and with alkalies, forming salts which are named nitrates.

Liquid Nitric Acid is a compound of anhydrous Nitric Acid and water, in the proportion to each other as 75 to 25; but this is the greatest strength of liquid Nitric Acid, its specific gravity being 1.5000. The anhydrous acid cannot exist except in a state of combination with some salifiable base, as, for example, in nitrate of potassa. The elements of the anhydrous acid are—

1 prop. of Nitrogen	= 14	or 26
5 prop. of Oxygen (8 × 5)	= 40	74
Equivalent	54	100

But this acid exists only in the nitrates: the acid of the Pharmacopœias consist of 1 prop. of Anhydrous acid = 54 + 1½ of water = 13.5, making the equivalent 67.5.

For medicinal purposes, Nitric Acid is procured by distilling together two parts of dried nitrate of potassa and nearly two parts of sulphuric acid. The theory of its production is simple: the affinity of the sulphuric acid for potassa is greater than that of the nitric; the sulphuric, therefore, when aided by a high temperature, breaks the affinities between the Nitric and the potassa of the nitrate, a double decomposition takes place, the anhydrous sulphuric acid, contained in the liquid acid employed, combines with the potassa, whilst its water combines with the dry nitric acid of the nitrate, now set free, and passes over into the receiver in the state of liquid Nitric Acid. A bisulphate of potassa remains in the retort: a quantity of oxygen gas is generally evolved towards the end of the operation, and may be collected.

The acid thus procured, if the nitrate of potassa have been pure, contains a little Nitrous Acid, which can be readily expelled. But the Nitric Acid of commerce always contains both sulphuric and muriatic acid: the first is detected by diluting the acid and adding a weak solution of nitrate of baryta; the second, the muriatic acid, is detected by adding a solution of nitrate of silver to the diluted acid. The proportion of these adulterations is ascertained by adding to a specific quantity of the suspected acid, largely diluted with distilled water, as much of the reagent as will precipitate the foreign acids; then drying the precipitate and weighing it. If the adulteration be muriatic

acid, its quantity may be determined by the weight of the dried chloride of silver and the proportion of hydrogen necessary for forming the chlorine into hydrochloric acid: if the adulteration be sulphuric acid, the simple weight of the sulphate of baryta obtained informs us of the proportion of the sulphuric acid existing in the nitric. Nitric Acid, for medicinal use, may be freed from these adulterations by slowly redistilling it.

As a medicinal agent, Nitric Acid is never administered unless largely diluted: it is less powerful as a general Tonic than sulphuric acid, and it differs from it in undergoing decomposition in its passage through the circulation; operating, consequently, rather by affording oxygen to the system than as a Tonic in its entire state. It possesses some advantage over sulphuric acid in cases of dyspepsia accompanied with sickness and great irritability of the stomach, as it rapidly allays these symptoms. It is also admirably adapted for keeping up the tone of the system under the irritation of a mercurial course; as it does not interfere with, but rather favours, the action set up by the mercury. For the same reason, it proves highly beneficial in alterative courses of mercurials in obstinate ulcerations of the legs, and in cases of impetigo. I have frequently administered the bichloride of mercury dissolved in Nitric Acid, without observing any inconvenience to result from the combination.

Nitric Acid, as I have already mentioned, can be administered only when largely diluted; and, therefore, to facilitate its administration, the London College orders the acid to be kept in a diluted state, in the proportion of one fluid ounce of the strong acid to nine fluid ounces of distilled water. The dose of this diluted acid is from m. x to m. xxx in f℥ii of water, sweetened with simple syrup. In this state it forms an agreeable potion, which is seldom objected to by patients, and which may be repeated every third or fourth hour. In cases of purpura, nothing facilitates the restoration of tone more than the liberal use of this potion. As an external, or topical Tonic, a lotion of the diluted acid, formed byadding f℥ii to f℥viii of water, is a useful application to old and indolent ulcers. The strength of the lotion may be proportionate to the degree of stimulus which the sores require: in half the above-mentioned strength, it forms a useful gargle in indolent ulcerations of the tonsils.

It is incompatible in prescriptions with sulphate of iron; alcohol; combustibles; acetates of lead, of mercury, and of potassa; and muriatic acid, by its union with which both acids are decomposed, and a distinct compound, nitro-muriatic acid, containing free chlorine, is the result. It cannot be improperly prescribed in the form of drops, in conjunction with tinctures,

particularly those containing volatile oils, for instance, lavender, cinnamon, and orange peel.

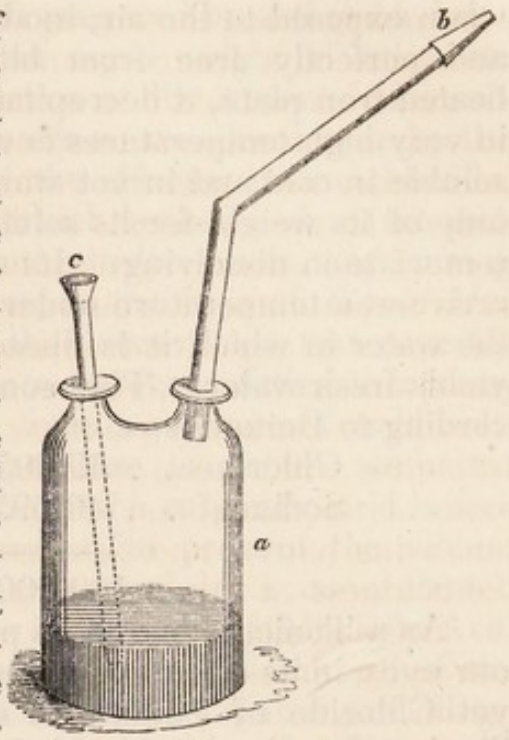
Nitric Acid, taken in a concentrated state, is a most virulent poison. The mucous membrane of the mouth becomes white, thickened, and slightly yellow in some places, and is easily detached: the epidermis of the lips is separated from the borders of the mouth, generally in a semilunar form, as if the glass from which the poison was taken had left the mark upon the lips. The general appearance of the face indicates the utmost anxiety; the pulse is small, scarcely perceptible; and there is the same icy coldness of the surface, as in poisoning by sulphuric acid. The patient groans deeply, and complains of pains of the throat and of the stomach; is afflicted with almost unceasing nausea and frequent vomiting; and, notwithstanding the coldness of the surface, large drops of sweat stand upon the face and chest. If these symptoms be not relieved, death generally ensues within twenty-four hours from taking the poison.

In such cases the stomach-pump should be used; and a mixture of magnesia and water, and mucilaginous drinks, administered; and, after the stomach has been emptied, bleeding, and the employment of counter-irritants.

q. CHLORINE.

Chlorine operates as a *Tonic*, both in its gaseous state and in combination with other bodies. In the simple state, dissolved in water, it has been advantageously administered in malignant sore throat, in the low stages of confluent smallpox, and in other diseases in which it has been necessary to employ powerful tonic means. The saturated solution, for the preparation of which a formula is given by the Dublin College, has scarcely any colour, a harsh, styptic taste, and exhales the odour of Chlorine: it contains about twice its volume of Chlorine; and may be exhibited in a mixture containing from half a fluid drachm to two fluid drachms in eight fluid ounces of water, sweetened with a little syrup, which should be taken, in divided doses, in the course of the day.

But a more important application of the tonic powers of Chlorine, discovered by M. Gannal, has been brought into use. This chemist, having perceived that bleachers who employed the chloride of lime were frequently relieved from threatened symptoms of phthisis, conceived the idea of trying its application, in a highly diluted state, to ulcerated lungs, and obtained a very sensible amelioration of the symptoms. He asserts that it cures such lesions of the lungs as are not absolutely incurable. Its sensible effects are—an increased facility of breathing, and



an increase of appetite and of strength. The application is made by adapting to one opening of a double-tubulated bottle, *a*, containing a portion of water at 90° Faht. a bent tube with an ivory mouth-piece *b*, and introducing into the other opening a small funnel, *c*, closely fitted in a cork, through which the charge of the saturated solution of Chlorine is poured. The charge at first should not exceed ten or twelve minims of the solution; but it may be gradually augmented to a fluid drachm: it may be inhaled twice in the twenty-four hours. If we reflect on the effect of Chlorine gas, in an undiluted state, operating as a powerful excitant, and also on the influence of astringents and excitants on ulcerated portions of the external surface of the body, we shall feel disposed to admit the probable beneficial influence of this powerful agent, mitigated by dilution. In this point of view, if diluted Chlorine, applied to an ulcer of the lungs, can afford to it such a degree of stimulus only as can aid the natural powers of life to effect a cure, there is much reason for believing that it may prove useful. In my own practice I have found it productive of much comfort to the patient.

SODÆ MURIAS. *Muriate of Soda.* L. E. D. *Common Sea Salt;* in chemical language, *Chloride of Sodium.*—This important salt is found abundantly in various parts of the world: in France, in Switzerland, the Tyrol, Hungary, Transylvania, and very extensively in England. In Spain, near Cordova, there is a mountain of common salt, 500 feet in height and nearly three miles in circumference. The diffusion of this salt is a wise provision of Providence, as it is essential for the health of both vegetables and animals; exciting the energy of the living system of both, when taken in small quantities; and increasing the vascular action and vigour of the frame: when swallowed in large doses, it proves emetic; and, in medium doses, purgative.

To do justice to the natural history, chemical properties, and therapeutical virtues of common salt, would require more space than can be spared in this work: I will, therefore, confine my remarks to a brief sketch of its chemical properties, and an account of its practical use as a Tonic.

Chloride of Sodium, in its purest state, is in white, semi-transparent, regular, cubical crystals, very slightly deliquescent

when exposed to the air, inodorous, with a taste strictly saline, and perfectly free from bitterness. When thrown upon a heated iron plate, it decrepitates, in a greater heat it *melts*, and in very high temperatures is volatilized *unaltered*. It is equally soluble in cold and in hot water, requiring two parts and a half only of its weight for its solution, and it passes into the state of a muriate in dissolving. Its solution continues unaltered till it arrive at a temperature under 28°, when the salt separates from the water in which it is dissolved: thence ice taken up at sea yields fresh water. The constituents of the Chloride are, according to Berzelius—

Chlorine . .	59.305	or	1 prop. =	35.45
Sodium . .	40.695		1 prop. =	23.3
	100.000		Equiv.	58.75

As a Tonic, although its powers are daily and hourly before our eyes, in its effects when taken with food or as a condiment, yet Chloride of Sodium is seldom prescribed as an officinal Tonic. In many states of the animal body there is a strong instinctive desire for salt, and this is powerfully exemplified in the habits of quadrupeds who come from the interior of the Continent of America, where there is no salt on the surface, to the sea shore to procure it. When this desire can be traced in delicate children, the greatest benefit is derived from the employment of the Chloride of Sodium as a Tonic; and I am induced to ascribe its value as an anthelmintic, or destroyer of intestinal worms, rather to its influence as a Tonic than to any other power it possesses. The best method of prescribing it, in such cases, is to mix from gr. x to ℈i in a glass of port wine, and to administer this mixture daily at noon. As a local Tonic, the solution of sea-salt is a useful application to old and indolent ulcers: the strength should be proportionate to the degree of stimulus which the sore requires. Its tonic influence on the skin shall be noticed in treating of the tonic effects of cold bathing.

2. Chloride of Lime. *Chloride of Lime.* L. E. D.—This salt, which is improperly named, is a compound of chlorine and calcium; for when the fluid is expelled by heat, pure chloride of calcium remains. This salt must not be confounded with chloride of lime, properly speaking, which is a mere admixture, not a chemical combination, of lime and chlorine. Dry chloride of Calcium is mixed with snow to produce a freezing mixture, which lowers the thermometer from + 32° to — 50.

3. Acidum Muriaticum. *Muriatic Acid.* L. E. D—Syn. *Hydrochloric Acid.*

In the ordinary temperature and under the usual pressure of the atmosphere, this acid is a gas, which forms dense vapours by uniting with the humidity of the air.

Muriatic or Hydrochloric Acid is prepared by acting on common salt, chloride of sodium, by an equal weight of sulphuric acid. In this process, one proportion of the water of the sulphuric acid and the chloride of sodium are decomposed; the hydrogen of the water unites with the chlorine of the chloride, and forms the Muriatic Acid gas, which is absorbed, at the moment of its formation, by the water in the retort, and, rising with it, is condensed in the receiver, in the form of *Liquid Muriatic Acid*, whilst the oxygen of the decomposed water unites with the sodium, and converts it into an oxide, fitting it to combine with the sulphuric acid and form a sulphate of soda. In conducting the pharmaceutical operation to obtain medicinal Muriatic Acid, it is necessary to dilute the sulphuric acid before pouring it upon the salt in the retort, to prevent the violent action which takes place when it is used in a concentrated state. Water dissolves 464 times its volume of Muriatic Acid gas to form Liquid Muriatic Acid. In the directions of the different colleges for forming it, those of the Edinburgh College are to be preferred, equal weights of chloride of sodium, sulphuric acid, and water being ordered. The acid is mixed with one third of water and cooled, and then poured on the chloride, in a glass retort, the rest of the water being put into the receiver. The sp. gr. of this acid, thus procured, is 1.170. The intention of drying the chloride at a red heat before using it, is to decompose the nitrates which are occasionally found in it.

Liquid Muriatic Acid, when perfectly pure, is colourless, strongly sour and acrid to the taste, and emitting suffocating fumes, which become more opaque when a glass rod, dipped in liquid ammonia, is held over them, owing to the immediate formation of muriate of ammonia. The pure acid, as ordered by the London College, should have a sp. gr. 1.160; it should not, when sufficiently diluted, afford a precipitate with the muriate of baryta. It unites with salifiable bases and forms muriates. It is composed of—

Hydrogen	1 prop. =	1	2.7
Chlorine	1 prop. =	35.45	97.3
	Equiv.	36.45	100.0

In the acid of commerce, iron is often present, and gives it a yellowish colour; but this is easily removed by redistillation, and for medicinal purposes it does no harm.

Muriatic Acid is a powerful Tonic, and as such is frequently and advantageously employed in typhus and other fevers of a similar type. I can bear ample testimony to its efficacy in malignant ulcerated sore throat, such as is frequently epidemic in the metropolis, both internally used and in gargles, combined with the tincture of capsicum, in infusion of roses. It is an excellent application to the gangrenous ulcers which occur in a

spongy or scorbutic state of the gums, and in gangrenous sore throat. It is applied by a small piece of sponge, fixed on a bougie or piece of whalebone, and, after being soaked, pressed so as to squeeze out of it all the superfluous acid. The sponge is to be conveyed to the ulcers and pressed upon them. The first effect is seemingly to increase the inflammation. Whether the tone produced by this acid, in these diseases, is to be attributed to the action of the entire acid on the nervous energy, or to its decomposition and the action of the chlorine, I will not venture to determine; although, from the effects of chlorine in its uncombined state, there is reason to lean to the latter opinion. In a concentrated state, Muriatic Acid is a virulent poison.

The dose of liquid Muriatic Acid is from m. x to m. xx in f℥ii of water or any vegetable infusion.

c. TONICS ACTING SOLELY UPON THE NERVES.

* *Material.*

a. COLD BATHING.—It is well known that water applied to the surface acts as a Tonic when its temperature is above 40° or below 70° of Faht.: and, although it be applied to a small portion only of the surface, yet its effects extend first to the whole surface, and then to the entire vascular system: a sensation of cold is immediately felt; but, if the application be transitory, the heat is soon recovered, reaction takes place. When any person is immersed in water at 60°, the first effect is a general condensation of the body, so that rings fall off, the skin becomes pale and rough, like goose skin, and sometimes there is even chattering of the teeth. On emerging from the water, however, if sufficient energy of the system exist, a sensation of warmth supervenes, the skin reddens, the action of the heart is increased in vigour, and, in a short time afterwards, a genial perspiration breaks out over the skin. We explain this by saying, that, when a stimulus is suddenly abstracted from the living system, the facility of excitement is increased, and the slightest excitant produces a greater effect than could have existed before such abstraction. When caloric, therefore, is abstracted from the body, as during its immersion in cold water, the action of the cutaneous and other superficial vessels is lessened, and a less degree of caloric produces greater excitement: thence, the glow and general warmth felt on the returning flow of the blood to the surface; and this continues until the excitability is restored to its natural equilibrium. Tone consists in a due degree of vigour in the muscular system, particularly the heart and arteries: by the reaction, therefore, which takes place after Cold Bathing, tone is as it were propagated over

the whole system; it is particularly so to the stomach, which first experiences it from the peculiar sympathy of that organ with the surface; the digestive powers are thereby augmented, a tendency even to plethora is induced, and cheerfulness and vigour of mind invariably follow. This reaction is always excited in a degree proportionate to the force of the living powers, and to the intensity of the cause which called it into operation. The system makes a powerful effort to overcome the sudden and general impression made on the sentient surface; thence an increase of animal heat takes place, by the impression made on the nervous energy, when the blood, which was suddenly repelled from the surface, again returns to it. It is not, however, the abstraction of heat from the surface, by a cold medium, that produces this reaction; it is the sudden application of the cold medium to a large extent of surface. If a person continue too long in the cold bath, the effort necessary to generate an unusual quantity of caloric in the system tends to destroy the animal powers.

Sea Bathing.—Part of the tone is induced by the nature of the medium, the great density of the fluid, and the stimulant effect of the saline particles left on the skin. The equable temperature of the sea would render it available at all seasons, were it not for the cold of the atmosphere to which the body must be necessarily exposed. During the immersion there is apparently less abstraction of caloric from the body than during immersion in fresh water, and the reaction which follows continues longer. Dr. Currie immersed two persons at the same time in fresh and in salt water at a very low temperature, for the space of thirty-five minutes: little inconvenience was felt by the individual who used the salt water; but the natural temperature of the other could not be restored without the aid of friction continued for a considerable time. It has always been a remark of seamen, that in dry weather neither rheumatism nor catarrhs are caught at sea, however frequently the body may be wet with the spray or waves of the sea; and, aware of this fact, Captain Bligh, who traversed an immense tract of ocean, with seventeen of his crew, in an open boat, preserved his companions and himself from these diseases, although they were exposed to frequent rains. He effected this by immersing the shirts and jackets of the seamen in the sea water, and ordering them to be worn in their moist state. This effect of sea water is certainly due to the saline particles which stimulate the skin as the aqueous particles evaporate: no absorption takes place; the effect on the surface is propagated to the whole system by that nervous sympathy to which we are forced to attribute the general tonic influence of substances that exert a primary effect on the nerves of the stomach.

The fresh-water cold bath is also Tonic, although in a less

degree than the sea-water bath. Much, however, depends on the degree of temperature at which it is employed. Thus, at 48° and 50°, which is the temperature of most fresh water springs, the degree of cold is too intense to be followed by tone: on the contrary, it acts as a sedative, and is followed by the same injurious results as too long immersion in any cold medium: the immersion is followed by shivering, headache, drowsiness, loss of appetite, and general debility. In many persons this effect is the constant result of cold bathing, whether in the sea or fresh water, even at a medium temperature; such individuals should either not bathe at all, or should fortify the system, before using the bath, by a hearty breakfast, or by taking wine, or by exercise sufficient to warm the body without causing sweating.

The conditions of the body, where the cold bath is particularly indicated, are debility in all the powers of the system, displayed by fatigue being induced on any slight exertion, and a weakened condition of the digestive organs; thence its importance as a Tonic, in various chronic diseases, and more especially those usually termed *nervous*, attended with tremors of the limbs, and listlessness and indolence of the mind, where no visceral disease or organic affection is present. This condition of the habit frequently follows severe and debilitating diseases; and is also a frequent attendant of sedentary occupations. But, in describing this state of the body as that which indicates the use of the cold bath as a Tonic, it is necessary to be aware that it requires to be cautiously employed when the powers of the body are too languid to induce reaction. The great object to be fulfilled, to secure the tonic effect of the bath, is to produce this reaction at the expense of as little animal heat as possible; and it is on this account that salt water is preferable to fresh. Whichever is employed, when the patient feels the shock of the immersion very severely, when no glow succeeds to it, and when other symptoms appear, indicating that the reaction is not equivalent to the contrary impression on the surface of the body, then the Cold Bath is invariably productive of harm.

In chronic diseases the Cold Bath is an admirable Tonic: it increases the animal temperature, which in these diseases is generally too low; and, consequently, it strengthens the moving powers, excites the nervous energy, and imparts activity to the whole frame; and, in these respects, it is preferable to exercise; it establishes not merely the perspiratory excretion, but it excites the whole circulating system, and also the nervous energy, producing not only a more universal, but a more permanent result. In no disease is the tonic influence of the cold bath more beneficial than in that feverish state which not unfrequently attacks studious men, whose pursuits are of a sedentary kind, require much exertion of thought, and excite a

considerable degree of anxiety. In such persons the pulse is generally quicker than natural; the hands are hot; the appetite impaired; the bowels irregular; and the night restless: and, when this state has been of long continuance, it prepares, as it were, the way for the worst of all diseases not mortal, confirmed hypochondriasis. Such persons bear cold-bathing well; and when, at the same time, the mind can be amused and diverted from its ordinary train of thinking, this diseased state readily yields to its powers. But as this disease, although attended with indigestion, yet differs from true dyspepsia, so it is not benefited by the use of the cold bath. It is not easy to give a satisfactory explanation of this difference; but it has been attempted to be explained by supposing that, owing to the sympathy between the stomach and the skin, every excessive impression on the latter must necessarily cause some disturbance of the former; and, therefore, as the process of digestion requires a pretty uniform state of animal temperature, where the stomach is weak this state cannot be interrupted with impunity. But, although this explanation is satisfactory as far as regards dyspepsia, yet, it does not clear up the reason why the cold bath is useful in the disease of the studious referred to, and nevertheless is injurious in true dyspepsia.

In some other diseases which require tonic and stimulant remedies, cold-bathing is hurtful: such is the case in chlorosis, a disease of young females, attended with an obstructed state of the menstrual discharge; in which, although steel and other tonics are indicated, yet cold-bathing increases headache and the chilliness and languor which always attend such a state of the habit.

The term cold-bathing, besides implying the immersion of the body in water, also comprehends the use of the *shower bath*. This is equivalent to the effusion or dashing of cold water over the body; as a Tonic, it is employed in the same diseases and at the same temperature as the cold bath. In intermittents, it has been found useful in breaking the morbid catenation of symptoms which constitutes the disease, when employed a quarter of an hour before the paroxysm is expected to make its attack; and it is more efficacious in such cases if salt be added to the water.

In weak and delicate frames of body, such as often present themselves in females, I have seen much advantage derived from the long-continued use of the shower bath throughout the year: but, in such cases, it is necessary to begin with water at a higher temperature than that of the atmosphere at the time.

b. EXERCISE.—When we contemplate the number and power of the moving organs of the body under the controul 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 Exercise, employed to restore vigour to the habit debilitated by previous disease, 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, which may be greatly extended by diverting the mind with a succession of new objects, or the conversation of a lively companion.

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 mere Horse 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 phophylactic 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; although we cannot accord in the opinion of Desault, that it tends to break down the tubercles, and to remove the accompanying obstructions of the liver; nor enter into the views of Salvidori, who directed his patients in the morning to climb some eminence till out of breath and bathed in sweat. I have often witnessed the beneficial effects of Horse Exercise in frames of body greatly weakened by asthma; and have seen indivi-

duals 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.

It is unnecessary to extend these remarks. The Exercise of convalescents, particularly those who have suffered from acute diseases, should not extend beyond certain limits. It may be continued up to, but certainly not beyond, the point of fatigue: in attending to this circumstance also, we ought to be aware that rest is not always the best method of relieving the uneasy sensation and apparent exhaustion which occur after immoderate exertion, in some states of the body; for these are often more readily dissipated by changing the nature of the exertion than by actual rest. At the same time, much danger may result from acting too long upon this principle: for, as the mere stimulus of a change must be regarded as purely mental, the exhaustion of the corporeal powers, when the exertion is over, is so great as sometimes to be productive of the most dangerous consequences. The degree of Exercise, therefore, which the body can sustain with impunity, is not always to be regulated by the sensation of the fatigue which it induces, but by closely observing the extent to which which the character of the frame, its muscular energy, and the actual powers of the constitution at the time, taken together, authorize its continuance.

c. FRICTION may be regarded as a species of exercise, and its effects 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, and over a large portion of the body. The ancients judiciously employed Frictions 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 fashion of shampooing, which has been properly introduced into this country. 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 in chronic rheumatism, has been fully discussed. It may be rationally enquired, whether any advantage is derived from aiding the Friction by stimulating embrocations or oils? If the Friction be well performed, and for a sufficient length of time, nothing of this kind is necessary. 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.*

The first of the Mental Tonics is Hope: let us enquire in what manner it operates as a Tonic?

A Tonic we know is a stimulus, but of a degree inferior to that which would produce a state of collapse; and that it must be applied in such a manner as shall keep up and render permanent the impression which it is capable of producing. Now, Hope operates in this manner in many diseases. This is particularly illustrated in *Nostalgia*, a disease which is common to the Swiss, the Scotch, and other mountaineers, when in a foreign country, if circumstances occur to awaken associations connected with the delights and enjoyments of their early years at home. This disorder, which is ushered in by great depression of spirits, melancholy and languor, deep sighing, trembling of the limbs, and other symptoms, not unlike those of phthisis, would prove fatal in a short time, were the hope of returning home not lighted up in the mind. Hope, in this instance, operates exactly as a material Tonic; it increases the energy of the heart and arteries; improves the secretions, particularly that of the liver; and not only sustains the powers of life, but, like a material Tonic, it fortifies those tissues which are organically affected in this disease against the morbid action that would otherwise be induced by them and lead to a fatal termination. That such morbid states occur, has been demonstrated by the post-mortem examinations of Dr. Avenbrucker, who had many opportunities of seeing the disease in the Spanish hospital at Vienna. This physician observed, that, in several persons who died of Nostalgia, the lungs were generally affected; that some parts of them were adherent to the diaphragm; in other parts they were indurated, or were even more or less ulcerated. The tonic effect of Hope in removing this disease is well known, and is a powerful agent in the hands of a judicious physician. If two physicians treat the same disease with similar remedies, and with equal skill in their application; yet, if one of them look grave and anxious before his patient, and drop hints that some uncertainty is connected with the result of the disease; whilst the other holds up to his patient the prospect of recovery, assumes a cheerful and confident expression of countenance before him, veiling every doubt that may hang upon the future, and directing the eye of the sick man to every enlivening ray that beams upon it; the certainty of success is more likely to follow the treatment of the latter than that of the former of these practitioners. "In dangerous maladies," says an able physician, "the person in whom there is the least fear of dying, has, other circumstances being the same, the fairest chance to survive;" and in this manner, Hope, aiding the efforts of Nature, gives an efficacy altogether unexpected to the application of art. "Tell a timorous man, who has been in the habit of looking up with reverence to the

opinion of his physician, that he is in danger, it may probably kill him: but let the doctor pronounce the sentence, with sufficient decision and solemnity, and under certain circumstances it will execute itself." In every case, therefore, in which Tonics are admissible, we may take advantage of Hope, as an exciting agent, which tends to increase the power of others upon the system, and which, when *properly applied*, rarely disappoints our expectation. I have put an emphasis upon the words *properly applied;* for, sometimes, like every other cause of excitement, that produced by holding up the hope of recovery is injurious; and the favourable termination of serious diseases is often aided by a pacific indifference in the patient with regard to the ultimate result.

2. *Confidence.*—On the same principles as Hope, Confidence operates as a tonic power; nothing is, therefore, of greater importance to the practitioner than securing the confidence of his patient, in order to insure the success of his practice: how is this to be effected? The first step for obtaining the command of so powerful a weapon against disease, is the mode of investigating the cause of disease. An inquisitive physician, who examines minutely into the usual habits, the exercise, regimen, sleep, and state of excretions, or whatever in any degree can have contributed to alter the health of the patient, as well as the state of the functions of the body itself, in such a manner as demonstrates an intimate acquaintance with his subject, is certain to attain that controul over the mind of his patient which alone can secure his confidence both in himself and in the means which he employs; and, having done so, like an intelligent general, who knows the value of his troops, he can rely with security on the results of the measures which he adopts. As a tonic power, the influence of Confidence might be illustrated by a thousand examples: for instance, the empiric owes to it the few cures which he blazons forth as the recommendation of his nostrum; but, although it is the prop of the impostor, yet, like the dew of Heaven which falls equally on the just and the unjust, it is not the less valuable when properly applied by the scientific practitioner.

Were any thing requisite to prove the power of mental Tonics in disease, it would be only necessary to refer to their influence in sustaining the body under fatigue which could not otherwise be borne. What is it but Hope and Confidence which enable a mother, night after night, to watch at the bed-side of a sick infant?—to bear up, even with a weak and delicate frame of body, under fatigues which no stranger could sustain, and yet, if the object of her solicitude recover, to suffer no inconvenience from the exertion:—take away the tonic powers of Hope and Confidence, or let all her attentions prove unavailing and her infant fall a victim to the malady, then her health will give way,

she will feel the exhaustion which naturally follows exertions too powerful for the strength of her body to sustain with impunity, and fall a victim of the anxiety and watching, under which Hope and Confidence has so long borne her up, and which could alone sustain her by their tonic powers.

Despair, indeed, in every instance where disease falls upon mortality, may be regarded as bearing the standard in the van of Death.

3. *Travelling* is also a mental Tonic; but it has a closer affinity with material Tonics than either Hope or Confidence. It is an undoubted fact that, however it is accomplished, the mind is so formed that certain impressions produced on our organs of sense, by external objects, are followed by correspondent sensations. Now, in what other manner does a material Tonic produce its effect, except that the sensation is communicated through the nervous extremities of the sentient organs of the stomach or of the skin, instead of those of the eye. The great advantage of Travelling, therefore, is the constant change of the excitant, the repetition of the salutary impression before its effect is dissipated, until, as in the administration of a material Tonic, the effect becomes permanent. In no disease is the advantage of the Tonic influence of Travelling 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: the question then arises, to what is this to be ascribed? Something, undoubtedly, is due to the state of the atmosphere, the temperature, and other physical properties, which distinguish one climate from another. In a dense atmosphere, for example, more oxygen exists in a given quantity of air, and this may increase the stimulant power of the heart; in a cold climate, however, the blood circulates more slowly through the lungs, and, therefore, the greater quantity of oxygen inhaled in a given time will go for nothing: the beneficial effect of a change from a colder to a more genial climate in Hypochondriasis may, in some degree, be attributed to physical causes; but much more advantage is procured by moving from place to place, than by remaining stationary even in the most favourable climate; and undoubtedly, in this case, the salutary effect can only be ascribed to the mental excitement produced by the constant change of scene.

It may be argued, that the depression of the mind in Hypochondriasis, as it depends on a weakened state of the digestive organs, should be removed by whatever gives tone and vigour to these parts, independent of mental impressions. But this mode

of reasoning is more specious than solid: many examples occur in which these organs are greatly diseased, and yet no Hypochondriasis follows; there is, therefore, some state of the nervous system which may suffer greatly from disordered functions in particular organs, but which, as it cannot be regarded as depending on these derangements, so it cannot be removed by their removal. Some predisposition must exist in the nervous system, or in the mind itself, before such functional disorders can produce Hypochondriasis. We know that no set of men are so liable to this disease as scientific and literary men. This has been attributed to their sedentary habits; but much is due, also, to the excitement which they experience being unvaried; as the disease most frequently occurs in those who turn their attention into one line of investigation, or to the prosecution of one branch of science. We know well the force of habit when the abuse of material excitants has been long indulged in; as, for example, opium; and the little impression which, in such cases, even the largest doses produce on the nervous energy: in the same manner, the constant application of the same mental excitants ceases to rouse the energies of the intellectual principle; and the body suffers in the general apathy which follows—the motion of the blood languishes; the surface is deprived of its requisite supply; the stomach and the intestines, from a consent of these with the state of the mind, are debilitated; congestion in the arterial trunks, and on the larger vessels succeed, and Hypochondriasis is firmly established. It is not wonderful, under these circumstances, that the functions of so important a gland as the liver should be disordered; and thence we find that the most common accompaniment of Hypochondriasis is an imperfect and improper formation of the bile. It is true that this disease is sometimes the effect, not the cause, of such a vitiated secretion; but the same circumstances which operate in the production of the one, are likely to influence the other. If this account of the disease be correct, it is evident that the torpor of the mind may, at least, be regarded as a great part of the malady: whatever, therefore, can produce new impressions adequate to excite the attention, must prove useful; and excitants of a mental kind, even although at first irksome and troublesome, yet, if they be sufficient to occupy the attention and to lead to a new series of ideas, cannot fail to prove beneficial. It is on these grounds that Travelling operates as a Tonic in Hypochondriasis; and even in all diseases of debility, if the fatigue be apportioned with judgment to the power of sustaining it. In prescribing Travelling as a Tonic, it is surely unnecessary to say, that countries ought to be recommended most fertile in those circumstances which are likely to rouse the curiosity and arrest the attention. "Cœlum," to use the words of the most elegant of the writers of modern medical latin, "patrio pulchrius, mores

festiviores, et scænæ novæ et amoenæ, mentem grate occupant, et imaginationem suavissime detinent*."

Having dilated so much on the effects of Travelling as a Tonic, it is unnecessary to enter into any details on the tonic influence of *Amusement*. It is the application of the same causes, under different circumstances, which produces the benefit, and affords, from the nature and repetition of the means, that degree of excitement which is necessary for rousing the energies and drawing forth the powers of the system, without inducing exhaustion.

Therapeutical Employment of Tonics.

Enough has been said in the account of the substances contained in this class of medicines, to demonstrate their importance as remedial agents. In deciding upon their employment, three things require to be attended to:—1. The choice of the Tonic is of great importance; for although all Tonics necessarily possess the same kind of powers, yet, these differ in degree: some are also more acrid and astringent than others; some owe their efficacy to the presence of certain alkaline principles, and some to bitter extractive or to volatile oil modified by combination with other vegetable constituents. 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 required, and not exceed the impression which can be sustained: if it be inadequate to the effect anticipated, the therapeutical indication will remain unfulfilled, and disappointment necessarily 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 respect to the peculiar diseases in which Tonics produce salutary effects, in none are these more conspicuous 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

* Gregory De Morbus Cœli Mutatione Medendis Diss. Inaug.

the Tonics to be employed, those which contain bitter extractive, devoid of astringency, are to be preferred: these act in a milder manner than those which contain also gallic acid, tannin, or the alkaloids. Bitters have, likewise, been found efficacious as vermifuges. The Tonic influence which they exert on the digestive organs alters that condition of the mucous membrane which favours the generation of intestinal worms; whilst, at the same time, some bitter substances operate as direct 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 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 undoubted 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. Whatever can improve the condition of the digestive organs and re-establish the assimilating power of the system, is likely to alter that state of the urinary secretion which constitutes diabetes; thence the important influence which Tonics exert in that 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 of the habit, manifested by a pallid or discoloured skin, a disordered state of the stomach, emaciation of the body, and a sluggish condition of the bowels. It is scarcely necessary to remark, that, in scurvy, the only antiscorbutics to be relied upon are Tonics.

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 and nice discrimination. 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. When ulceration of the bowels occurs, it is perhaps better to permit the prostration of strength, which invariably accompanies such a state, to proceed for some time, until evident symptoms of collapse begin to shew themselves, before prescribing Tonics: "for," as Dr. Bright has justly remarked, "when administered too soon, they frequently kindle the inflammatory action with redoubled violence, and then it is that the most appalling combination of debility and nervous excitement is seen for one or two days to precede death." In such cases, also, when they are actually indicated, those substances which are purely tonic and as little stimulant as possible should be selected. In typhus fever, the indiscriminate use of Tonics has been productive of much mischief. The appearance of languor and debility is no reason why Tonics should be prescribed; as, in these instances, they have been found to increase all the symptoms, without improving the tone of the habit. The statement of Dr. Clark's experience of the advantages derived from cinchona in every stage of fever, is at variance with this opinion: but ample experience has demonstrated that it is only after the febrile symptoms have been wholly subdued, when the patient does not rally, and strength is too slowly recovered, that Tonics are beneficial. Under certain circumstances, however, 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 medicine in intermittents, it might be supposed that little remains to be said regarding the employment of Tonics in these 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 procured by other means 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, I must confess that I am 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 cases of intermittents complicated with affections of the brain or the thoracic or abdominal viscera, Tonics ought not to be resorted to until the local affections are subdued in intensity, if not wholly removed. But, where the paroxysms return with much severity, and are likely to be productive of danger in weak constitutions, it would be improper to delay the use of Tonics; for, the local affection often owes much of its aggravated character to the impression made by each recurring paroxysm. In such cases, however, the least stimulating Tonics should be selected; such, for example, as Quassia and Calumba.

In remittent fevers, the utmost caution should be observed in prescribing Tonics. The remission should be complete, or rather the disease should be transformed into the intermittent type, before they can, with propriety, be employed: indeed, nothing is so likely to change a remittent into continued fever as the injudicious employment of Tonics. 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 administration of an emetic, I accord with those who delay the use of Tonics until the advanced stage of the disease, when it proves obstinate: then the Cascarilla, which is generally preferred in such cases, maintains the tone of the stomach and bowels, and enables us to proceed with the alterative and purgative plan of treatment. I have already mentioned the circumstances under which Cinchona and other Tonics are likely to prove useful in hectic; but, in this modification of fever, 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, although it is proper to prescribe them with caution in any form of fever complicated with local inflammation, yet, we ought not to be prevented by the dread of inflammatory symptoms from employing a class of remedies so well calculated to restore the strength and vigour of the nervous system, essential for carrying on the functions of life: we must always recollect that excitement is not tone, nor increased vascular action strength.

SECTION VIII.

ASTRINGENTS.—MEDICAMENTIA ASTRINGENTIA*.

ASTRINGENTS are substances which produce contraction and condensation of the muscular tissue. To understand this definition, we must know what is meant by muscular tissue and its properties. As far as the unaided power of the eye can guide us, the muscular tissue appears to consist of bundles of fibres, which are flattish, linear, soft, white in some animals, red in others, and plaited in their length. But, when the microscope is called in to aid our limited vision, we find that the fibres, of which these bundles are composed, are themselves bundles of smaller fibres, enclosed in thin membranous expansions. If we trace the nature of these fibres from the writings of microscopic observers, we find the most opposite descriptions. Muys and Lewenhoeck maintained that each fibre is composed of still smaller fibrils, in the proportion, says Muys, of 900 in the thickness of the finest hair; but, according to Lewenhoeck, of 3180, as he assures us that he counted that number in the muscular fibre of a fish. On the contrary, Prochaska avers, in the most positive manner, that the size of the ultimate fibril is about the 50th part only of the diameter of the red globule of the blood. Later investigations even extend this magnitude: the observations of Sir E. Home and Mr. Bauer make the ultimate filament to consist of a series of globules, exactly corresponding in size with the uncoloured globules of the blood, connected by an elastic medium, by means of which a visible interval may be produced between the globules; but this globular structure is denied by Dr. Hodgkins, who regards the ultimate filament as truly fibrous. Mr. Hare affirms that each fibre consists of minute tubes, $\frac{1}{400}$th part of an inch in diameter, and exhibiting longitudinal striæ with transverse bands. Mascagni describes it to be a small cylinder filled with glutinous matter; whilst Meckel and Rudolphi believe that it is solid. It would be out of place here to criticise these descriptions of the ultimate muscular filament: the knowledge conveys no real information, and, in the language of Bichat, "is merely a concourse of vague ideas." Whatever may be the form and magnitude of this part of our structure, it is of more importance to know that it is connected with cellular tissue, exhalant and absorbent vessels, arteries, and veins, as well as nerves, both of sensation and of motion. The distribu-

* Derived from *astringere*, to contract.

tion of nerves to muscles is unequal, and the power of contraction appears to be nearly in the ratio of the number with which a muscle is supplied. The nervous trunks, in entering a muscle, run in the direction of the muscular fasciculi, giving out laterally twigs which divide and subdivide in the interstices, until they can no longer be traced, and appear as if absorbed or lost in the tissue of the fibrils. It was at one time believed that the nervous filaments deliquesce into an invisible pulp, and unite intimately with muscular fibrils; but the later observations of MM. Prevost and Dumas have demonstrated the error of this opinion. According to these physiologists, the minute filaments of a nervous cord, entering a muscle, traverse its fibres at a right angle and at short distances from one another, and then either return to the same nerve or anastomose with some neighbouring branch of another. I am most anxious to solicit attention to this fact, as it applies directly to our enquiry. In some instances, as in the muscles of the face, there is a junction of nerves of sensation with nerves of motion: yet this union does appear to exist in all muscles. With regard to blood-vessels, no organs in proportion to the extent of their volume or bulk are so amply supplied with blood as muscles. The arteries, given off from the neighbouring large trunks, penetrate the substance of the muscle, then divide to supply the secondary bundles of fibres, and again and again subdivide until they become capillaries attached to the fibrils. Such is the muscular tissue: therefore, under whatever form it appears, it is a compound substance; it possesses also compound functions, or, in other words, both physical and vital properties.

A muscle owes its physical properties, its cohesion, flexibility, and extensibility, to the same causes as matter in general: its elasticity is also a physical property; but its contractility, or the power of shortening itself, is solely a vital property. In this contraction there is a real generation of power: it is distinct from any other power in nature, is peculiar to life, and is regulated by laws different from those of any other power: it does not cease immediately on the extinction of life, and indeed continues in some degree until putrefaction take place. But, although it be admitted that the contractility be inherent in the muscular fibre, it must, also, be admitted that we know of no means by which this power can be excited without the intervention of the nerves. If the muscle on the belly of a frog be so placed in a frame that the galvanic fluid may be directed through it, the following phenomena become apparent under the microscope. When the stimulus is applied, the fibres shorten themselves, or rather the two extremities of the fibres are seen to approach one another, by the intermediate space bending at numerous angles into zig-zag lines; but when the stimulus is withdrawn, the fibres regain their straight direction.

Prevost and Dumas, who made this observation, in confirmation of what had been previously observed by Dr. Hales, assert that these angles are nearly at equal distances, and correspond with the intersection of the nervous filaments. Now, it may be asked, is this condition of the muscular fibre peculiar to it only when that power which may justly be denominated muscular is exerted? is the same fibre, whatever may be its condition as to tone, a straight fibre, when this power is dormant? To reply to this question satisfactorily, would require more powerful microscopes, and a greater perfection in using them than has been yet attained; I will therefore assume it as a fact, that, whatever may be the linear direction of the ultimate muscular fibrils in their state of tone, or greatest density and cohesion, this state is intimately connected with and solely dependent on vitality. This is demonstrated by the fact, that a muscle, which during life can sustain a certain weight, is torn asunder by the same weight after death, or after it has been for a short time separated from the living body: the great tonicity of strength of muscles during life depends, therefore, on a cause different from that of simple cohesion, and exists only during the life of the part. But this state is not always the same during life. In certain conditions of the habit, the muscular fibres seem to lose in a great degree their cohesiveness and elasticity; and with these, their contractility, or property of responding to the will and of contracting on the application of material excitants, is lessened; and the hollow muscles, in particular those surrounding the arteries, lose their power of resisting the pressure of the contained fluids, which either burst their coats or find their way through them, producing what is termed passive hæmorrhage. This loss of contractile power is also perceived in the abdominal muscles of women who have borne many children, and in the scrotum after the discharge of the fluid from an old hydrocele. Astringents are indicated to remove this condition of the muscular tissue, and, keeping in view the nature of the parts on which their influence is exerted, let us examine in what manner their action is to be explained.

Most of the writers on Materia Medica have endeavoured to explain the influence of Astringents on the living body, by reasoning analogically from their influence in hardening and condensing dead animal matter. It is true that the substances which bestow toughness, solidity, and impermeability, to the soft skin of a dead animal, so as to convert it into leather, operate as Astringents on the living muscular fibre. Looking at this fact, were the enquiry to proceed no further, it is not surprising that erroneous inferences should be deduced from it in explaining the action of Astringents: indeed, the presence of life seems in some instances rather to favour than to resist the operation of Astringents. But still the appearance

of similar results, in conditions of the body so opposite as that of life and death, is not conclusive that the cause is the same in both cases. In examining the question, let us first trace the causes of the effects which Astringents produce upon dead animal matter; then examine whether the same circumstances occur in the living body, and endeavour to frame some satisfactory theory of the operation of Astringents on the living solid.

The material agents which produce on dead animal matter that change of condition which is supposed to be the result of astringency, are *cold*, *alcohol*, *acids*, and *tannin*.

Cold, the first of these agents, is a negative quality, the absence of a positive agent, *caloric*. When caloric passes from a body containing much of it, into another which contains less, until both arrive at an equilibrium, and the bulk of the former is lessened, that of the latter is increased; and the consequence of its accumulation in any body is the separation of the particles and a consequent reduction of the cohesion of that body. Now, if the presence of caloric weakens this force, the abstraction of it must necessarily increase it; the body is condensed, occupies smaller space, and proves more capable of resisting any force applied to separate its parts than when the caloric is present in it; or, in other words, the strength of the body is augmented by the abstraction of caloric. A thong of an untanned skin, which can support a weight of ten pounds in a temperature of 85°, will support an additional weight at a temperature of 40°. With respect to the living body, it is an undoubted fact that cold operates as an Astringent to the animal solid. In warm weather, in the same climates, the muscles of the living animal are softer, less capable of powerful action, and more feeble in every respect than in cold weather; nevertheless, caloric is a stimulant to the living body; and as such it ought to augment the strength of the muscles. To explain and reconcile these contrary facts, we must keep in view that law of the system by which the continued action of every stimulant is followed by collapse: that, when this occurs, the vitality of the part is so much lowered, that the ordinary physical laws connected with the operation of caloric exert their influence on the body; and, consequently, the debility of a muscle in warm weather is due to the same cause which weakens the cohesive power of dead animal matter. Abstract caloric, therefore, from a living body, the first effect is of a physical kind; the parts of the living muscle are mechanically condensed: but it is the exertion of the living principle on the restored excitability of the part which renders the condensation permanent and maintains its tonic power. Thence we may conclude that, as far as *cold* operates as an astringent, we cannot explain its operation as such by reference merely to its effects upon dead animal matter.

With regard to the action of the second agent, if a piece of muscle of a dead animal be put into *alcohol*, it lessens its bulk and hardens it, and this is generally referred to the astringent property of the spirit; but chemistry informs us that alcohol has a strong affinity for water; that, in attracting it from the animal matter, the albumen is coagulated; and that, this contracting, the other solid components are more closely compacted with it, and the whole mass becomes smaller than it was before it was put into the alcohol. Now, when alcohol is applied to the surface of the living body, it operates as an excitant, but no coagulation of albumen results: if the quantity be great, and its strength considerable, an immediate cessation of motion takes place in the capillaries; the globules of the blood stagnate, as it were, and become compacted in the vessels; the vitality of the part is either suspended or destroyed—a fact which is rendered obvious in the web of the foot of a frog examined under a powerful microscope. But if, on the other hand, inflammation previously exists in the vessels of the part, the application of diluted alcohol stimulates the coats of the inflamed vessels, contracts their diameters, by constringing their circular fibres, and thus relieves the previously overloaded vessels. In this case, we can derive no aid in explaining the cause of the astringency of alcohol applied to the living body, by reference to its effects on dead animal matter.

Nearly the same reasoning is applicable to the action of dilute *acids*, which act as Astringents, whether externally applied or taken into the stomach. These acids corrugate the dead animal fibre; and act chemically upon it, coagulating the albumen, and forming new compounds: on the living fibre they operate as excitants and tonics, increasing the general vigour of the frame and producing that state which is termed tone, in which the adhesive power of the parts is augmented without any change in their composition. Here, again, are two states of bodies as opposite as possible, produced by the action of the same substances: but certainly from very different impressions.

The last of the astringent substances referred to is *tannin*. Plants which contain it, when taken into the mouth, seem to draw the parts together; and by the extent of this sensation we judge of the degree of astringency of the plant. When applied to dead animal matter, they apparently act in the same manner, shortening the longitudinal length of muscular fibres, and diminishing the diameter of vessels. But, besides these effects, we find that a new substance is formed which did not previously exist: the tannin unites chemically with the gelatine of the dead animal matter, and forms a solid, insoluble compound, which resists the action of water and does not putrefy. Something of the same kind is produced by the application of tannin to the living body: thus, if Catechu and other powerful Astringents be

mixed with newly drawn blood, whilst it is yet flowing from the vein of an animal, the blood is coagulated sooner and more firmly than when no astringent matter is mixed with it; and, when the aqueous solution of Catechu is injected into the veins of living dogs, the animals are killed, and the blood in the heart and large vessels is found firmly coagulated. We nevertheless cannot admit that vegetable Astringents operate in the same manner on living as on dead animal matter, obviating mechanical laxity by their coagulating power; for, unless debility be a mere mechanical defect of cohesion of the muscles, this state cannot be removed by the coagulating power of the astringents, as in dead animal matter: to use the language of Dr. John Murray, "it is now admitted that every degree of strength or weakness depends much more on correspondent variations in the state of the powers peculiar to living matter; and substances capable of obviating disease dependent on any state of debility, must be such as are capable of acting upon these powers. Many substances accordingly, arranged as Astringents, occasion very considerable alterations in some of the functions: they produce effects which cannot be referred to their condensing power, allowing them to possess it; and, therefore, in all the changes they produce, part of their operation, at least, must be referred to actions which they exert, conformable to the laws of the living system." Upon the whole, we have no hesitation in concluding, that no satisfactory explanation of the action of Astringents in the living body can be founded on the analogy of their action on dead animal matter. Indeed, it may be affirmed, not only of Astringents, but of all medicines, that their operation does not depend on ordinary physical laws—those "of matter and motion which take place in inanimate bodies—but on a principle which subsists in living bodies only*." Thence we refer the action of Astringents to the laws of the living system; and it is evident that they operate chiefly as excitants: but, in stating this opinion, it is requisite to draw the distinction between Astringents, Excitants properly so called, and Tonics. *Excitants* act powerfully on the excitability of the part to which they are applied, causing sensation and a sudden contraction or motion; and extending their action over the whole habit: but this is followed by relaxation. *Astringents* operate, also, by causing sudden contraction: which is evidently different, both in degree and in kind, from that caused by excitants. *Tonics*, whilst they promote contraction and density, operate slowly, and their influence is confined within that limit which may be regarded as the natural state of the healthy solid. Thus, the distinction between the three powers, stimulus, tone, and astringency, is sufficiently obvious. If an astringent be appled to any part of the body on

* Cullen, Lectures on Mat. Med.

which the action induced admits of ocular demonstration—as, for example, the lips—the first effect produced is a contraction of the muscular fibres and the blood-vessels of the part; the lips become pale, a sensation of dryness and roughness is felt on the palate, the effect of a real corrugation, owing to the action of the Astringent on the motor nerves of the parts exciting the contractility of the muscular fibres. But this action differs from that of an ordinary excitant, which rather rouses the sensibility than causes the contractility of the muscular fibre; whereas the Astringent acts on the contractility only, and a corrugation or new arrangement of the component fibrils—shortening, thickening, and condensation—is the consequence. We are conscious of this effect when it thus occurs in a sensible part; but the sensation appears to arise rather from the compression of the extremities of the sensitive nerves, by the condensation of the contracted fibres, than from any immediate impression of the astringent substance on the sensitive nerves. The sensation therefore induced is a secondary effect; arising from the immediate impression of the Astringent on the minute extremities of the motor nerves.

In regarding Astringents as excitants, we should understand the distinction between their operation and that of excitants that affect, decidedly, the sensibility. When a general excitant is applied to a sensitive part of the body, the impression is made on a set of nerves which serve merely as media of communication between the brain and the parts affected; the mind, therefore, through the medium of these stimulated nerves of the brain, becomes conscious of the impression; and the motion which follows is the consequence of that affection of the mind which we term volition, operating on the origin of the nerves of motion, supplying the impressed or stimulated part. It may be contended that contractions occur in muscular parts from the application of excitants independent of volition; for a sharp instrument run into any muscular part will produce an immediate contraction. I admit the fact; and I must also admit that, when contraction occurs in a muscle separated from the body, the effect cannot be regarded as the result of volition: but I contend that, in every instance accompanied with sensation, volition is more or less the power which calls the muscle into action. When an Astringent, however, acts upon a part, no communication of this kind takes place, the nerves of motion are *immediately impressed*, and a movement in the fibres which they supply occurs.

If this view of the subject be correct, we may venture to explain the operation of Astringents by saying, that they *stimulate directly the ultimate fibrils of the motor nerves*, and, through them, produce an immediate effect upon the insensible contractility of the fibres which these nerves supply. It is not difficult to conceive that such an action, excited in a part, may be propa-

gated by sympathy to other parts, or even to the whole system: thence, if any acerb fruit be chewed, along with the corrugation, a peculiar feeling extends over the whole body. This extension of the action of Astringents may, in some degree, explain the benefit resulting from their employment in checking the inordinate secretions of distant organs: but it is more probable that they are taken into the circulation; for, without such a supposition, we should not be able to explain the manner in which they act in stopping hæmorrhage when internally administered, especially when taken into the stomach. Mr. Brodie gave to a patient, who had a frightful hæmorrhage from the prostate gland, and in whom all other remedies had failed, a large dose of Ruspini's styptic, and repeated the dose twice in the course of twelve hours. About half an hour after the first dose was taken, the bleeding ceased, and it never recurred.

From these premises, I venture to offer the following theory on the nature of Astringency. I conceive it to be a power which, through the medium of the motor nerves, acts on the *insensible* contractility of the muscular fibril, producing a closer approximation of their component particles; and, by thus augmenting their cohesion, causing a greater and more permanent density, and a corresponding vigour in the muscular tissue. This action differs from ordinary muscular contraction, in not being dependent on the nerves of sensation, and consequently in not being the result of any communication with the sensorium; in not exhausting excitability; and in the permanency of its effects. The movements constituting muscular contraction are the consequence of impressions conveyed to the brain, through the sensitive nerves, and thence to the motor nerves of the part: the contractions following the application of Astringents are the result of direct impressions on the motor nerves, altogether unconnected with those of sensation.

Let us now examine the manner in which this class of medicines operate upon the principal organs of the body.

1. *Action of Astringents upon the Digestive Organs.*—When a moderate Astringent is taken into the stomach, it acts upon the nerves of the organ, shortening the muscular fibres, not only of its tunics, but those of its blood vessels, lessening the capacity of the viscus, and giving density to its coats; this operation upon the moving fibres is tonic: but, if the Astringent be a powerful one, or the dose large, a painful sensation of constriction in the organ is experienced, and its local impression is felt over all the internal organs. The mucous membrane of the alimentary canal becomes comparatively dry, from its usual exhalations being diminished; and costiveness is the result.

2.—*upon the Circulating and Respiratory Organs.*—When Astringents are taken into the circulation, the circular fibres of the arteries are shortened, the diameter of the vessels diminished,

and the power, both of these and of the heart, augmented; so that the pulse feels firmer and tenser; but, nevertheless, the circulation is not accelerated; or, in other words, a tonic effect is the result. It is to this general contraction of the vessels, and their increased density, that may be justly attributed the power of Astringents in hæmorrhages of internal organs, such as the bladder of urine and the kidneys, to which they cannot be directly applied. In relaxation of the mucous membrane of the bronchial tubes, and a superabundant excretion of mucus into the cells, the influence of Astringents becomes strikingly obvious; and can only be explained on the supposition that the astringent is absorbed, and acts upon the muscular coats of these tubes and cells.

3.—*upon the Secerning System.*—From what has been said, it is evident that Astringents diminish, to a certain extent, the secretions; but most particularly the secretion of the kidneys. When the extreme vessels through which the urine filters into the papillæ of the kidneys are in a state of great relaxation in diabetes, there can be no doubt that any benefit derived from Astringents, in this state of the urinary organs, can only be referred to the direct application of the Astringent to the relaxed vessels. Astringents, indeed, it is well known, lessen the quantity of the urine, but not that of the saccharine matter in diabetic urine.

4.—*upon the Nervous System.*—Little requires to be said upon this part of our subject; for, although it cannot be denied that the impression made by Astringents on the nerves of the stomach is communicated through the medium of the nerves to every part of the system, yet, this influence approaches more to that exerted by a tonic power than one purely astringent. It is no argument against the correctness of this opinion, that a few grains of acetate of lead, taken into the stomach, will restrain an internal hæmorrhage; for, in this instance, the influence of the salt of lead is probably to be ascribed rather to the diminished energy of the circulation which follows its administration than to any astringent property inherent in the preparation. Indeed, several substances usually regarded as Astringents, and undoubtedly capable of checking hæmorrhages, produce their effects in the manner just explained: by a sedative impression on the nervous system, diminishing the action of the circulating organs.

All substances regarded as Astringents operate by one or other of the modes which have been described in the foregoing remarks: I have therefore founded upon them the principal divisions of the table of Astringents. In the first division, I regard the substances arranged in it as exerting a *tonic power*, although I am satisfied that the power of *simple Astringents* and that of *simple tonics* differ, as I have already stated, in several

respects; yet, as they may be substituted for Tonics in diseases of debility, and some of them have the power of cutting short the paroxysm of ague, if given a short time antecedent to its accession, I have adopted the term *tonic* power, for want of a better. The second mode I have stated to be the exertion of a *sedative power*. On this subject I would add, that, although a sedative power is capable of checking a hæmorrhage, by diminishing the impetus of the vascular system, yet, the substances placed under this head act primarily as local Astringents, by corrugating the extreme fibrils. To illustrate this by an example, let us suppose a *diarrhœa*, arising from acrid bile flowing into the duodenum:—an ordinary sedative administered under these circumstances would lessen the irritability of the intestines, and consequently render them less susceptible of the impression of the acrid matter; but a sedative Astringent would more certainly check the diarrhœa, by not only diminishing irritability, but, by its astringent influence, repressing the flow of the excretions of the canal itself, and also that of the acrid bile into it.

TABLE OF ASTRINGENTS.

A. ASTRINGENTS WHICH EXERT A TONIC INFLUENCE ON THE SYSTEM.

* *Organic Products.*

a. TANNIN—

combined with Gallic Acid, in

Roots of	Krameria *triandria*	4.	1.	Polygaleæ.
	Rumex *aquaticus*	6.	3.	Polygoneæ.
	Polygonum *bistorta*	8.	3.	———
	Geum *Urbanum*	12.	5.	Rosaceæ.
	Tormentilla *erecta*	12.	5.	———
Plant	Lythrum *Salicaria*	11.	1.	Salicareæ.
	Boletus *Ignarius*	24.	13.	Fungi.
Bark	Quercus *pedunculata*	21.	7.	Cupulifereæ.
Leaves	Arbutus Uva Ursi	10.	1.	Ericineæ.
Flowers	Rosa *Gallica*	12.	5.	Rosaceæ.
Fruit	Prunus *spinosa*	12.	1.	Amygdaleæ.
	Punica *Granatum*	12.	1.	Myrtaceæ.
Secretions	Pterocarpus *erinaceus*	17.	1.	Leguminosæ.
	Acacia *Catechu*	17.	1.	———
	Eucalyptus *resinifera*			Myrtaceæ.
Disease.	Galls.			

b. HEMATINE, Hæmatoxylon Campechianum. 10. 1. Leguminosæ.

** *Inorganic Products.*

c. ACIDS—
Sulphuric Acid.
Acetic Acid.
Gallic Acid.

d. METALLIC SALTS—
Alum.
Sulphate of Iron.
Muriate of Iron.
Sulphate of Copper.
Sulphate of Zinc.
Acetate of Zinc.
Nitrate of Silver.

B. ASTRINGENTS WHICH EXERT A SEDATIVE INFLUENCE.

e. METALLIC SALTS.
Carbonate of Lead.
Acetate of Lead.
Subacetate of Lead.

f. COLD.
Cold Water.
Evaporating Lotions.

C. SUBSTANCES OPERATING CHEMICALLY AS ASTRINGENTS.

g. CARBONATE OF LIME.

A. ASTRINGENTS WHICH EXERT A TONIC INFLUENCE ON THE SYSTEM.

* *Organic Products.*

a. TANNIN, TANNIC ACID.

Tannin is a peculiar vegetable principle. It received its name from the circumstance of its forming the principal agent in the operation of converting the skins of animals into leather; a process in which this principle, as obtained from various astringent vegetables, is precipitated upon the gelatine of the skins from water in which it is held in solution, and in which the skins, properly prepared, are placed: they are thus rendered impermeable to water, and incapable of undergoing the putrefactive process under the ordinary circumstances which favour that process, in untanned animal matters. This process is

termed *Tanning;* thence, the French chemists named the principle on which it depends, *Tannin.*

According to M. Pelouze, Tannin is procured by introducing powdered gall-nuts into a tube, closed at one end, and pouring over it sulphuric ether. The tube is then inverted in a common jar or bottle. The ether gradually yields its water to the Tannin, and forms with it a thick syrup, which is pushed into the bottle by the expansion of the ether above it. This syrup, which consists of water, ether, and Tannin, being evaporated, leaves the latter in a state of purity. M. Pelouze says that 100 parts of gall-nuts yield 40 of Tannin*.

Tannin, when pure, is nearly colourless: it is unalterable in the air, and is easily pulverized. M. Pelouze contends that it is a true acid, represented by C. 18, H. 18, O. 12: it decomposes the carbonates with effervescence, and forms tannates with the oxides. It is inodorous; its taste is astringent; it dissolves readily in water; and is soluble in alcohol and ether. When exposed to the air in solution, it absorbs oxygen, which changes it into gallic acid. Protosulphate of iron produces no alteration on pure Tannin; but the persulphate immediately precipitates it, in combination with the oxide, of a deep or greyish-green colour: the persulphate is thus changed into a *Tannate of the peroxide of Iron;* but if an excess of the solution be added, what remains undecomposed of the persulphate is converted into the protosulphate, owing to the Tannin attracting the oxygen. The most striking property of Tannin is the formation of an insoluble compound when it combines with gelatine. The precipitate is a compound of—Gelatine 54 + Tannin 46 = 100; and is known under the name of *Tanno-Gelatine.* It affords a pretty accurate test of the quantity of Tannin contained in any astringent vegetable infusion or decoction. The concentrated solution of gelatine, therefore, is the test of the presence of Tannin in vegetable infusions or decoctions. If an excess of the solution of gelatine, however, be added to the vegetable infusion, the precipitate is redissolved. Lime water and barytic water precipitate Tannin from its solution, the precipitate being a compound of the earth and the Tannin. When the earth is separated by an acid, the freed Tannin again acts upon gelatine. From the analysis of Berzelius, the constituents of Tannin appear to be—Hydrogen 4.186, Carbon 51.160, Oxygen 44.654, in 100.000 parts. Its equivalent is 215.16.

But Tannin has been rarely procured in a state of purity. It is found chiefly in the inner bark of the roots and the stem of trees; sometimes it is contained in the wood, occasionally in the petals of the flowers, varying in character in different plants,

* Ann. de Chim. et de Phys. t. liv, p. 337.

owing to its combination with other principles. It has been employed, in its pure state, in uterine hæmorrhages; and M. Cavalier says it has succeeded in stopping these when many other astringents have failed. He gives it in doses of two grains every two hours. For this purpose it can be procured sufficiently pure from a solution of catechu in cold distilled water, filtered and evaporated to dryness. Tannin, as it exists in plants, is generally combined with

b. Gallic Acid.

Gallic Acid is a crystallizable acid, procured in silky prisms. It was first obtained by Scheele from gall-nuts: he published his method of procuring it in 1786. M. Pelouze supposes that it does not exist ready formed in galls, but is the result of some change in the Tannin. Its taste is slightly acid, sweetish, and astringent. It is inodorous at the ordinary temperature of the atmosphere, but has an unpleasant, peculiar odour when heated. It is soluble in 100 parts of water at 60°. Alcohol dissolves one fourth of its weight; ether also dissolves it. The crystals, when exposed to a moderate heat, lose 9.45 per cent. of weight, and effloresce. Its aqueous solution undergoes rapid decomposition when heated, and also spontaneous decomposition, becoming mouldy, when it is exposed to the air. It sublimes by heat; and is converted into pyro-gallic acid; leaving a black acid matter behind, which M. Pelouze calls *Metagallic* acid. Pyro-gallic acid is whiter than gallic acid, has a slightly bitter taste, and is soluble in 1½ parts of water at 56° Fahr. and in ether. The aqueous solution reduces the persulphate of iron to the protosulphate, and reduces instantly nitrate of silver and of mercury to the metallic state.

Gallic acid forms soluble gallates with the alkalies. With barytic water and lime water it forms bluish-red flaky precipitates. It strikes a blue-black with all the salts of iron.

It is composed, according to the analysis of Berzelius, of—

Hydrogen . . .	5.00	or 3 eq.	= 3
Carbon	56.64	7	= 42
Oxygen . . .	38.36	5	= 40
	100.00	Equiv.	85

* *Roots.*

Krameriæ Triandriæ Radix. *Ratanhy Root**. L. D.—The Krameria *triandria* is a plant belonging to the natural

* The name *Ratanhia*, in Huanuco, signifies "spreading: in some provinces the plant is called *Mapato*, villous, or tomentose, the young shoots being white and silky; in other places it is called *Pumacuchu*.

order Polygaleæ*. It is a native of Peru, growing in arid and sandy places in several of the provinces; but most abundantly near the city of Huanuco. Another species of the same genus, Krameria *Ixina*, a native of the Antilles, furnishes roots very similar in their appearances to those of K. *triandria*†. The root is the part of the plant medicinally employed. It is in pieces of various thickness, of a dark red colour, breaking short, and exhibiting in the fracture a woody centre, and an easily separated, fibrous bark, which contains the active part of the root, the woody part being completely inert. On this account, in choosing Ratanhy Root, the small roots are to be preferred, as in these the bark is comparatively thicker than in the larger roots.

The bark of Ratanhy root has a bitter, astringent taste, at first nauseous, but afterwards sweetish. The odour is earthy, and this is also the case with the decoction, which smells not unlike a raw potatoe. The bruised root yields to boiling water a reddish-brown infusion, which is deepened by the pure alkalies; but no precipitate is thrown down. With the proto-sulphate of iron it forms a greenish, with persulphate a deep green, with isinglass solution a dirty white, and with lime water a pinkish precipitate. These reagents demonstrate that Ratanhy root owes its astringency to tannin. Alcohol digested on it takes up the colouring matter of the root, and part of its tannin; and also detects the presence of resin, which is slowly separated when the tincture is poured into water. According to Vogel, the constituents of 100 parts of this root are—40 of a peculiar principle, which he names modified tannin; 1.50 of mucilage; 0.50 of fecula; 48.00 of fibrine; and 10.00 of water and loss: but this analysis is not to be depended on, as it mentions neither resin nor pure tannin, both of which are certainly constituents of Ratanhy root. M. Peschier of Geneva has also stated that he has detected a peculiar acid in this root, which he names the Krameric; but its existence is doubtful‡; and has been denied by M. Chevallier§.

As an Astringent, the root is a valuable remedial agent. The Peruvians employ it in dysentery; they long employed it as a tooth brush, to give a firmness to the gums and impart a fine red to their lips, thence the Spanish name of the plant, Ruiz para los dientes. In combination with purified animal charcoal, in the proportion of one part to three of the charcoal, it forms the best tooth powder that can be produced. It is not yet much employed as a medicinal Astringent. The dose of the root, in substance, is from gr. x to ʒss: the best form of giving it is in

* Woodville's Medical Botany, third edition, vol. v, p. 129. London Dispensatory, art. Krameria. Richard, Hist. Nat. Med. t. ii, p. 754.

† The term triandria arises from one of the stamens being always suppressed.

‡ Journ. de Pharm. t. vi, p. 45. § Dict. des Drogues, t. i, p. 122.

infusion or decoction, made with ℥i of the bruised root to a pint of water; and of this f℥ii may be taken three or four times a day. A tincture is also prepared with it, and an extract, which contains all the tannin, and, of course, all the active matter of the root. Salts of iron; acetate of lead; the mercurial salts; tartar emetic; and the mineral acids, except in small quantity, are incompatible in prescriptions with infusions of Krameria. But as the alkalies merely deepen the colour of the decoction, they may be combined with it: a great advantage, indeed, in those cases of dyspepsia in which a direct bitter is not required; and in calculous affections of the kidneys. As in the case of other astringent vegetables, ipecacuanha is incompatible with infusion of Krameria.

When the decoction of Ratanhy is taken into the stomach, it tinges the fæces of a red colour, which continues for some days after the use of the medicine is discontinued. It does not affect the urine. It is a powerful tonic-astringent, but, when taken daily for some time, it is productive of uncomfortable sensations —sickness, pains in the lower belly, and costiveness; sometimes tingling over the whole skin; flying pains in the limbs, and even spitting of blood. Ratanhy is, nevertheless, administered with advantage in passive hæmorrhages, whether from the stomach, the chest, the nostrils, or any part of the habit. M. Barbier recommends it strongly in cases of softening of the tissue of the heart and the dilatation of its ventricles. In diarrhœa, if irritation or subacute inflammation exist in the intestinal canal, Ratanhy often produces heat of the epigastrium, thirst, cardialgia, sometimes vomiting and flatulence. These symptoms, however, and also diarrhœa, gradually abate, the appetite returns, and the salutary influence of the remedy becomes apparent: but when they increase in violence, then the medicine should be discontinued. Ratanhy has been found useful in leucorrhœa; and in a debilitated state of the habit, attended with profuse sweating. Administered in diabetes, it diminishes the quantity of urine; but the morbid qualities of the secretion remain unaltered.

b. RUMEX AQUATICUS. *Great Water Dock.* D.—This is an indigenous perennial plant, found in ditches and on the banks of streams. It belongs to the natural order *Polygoneæ**. The roots of this Dock are somewhat tuberous, break with a starchy fracture, and exhibit a white centre, whilst the cortical part is pale yellow, covered with a reddish brown cuticle. It has a faint, peculiar odour, and an austere, bitter taste. It yields its virtues to water. The decoction strikes a black with persulphate of iron, and throws down a precipitate with lime and barytic waters;

* Woodville's Med. Bot. 3d edit. p. 658, pl. 229. London Dispensatory, art. Rumex.

iodine demonstrates the presence of a very considerable proportion of fecula in it. Gelatine detects tannin, and muriate of tin extractive. According to the experiments of Deyeux, it contains a large proportion of free sulphur.

In full doses, the decoction of this root purges; but, in small doses, it operates as an astringent. It was formerly in great repute as a remedy in cutaneous affections. In every old author who treats of skin diseases, we shall find it described under the names *Lapathum*, *Hydrolapathum*, and *Herba Britannica;* it is still recommended as a specific in various species of dartres on the Continent; and, probably by means of the free sulphur which it contains, it has been found a tolerably certain remedy for scabies. I have had no experience of its efficacy, except in two diseases, both of which are extremely troublesome to remove by other means: I refer to Herpes labialis, when it changes into a species of Impetigo; and Ichthyosis, or fish-skin eruption. But the most useful of all our indigenous remedies in cases of Ichthyosis is another species of Rumex, much more common and generally known than the *aquaticus*, the Rumex *obtusifolius*.

The decoction of the root of this plant is bitter and nauseous; and less astringent than that of the Rumex *aquaticus*. It appears, from the action of reagents, to contain tannin, extractive, starch, and a bitter principle; but it also contains some purgative matter, as it operates powerfully on the bowels.

The dose of the decoction, made with an ounce of the root and one pint of water, is f℥iss twice or thrice a day.

3. Polygoni Bistortæ Radix. *Root of Bistort.* L. E. D. —This plant, named from the form of the root, which is twice turned, *bis torta*, is very widely diffused, being found over the greater part of Europe and Asia, in all elevations, in the low, marshy grounds of this country, and on the Carpathian Alps, at a height of 4476 feet. It belongs to the natural order Polygoneæ*.

The dried root of Bistort is inodorous, and has an austere, acerb taste: its decoction indicates a free acid, by its action on vegetable blues; and we conclude that it is tannin, as it blackens the salts of iron and precipitates gelatine: the tincture of iodine detects fecula; and the muriate of tin throws down extractive. Besides the tannin, fecula†, and extractive, this root contains also some oxalic acid, which throws down a copious precipitate with lime water.

The astringent powers of Bistort root are considerable; and

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* Woodville's Med. Bot. third ed. p. 668, pl. 232. London Dispensatory, art. Polygonum. Richard, Hist. Nat. Med. t. i, p. 502.

† The quantity of fecula is so great, that the poorer classes of the people in Siberia employ it as food, after it has been submitted to decoction in water, to extract the bitter and astringent principle.

applicable to all cases in which simple Astringents are required. The fecula and extractive are disadvantageous in keeping the decoction, and in forming what may be termed an elegant mixture; but the demulcent properties which these confer upon it render it an admirable local Astringent in leucorrhœa and other mucous discharges from the vagina. It is very seldom employed in modern practice, probably from the circumstances to which I have alluded, and partly from the uncertainty of its powers, owing to the modifying influence of soil and climate. Thus, from the formation of a greater proportion of fecula and less tannin in the climate of Iceland, the natives of that bleak country eat the Bistort root both raw and converted into bread.

The dose of powdered Bistort root, the best form in which it can be administered, is from fifteen grains to a drachm. It may be advantageously combined with aromatics.

4. GEUM *Urbanum*. I have already described this plant; therefore it is unnecessary again to enter into any details respecting it. It is seldom employed as an Astringent.

5. TORMENTILLÆ ERECTÆ RADIX. *Tormentil Root.* L. E. D.—This plant, were it an exotic, would be very highly prized for its astringent qualities. It is a very common indigenous, perennial plant, belonging to the natural order Rosaceæ*. The root is thick, oblong, tuberculated, of a dark yellow colour exteriorly and pinkish within; it is inodorous, and has a very astringent, bitter taste, accompanied with a slight aromatic flavour. When distilled in water, it imparts to the fluid the odour of the rose. According to the analysis of Dr. Meissner of Berlin, 1000 grains of the root of Tormentil yield—myricine, 2 grains; cerine $5\frac{1}{8}$; resin $4\frac{1}{4}$; tannin 174; red colouring matter (extractive?) $180\frac{1}{2}$; red colouring matter modified $25\frac{3}{4}$; gum 282; gummy extractive, united with some tannin and a calcareous salt, $43\frac{1}{4}$; extractive, 77; volatile oil, traces; and ligneous fibre and water $206\frac{1}{2}$. Dr. Meissner gives us no idea of the nature of the red colouring matter, or rouge de tormentille, as he terms it; and it is not easy to understand what he means by the two kinds of extractive. The proportion of tannin appears small in reference to its astringent powers. A precipitate is formed of tannin with lime water; and, as this is inert, lime water and chalk mixture are incompatible in prescription with Tormentil root. If it be requisite to combine so useful and powerful an Astringent with the chalk mixture, the Tormentil root should be in the state of powder†.

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* Woodville's Med. Bot. third ed. p. 503, pl. 181. London Dispensatory, art. Tormentil. Richard, Hist. Nat. Med. t. ii, p. 429.

† Except nut-galls and catechu, Tormentil root contains more of the vegetable astringent principle than any other vegetable production; and on this account it is employed in the Orcades in tanning leather.

Decoction is the best form of administering Tormentil. It is chiefly useful in cases, requiring the employment of Astringents, in which there exists an atony of the system:—Leucorrhœa, for example, passive hæmorhages, and diarrhœa unconnected with any source of irritation. It is so little stimulant, that the presence of febrile excitement does not stand in the way of its administration. In stating this, it might be asked in what manner are we to explain its influence in destroying warts? for which a rag dipped in a strong decoction, and laid over the warts, has been successfully used. It is probable that the benefit in this case is derived from the astringency of the decoction acting on the warts in the same manner as on dead animal matter; the vitality of these growths being in a low state, and incapable of resisting the chemical action of the Tormentil. On the same principles may be explained its utility as an injection in polypus of the uterus. The dose of the powdered root is from ʒss to ʒi; that of a decoction, made with ℥i of the bruised root and a fluid pint of boiling distilled water, from fʒx to f℥ii.

* * *Plants.*

1. Lythri Salicariæ Herba. *Loosestrife.* D.—This is an indigenous plant, growing in marshy places, and on the banks of rivers, flowering from June till September, belonging to the natural order Salicareæ*. In its dried state it has an herbaceous, subastringent taste, and evidently contains tannin, from the action of its decoction on the salts of iron. It was formerly employed in diarrhœa and dysentery, in which it was strongly recommended by Stoërck and de Haen; but it has deservedly fallen into disuse, and is retained only in one British Pharmacopœia, that of the Dublin College. It may be administered in powder, in doses of from ʒss to ℈iv, or in decoction, made with two ounces of the root and a quart of water boiled down to one pint, in doses of two or three fluid ounces.

2. Boletus Ignarius. *Agaric.* E.—This fungus grows on the trunks of trees†, especially the oak, from which it may be cut in August and September. In form, the entire fungus resembles that of the hoof of a horse; its colour is reddish-brown; it is thick, fibrous, and very tough. For astringent purposes, it is prepared by cutting it into thin slices and beating these in a mortar until it can be readily torn into small pieces. M. Bouillon la Grange has analyzed the Agaric, and found in it an extractive matter, a small quantity of resin, some ani-

* Woodville's Med. Bot. thrid edit. vol. v, p. 65, pl. 19. London Dispensatory, art. Lythrum.

† Woodville's Med. Bot. third edit. vol. v, p. 808, pl. 273. London Dispensatory, art Boletus. Richard, Hist. Nat. Med. t. i, p. 274.

malyzed matter, hydrochlorate of potassa, sulphate of lime, and, when it was burned or incinerated, phosphate of lime and of magnesia, and some traces of iron.

Agaric is chiefly used on the Continent as an external styptic; but in this country it is scarcely ever employed.

* * * *Barks.*

b. QUERCUS PEDUNCULATÆ CORTEX. *Oak Bark.* L. E. D.—This noble tree, the pride of our forests, from which we derive much of our national importance as a commercial people, and which floats, the bulwarks of our maritime glory, the "knotty, unwedgeable, and gnarled oak of England," belongs to the natural order Cupuliferæ*.

It is curious to trace the history of the Oak. It was held sacred by the Greeks, the Romans, the Gauls, and the Britons. At an early period it was cultivated in Britain as a fruit tree, and the failure of an acorn crop was accounted a cause of famine†. After this period, the acorn was still of great importance to the large herds of swine which constituted much of the wealth of our Saxon ancestry, who felt more the power of tyranny in the conversion of their forests into hunting grounds, than in all the other acts of the Norman Conqueror. Some of the aboriginal Oaks long remained to attest the great age to which this noble tree attains: and some still exist upwards of one thousand years old‡. The size to which the Oak accasionally attains is no less remarkable. It sometimes acquires nearly forty feet in circumference and one hundred feet in altitude§.

This officinal species has been confounded with the Quercus robur, which, however, differs from it in having the fruit or acorns sessile; whereas, in the officinal Oak, they are supported on peduncles, or rather pedicels, from one to two inches long, whence the trivial name *pedunculata*.

Although every part of the Oak is astringent, yet the bark of the smaller branches is the only part officinally used. Oak bark is covered with a bluish-grey epidermis, and is of a pale

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* (Quercus robur) Woodville's Med. Bot. third edit. p. 23, pl. 10. London Dispensatory, art. Quercus. Richard, Hist. Nat. Med. t. i, p. 444.

† Some of the species of Quercus, the Quercus Ilex, and some other species of South American growth, produce acorns which are mild and nutritive; and even the kernels of the common oak might be rendered edible by boiling them in an alkaline ley, were it necessary, in any period of famine, to resort to them as food.

‡ Bull Oak, Wedgenock Park, Warwickshire, is said to be near 1000 years of age: Swicar Lawn Oak is 600 years old: the great Salcey Forest Oak was 1500 years old in 1794; and the Bently Oak was as old.

§ Moccas Park Oak is 36 feet in circumference, at 3 feet from the ground: Cowthorpe Oak, in 1776, measured 78 feet in circumference, 3 feet from the soil: and Damory's Oak, in Dorsetshire, 68 feet.

red colour within. For medicinal purposes, it is peeled in spring; as, at that season, it contains eight per cent. more of astringent matter than in the autumn. The bark is inodorous, and has a rough, astringent taste. The portion richest in tannin has been ascertained, by Sir H. Davy, to be the inner cortical part. He found that ʒi of this part yields 77 grains of tannin; that the cellular integument, or middle coloured part, yields 19 grains only; and the epidermis scarcely any quantity, either of tannin or extractive*. Besides containing *tannin*, and perhaps *gallic acid*, muriate of tin displays also extractive in the decoction†, which is precipitated by lime water, carbonate of potassa, and acetate of lead; but Vauquelin ascertained, what is remarkable, that no precipitate is produced by the solution of tartar emetic, or the infusion of yellow cinchona bark.

Oak Bark is a valuable Astringent, whether administered internally or applied externally; and may be used in all cases requiring Astringents. The best form of administering it is that of decoction; for it can scarcely be reduced to powder. The dose of the officinal decoction is from fʒi to fʒii, twice or three times a day. The Dublin College orders an extract to be prepared by evaporating the decoction: but it is less active than the decoction, perhaps owing to the conversion of the tannin into extractive. The astringency of a strong decoction of Oak Bark, when it is swallowed, is powerfully felt in the stomach, inducing, invariably, cardialgia and spasm when it is given alone: thence its internal employment is seldom resorted to; although it has been used in some of the Continental military hospitals, as a substitute for cinchona bark, in the following combination:

℞ Pulveris Quercus corticis . gr. 120
——— Gallarum . . . gr. 30
——— Gentianæ Radicis gr. 35
——— Anthem. nob. flor. gr. 20
——— Cetrariæ Islandici gr. 5—Misce.

This powder is ordered to be given half an hour previous to the accession of the paroxysm of ague. It is said to have proved successful in many instances; but its bulk is a great objection to its employment, and the large proportion of Oak Bark renders it difficult to be retained on many stomachs.

The external application and topical use of the decoction is more frequent and beneficial than its internal administration. In prolapsus ani, in leucorrhœa, and in uterine hæmorrhage,

* The bark of the Quercus *alba*, of the North American States, contains a much larger proportion of tannin than that of the common Oak. An infusion of ʒss in fʒxii of boiling water, taken in doses of fʒii every third hour, has been found to check ague.

† It is owing to the extractive that the saw-dust of the Oak is employed as a dying material, to impart a fawn colour to cottons.

it may be advantageously used as a lotion and injection; and as a gargle, in those states of the fauces which indicate great relaxation of the mucous membrane.

* * * * *Leaves.*

1. Arbutus Uva Ursi. *Bear's Wortleberry.*—Although, in treating of tonics, the leaves of this plant were mentioned, yet, as an Astringent, several circumstances require to be noticed in this place. According to the analysis of Dr. Meissner, 1000 grains of it contain—12 grains of gallic acid; 29 of tannin, united with gallic acid; 335 of pure tannin; 44 of resin; 63½ of chlorophylle; 33½ of extractive, combined with malate of lime and of soda; 8⅝ of extractive oxydized with citrate of lime; 157 of gum; 176 of extractive; and 156 of ligneous matter and water. But, from the effect of the infusion, produced by simply triturating the leaves with cold distilled water on persulphate of iron, I am of opinion that the proportion of gallic acid is greatly underrated in this analysis. The action of gelatine indicates the large proportion of tannin; and we are equally convinced of the abundance of extractive, from the effect of the addition of muriate of tin to the decoction: oxalate of ammonia demonstrates the presence of lime: but, with the cold infusion, none of these results occur. Carbonate of potassa acts upon it nearly as on a solution of pure gallic acid, except that a slight precipitate takes place; and lime water throws down a gallate of lime—which is a fact of some practical importance.

As an Astringent, Uva Ursi possesses considerable powers: it is taken into the circulation, and may be detected in the urine forty-five minutes after it has been taken; and it is probable that to this circumstance it is found useful in chronic inflammation of the bladder. Mr. Brodie says he has been disappointed in its use in this disease: but I have seen it serviceable in several instances. To the absorption of it, we may also attribute its effects in preventing the formation of urinary calculi in the kidneys. It was introduced into practice for this purpose by De Haen; who, with many others, ascribed its powers to some solvent property. Dr. Cullen referred them solely to the tonic influence of the remedy on the stomach, preventing the formation of acid in that viscus: but, although it certainly possesses no solvent powers, yet, as it enters the circulation, and is excreted by the kidneys, it is very probable that something is to be ascribed to its local influence as an Astringent on the kidney itself, in giving it tone, allaying inordinate action, and, consequently, producing a more healthy secretion and excretion than would otherwise take place in those conditions of the habit favourable to the formation of calculus. Dr. Smith Barton asserts that "it favours the expulsion of

granules of calculi;" an effect that might be ascribed to its diuretic powers, which Alibert regards as its sole quality; "tout se reduit a dire," says he, in summing up its value as a medicine, "que le Raisin d'Ours a une action manifestement diuretique dans certaines circonstances." Its action on the kidney, however, is that of an astringent and a tonic: and, when the cold infusion is used, is chiefly due to the gallic acid which it contains. In this state, it more directly passes into the circulation, and operates as a diuretic: but still, there can be no doubt that some of the benefit derived from it, even as a diuretic, is due to its primary action on the stomach; particularly as it is generally anministered in the form of powder. It is given in powder, in doses of from one scruple to a drachm, or more: in decoction, made with one ounce of the leaves and one pint of water; or in infusion, made by rubbing in a mortar ʒii of the leaves with a fluid pint of distilled water; the dose is fʒi to fʒiv. In this form, I have ordered it with great advantage in hæmorrhages of the bladder and the prostate gland.

* * * * * *Flowers.*

1. Rosæ Gallicæ Petallæ. *Petals of the Red Rose.* L. E. D.—The well-known and elegant flower requires no description: it forms the type of the natural order Rosaceæ*. The unblown buds yield the petals for medicinal use. This Rose has less fragrance than many of the other species of the genus; but the fragrance of the petals is increased by drying; and, what is curious, by the addition of iodine: the taste is agreeably bitter, and slightly aromatic. The odour is communicated to a large portion of water, but no astringency accompanies it; and, therefore, the application of rose-water to inflamed surfaces affords no more relief than that of common distilled water. Boiling water extracts the odour, taste, colour, and astringent properties of Rosa *Gallica*. The infusion shews the presence of a free acid, which is tannin, by its effects on litmus, the sulphates of iron, and gelatine; and muriate of tin, that of much extractive. Mr. Cartier has published an

* The beauty and fragrance of the Rose have given an interest to it in the eyes of every cultivated nation in the world; and, in some Oriental countries, the passion for it extends to a degree of luxurious indulgence that we can scarcely form any idea of in our phlegmatic climate. In Persia, it is common to recline on beds of roses in all their freshness; but the general result of such a voluptuous indulgence is a severe catarrh. Even in Morocco, as Mr. Jackson, in his account of that empire, informs us, the rich odoriferous petals of the Musk Rose are made up in mattresses for the men of rank to recline upon. It is extraordinary that, notwithstanding the permanency of its odour, the Rose furnishes so small a portion of volatile oil. At Lucknow, in Hindostan, where the best attar of roses is distilled, not more than three drachms are procured from a hundred weight of petals, freed from every other part.

analysis of this rose*. He found tannin, gallic acid, a colouring matter, a volatile oil, a fatty matter, albumen, soluble salts with bases of potassa, lime, silex, and oxide of iron. The astringent properties of the petals depends on the tannin which they contain†.

The influence of the petals of this Rose, as a remedial agent, is very moderate; although, at one time, they were in great reputation, and many imaginary virtues were attributed to them. They enter into several pharmaceutical preparations, namely, a conserve or confection, an infusion, a syrup, and a honey. All of these, with the exception of the honey, tend to constipate the bowels. The confection has been much recommended in chronic coughs, in which a gentle tonic and astringent is indicated; and, acidulated with sulphuric acid, in sweating connected with general debility of the system. On the same principle, the confection has been used in diarrhœa, in some passive hæmorrhages, and in leucorrhœa. As a gentle topical Astringent, the infusion, acidulated, is a useful gargle in affections of the fauces, and a collyrium in some species of ophthalmia. The infusion of the confection is an excellent vehicle for the administration of the sulphate of quinia.

* * * * * * *Fruits.*

1. PUNICÆ GRANATI TUNICA BACCÆ EXTERIOR. *Outer Rind of the Pomegranate.* L. D.—The Pomegranate is well known in the conservatories of this country, and is even naturalized to the variable state of our atmosphere: it is a native of those shores which are bathed by the waters of the Mediterranean; thence its name *Punica*, imposed by the Romans, who first saw it in the neighbourhood of ancient Carthage. It is now cultivated in the milder regions of Europe, and in the East and West Indies, where the fruit is both larger and higher flavoured than in the native country of the plant. It belongs to the natural order Myrtaceæ‡.

In England, the Pomegranate seldom grows beyond the magnitude of a shrub. The fruit is mentioned by Theophrastus and Dioscorides under the name of *Roa;* by Hippocrates under that of Σιδιον; and by Celsus, *Punica Malum:* it is about the size of

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* Journal de Pharmacie, t. vii, p. 527.

† A curious effect results from the gallic acid which they contain acting upon iron. If the fresh petals of the Province Rose be beaten to a pulp, in an iron mortar, for some hours, they are converted into an intense black paste, which, being rolled into little beads, and dried, become so hard that they may be polished like ebony. Beads made in this manner are exported from Turkey to Catholic countries, under the name of rose beads or rose pearls, for the purpose of forming rosaries. They retain the odour of the flower.

‡ Woodville's Med. Bot. 3d edit. p. 531, pl. 190. London Dispensatory, art. Punica. Richard, Hist. Nat. Med. t. ii, p. 408.

an orange, globular and crowned with the remains of the calyx. The rind, which is the part employed as an Astringent, is coriaceous, of a reddish-yellow colour, and having a very styptic taste. The pulp which it covers is succulent, contained in cells divided by membranes, and crowded with seeds. It is red, pleasantly acid, cooling and gently aperient. All the other parts of the Pomegranate plant are astringent; and, as an exception to the other individuals of the natural order to which it belongs, the leaves of the Pomegranate contain no volatile oil, but much tannin. The bark of the fruit is called *Malicorium*. The petals are medicinally employed under the name of *Balaustines:* they are inodorous, acerb, and contain a large quantity of tannin: their action on the system is tonic and astringent.

Balaustines afford a red, aqueous infusion, which the sulphates of iron blacken. The infusion has been employed with great advantage as a gargle in relaxation of the uvula and inflammation of the fauces; and is internally administered in chronic diarrhœa. In the last-mentioned disease, Balaustines have been given in the form of powder, suspended in mucilage of quince seed; or the decoction, in conjunction with the same mucilage, may be exhibited as an enema. The bark of the fruit possesses the same astringent properties as the *baulaustines*, but in a higher degree; and communicates its properties to water. From the deep black-blue which it strikes with the sulphates of iron, and the slight precipitate which it affords with gelatine, it is supposed to contain more gallic acid than tannin. According to the analysis of Mitouart, it contains tannin, gallic acid, wax, and a saccharine substance, one part of which is soluble in alcohol and crystallizable, the other soluble in water. The decoction is precipitated by carbonate of potassa, but not by pure potassa; thence, if an alkali is requisite to be given with either pomegranate bark or balaustines, the pure alkalies must be employed. Lime water precipitates the decoction; and, owing to the tannin which it contains, it is also precipitated by sulphuric acid copiously, and muriatic slightly, but not by nitric acid.

The bark of the Pomegranate is a remedy of great antiquity in chronic diarrhœa, and in the protracted stage of dysentery. Locally employed, it forms a useful injection in leucorrhœa when no inflammatory symptoms are present, and as a gargle in relaxation of the uvula and fauces. The best form of administering the Pomegranate Bark is decoction, made with ʒiv of the powdered bark in f℥vi of water.

In Hindostan, where the Pomegranate was introduced from Persia, the bark of the root has been long medicinally employed as a remedy for the expulsion of tape worm; and, according to M. Deslandz, the negroes of St. Domingo use it for the same purpose. If the accounts that are given of it be correct, it is surprising that it has not been long since introduced into this

country*. It has been lately admitted into the list of Materia Medica of the Dublin College. This bark is of a yellow colour within and an ash-grey on the exterior. On analysis, it yields the same principles as the Malecorium. It may be administered, in the form of powder, in doses of eight grains to a scruple, twice or thrice a day. In India, the decoction is made by boiling ʒii of the bark, in a pint and a half of water, down to fʒix, of which fʒii are given every half hour, until the worm is expelled, which generally occurs in twelve hours after the first quantity has been administered. It is the bark of the root of the wild Pomegranate which is generally employed; but M. Pichonnier asserts that the fresh root of the cultivated plant is equally efficacious. The strong decoction appears to excite considerable nausea, but experience has proved that there is no necessity for making it so strong. In many instances, even in weak doses, it causes griping. It also acts on the nervous centres, producing vertigo, tremblings, and the sensation of intoxication, with weariness in the thighs and legs, and other symptoms indicative of a poisonous quality in the bark. Mr. Breton† mentions that he placed live tæniæ in the decoction of the bark of the Pomegranate root, and also in a mixture of the powder of the root in water, and observed that "the instant they (the tæniæ) were plunged in these preparations, they writhed, and otherwise manifested great pain, and died in the space of five minutes." That their death, in these cases, arose from the influence of the bark, is evident, as these worms live several hours after expulsion, when kept in plain tepid water. It is not, however, easy to say how much of this effect is due to the astringency of the bark. It possesses chemical properties different from those either of Balaustines or the Malecorium. If it is moistened with a little water and rubbed upon paper, it leaves a yellow trace, which passes to a deep blue when touched with sulphate of iron: these traces, moistened with an acid, acquire a rose tint, which soon disappears, leaving a dull brownish-yellow colour. If experience shall confirm its efficacy in tape worms, this bark will soon supersede the use of the essential oil of turpentine, the intoxicating effects of which, when taken in the dose necessary to expel tæniæ, is a great objection to its employment.

2. Pruni Spinosæ Fructus. *The Sloe.*—This is one of the few fruits indigenous to our climate. The plant is a shrub, common in hedge rows, flowering in March and April, before the leaves appear. It is arranged in the natural order Amygdaleæ‡. The fruit is a drupe, about the size of a large pea, of

* Celsus informs us that the ancients used it as a vermifuge.—De Medicina, lib. iv, § xvii.

† Medico-Chirurg. Trans. vol. xi, p. 301.

‡ Woodville's Med. Bot. third edition, p. 518, pl. 186. Richard, Hist. Nat. Med. t. ii, p. 441.

a black colour, covered with bright blue bloom. It has a sharp, austere taste.

As an Astringent, the Sloe was employed in the time of Dioscorides, and is still used as a domestic remedy, although it has been rejected from the Pharmacopœias. It has one advantage over many other substances in this class of remedies: it exerts no stimulant influence, and, therefore, may be administered even when inflammatory symptoms exist. It has been recommended in diarrhœas, especially in those of a chronic character, such as are often brought on in India; in hæmorrhages, and as a topical Astringent in enlargements of the tonsils and relaxation of the uvula. It was formerly administered as a conserve; but the inspissated juice of the unripe fruit, or a tincture in proof spirit, is preferable. The inspissated hardened juice may be given in powder, in doses of from eight grains to a scruple, three or four times a day.

* * * * * * * * *Vegetable Secretions.*

1. KINO. L. E. D.—The Kino, originally introduced into the list of Materia Medica of the British Colleges, came from Africa; and, from a specimen sent home by Mungo Park, it has been ascertained to be the juice of a species of Pterocarpus, which De Candolle has described in the Encyclopédie Methodique, under the specific name *Erinacea**. The London College, overlooking the fact that scarcely any of this kind of Kino is now found in the market, has designated this plant, in their Pharmacopœia, as the source of Kino. The Edinburgh College, in its Pharmacopœia, has put down Kino as the production of the Eucalyptus *resinifera*, a tree which is a native of New Holland and Van Dieman's Land, belonging to the natural order Myrtaceæ: its juice resembles Kino in many respects, and even in the effect of reagents upon it. It exudes spontaneously from the tree, in the manner of some gums, and is inspissated in the sun. It differs from Kino in being less easily pulverized; in adhering to the teeth when chewed; and in gelatinizing in the tincture.

The Dublin College formerly considered Kino as the production of the Butea *frondosa*, a native of the coast of Coromandel; but the red juice of this plant is certainly not Kino; and the Dublin College, convinced of this, has left the plant unnamed.

The greater part of the Kino now found in commerce is the inspissated juice of the Nauclea *Gambir*, an Indian plant, belonging to the natural order Rubiaceæ†. The Kino is neither

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* Woodville's Med. Bot. third ed. vol. v. p. 44, pl. 12. London Dispensatory, art. Kino.

† Linnæan Trans. vol. ix.

a gum nor a resin, but a dry extract, prepared from the leaves and the young twigs of this Nauclea, which are boiled in water for an hour and a half, and the decoction repeated with fresh quantities of water: these combined decoctions are next inspissated to the consistence of honey, then poured upon plates, and, when it is sufficiently solidified, the cake is divided into small portions, and the drying completed by exposure to the sun, taking care to turn the mass regularly and frequently. Another process consists in infusing the leaves and young twigs for some hours in water: the infusion, when inspissated, forms a feculent deposit which is moulded into little cakes. These are very rarely found in the European market; but the first preparation is brought home in considerable quantity.

The *East India Kino*, the production of the Nauclea *Gambir*, is sometimes in irregular masses, dry and brittle, dividing readily into smaller pieces: sometimes it is in small brittle fragments, apparently the larger masses broken down, of a deep uniform claret-brown colour, shining and breaking with a vitreous fracture, exhibiting sometimes small cavities in the interior of the pieces. The colour and exterior aspect of this Kino varies in the different parts of India where it is made. Hunter says that that made in Sumatra and on the coast of Malabar is lighter coloured than that which is made elsewhere. It is easily pulverized, and affords a powder of a brown chocolate hue. When in the solid state, this species of Kino is inodorous; but, when dissolved in boiling water, it exhales a slight bituminous odour; when chewed, it scarcely colours the saliva, and has a slightly bitter, astringent taste.

The *New Holland Kino* is procured by wounding the Eucalyptus *resinifera*, and allowing the exuding juice to dry in the sun. It is bitterish and astringent to the taste, breaks with a glassy fracture, and affords a brown-coloured powder.

As scarcely any *Jamaica* or *African* Kino can be procured, it is unnecessary to describe these varieties*.

All the varieties of Kino are more soluble in hot than in cold water; and, in cooling, the solution lets fall a precipitate, which agglutinates into masses that can be softened by heat. This residue of the aqueous decoction is insoluble in alcohol and cannot be fused by heat. Alcohol dissolves nearly the whole of the *East Indian Kino*, forming a deep claret-coloured tincture which is not resinous, and is not rendered turbid on the addition of water. It is also very soluble in ether; and the solution, when poured on water, leaves no pellicle on its surface. The *Botany Bay Kino* yields only two parts in three to alcohol, and forms a deep brown tincture. Ether dissolves about one twentieth, and forms a brownish straw-coloured solution, which leaves a thin

* Both are described in the London Dispensatory, art. Kino.

resinous pellicle when it is evaporated in water. The solutions of Kino are affected by the reagents which demonstrate the presence of tannin in other astringent vegetable solutions; but the results demonstrate that the tannin exists in a particular state. Thus—*gelatine* throws down a precipitate of a rose colour; *persulphate of iron* strikes a deep green hue, and the precipitate is unalterable in the air; *permuriate of mercury* throws down a reddish precipitate. The alkalies merely deepen the colour: but copious precipitates are thrown down by their carbonates: all the *mineral acids* produce brown precipitates.

I might here mention the analysis of Vauquelin; but it was made with the Kino, not generally found in the shops, obtained from the Coccoloba *uvifera*, a tree growing in Jamaica. In chemical properties, however, all the varieties of Kino so far accord, that we may safely pronounce their constituents to be tannin, extractive, and a peculiar principle insoluble either in water or alcohol. The Kino of the Eucalyptus *resinifera* most resembles that now generally found in commerce.

Kino is a valuable Astringent in all cases that require the aid of Astringents; although Dr. John Davy maintains that it possesses little power on the animal œconomy when given alone. It was introduced into medicine by Dr. Fothergill, on account of its astringent properties; it is employed in diarrhœas when they are kept up rather by general relaxation of the intestinal canal than by irritation of the mucous membrane. It is said to be less effective than catechu; but this is not in accordance with my experience; and I cannot readily perceive upon what ground it should not be at least an equally useful Astringent. Dr. Pemberton recommends it highly, in combination with opium, in Pyrosis. The opium of itself relieves the pain and spasmodic part of the attack; and the Kino, in giving tone, consequently allays irritability. Dr. Pemberton prefers it to other vegetable Astringents, "because," says he, "in this drug you have a medicine which exerts its power to restrain the discharge of the glands, when they are secreting too much, without exerting any such powers on the glands when they are acting naturally." Without criticising too closely the hypothetical nature of this explanation, there is no doubt of the efficacy of this application of Kino and its use in dyspepsia. It may be administered either in substance or in infusion or tincture. The dose in substance is from gr. x to ʒi, that of the infusion f ʒxii, and of the tincture made with proof spirit f ʒi. In prescribing Kino, it should be known that the alkalies destroy its astringency, and that it differs from some of the other vegetable Astringents in throwing down precipitates with bichloride of mercury as well as with tartrate of antimony and potassa.

The local and external employment of Kino has been much neglected in this country and in Europe. Its peculiar proper-

ties adapt it for many cases of local affections: for gargles in relaxation of the uvula, and as a dentrifice, in combination with charcoal, in a spongy state of the gums. The Malays apply it externally to cure burns and other abrasions of the skin; and I can bear testimony to its utility, when employed as a styptic, to give tone and to diminish the ichorous discharge of flabby ill-conditioned ulcers. In some respects, in these cases, the tannin operates nearly in the same manner as on dead animal matter, by coagulating the albumen and forming a kind of covering from the air; whilst, at the same time, its tonic influence on the living system tends to counteract that state which is always the attendant, if not the predisposing cause, of gangrene. Were Dr. Pemberton's view of the action of Kino correct—namely, that "it contracts a vessel too much relaxed, to its natural standard, but that it is unable to contract it any farther," it might be most advantageously employed in gleet. But the remark requires to be more narrowly examined before it can be implicitly acted upon.

2. CATECHU. L. E. D.—This is a substance which was originally brought from Japan; and, being regarded as an earth, was called Terra Japonica. It is now imported from Bengal and Bombay, and is known to be an extract of the wood of the Acacia *Catechu*, a tree of the natural order Leguminosæ*. It is a solid, brownish, infusible substance, very astringent, and heavier than water.

The whole of the tree yields Catechu; but it is prepared only from the chips of the interior hard, brown, or heart wood. These are boiled in water; the decoction evaporated, and, finally, inspissated in the sun until it is brought to a considerable thickness, when the mass is spread out on a mat, previously covered with the ashes of cow's dung; and being divided into square pieces by means of a string, these are gradually hardened†. It has been stated by Dr. Duncan, and is generally believed in Europe, that another species of Catechu is procured, in Mysore, from the areca nut; But Dr. Wallich has informed me that this is a mistake, and that all the other kinds are the productions of other species of Acacia‡.

Catechu is imported into this country from Bengal and Bombay. The varieties are distinguished as pale and dark.

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* Woodville's Med. Bot. 3d edit. p. 433, pl. 157. London Dispensatory, art. Catechu. Richard, Hist. Nat. Med. t. ii, p. 537.

† Mr. Kerr, who first gave the public correct information on the origin of the Catechu, says that the name is a compound of two Oriental words, *Cate*, which signifies a tree, and *Chu*, which signifies juice.

‡ In South America, a substance is procured from the Cinchona *excelsa*, which closely resembles Catechu. It is also well known that a species of tannin, termed *Bablah*, is prepared in Upper Egypt from the pods of the Acacia Arabica. Indeed, almost all the beautiful and extensive family of Acacia yield tannin.

The first kind, pale Catechu, is generally in small square cakes, of a pale, reddish-brown colour; light and friable; breaking with a rough fracture; its taste is at first bitterish and astringent; but, after being chewed for a short time, it leaves a sweetness on the palate. The second kind, or dark Catechu, is generally in balls, or roundish masses, having an iron-rust colour externally, and a deeper colour within, often streaked or marbled. It is less bitter than the pale kind, and leaves more sweetness on the palate. The third sort is in larger and more irregular masses than the other two kinds; and is frequently covered with leaves. The colour is a deep chocolate or black; the fracture shining and resinous. The taste of this species is bitter and astringent like the first, and impresses the same sweetness on the palate as the two other kinds. I am of opinion that these diversities depend on the mode of preparation, and that all the kinds are mere varieties of the same substance. Catechu is also distinguished by the name of the Presidency whence it is exported; as, for instance, Bengal and Bombay Catechu. The former is lighter than the latter, its sp. gr. being 1.28; and that of Bombay 1.39.

Sir Humphrey Davy examined the chemical properties of Catechu, and found that very little difference exists between the varieties. 100 grains macerated in 18 ounces of water, left $7\frac{1}{4}$ grains only undissolved; and these were impurities, consisting of carbonate of lime, aluminous earth, and sand. The solutions of Catechu vary in colour according to the variety from which they are made; all of them are inodorous, slightly redden the tincture of litmus, strike a deep green with persulphate of iron, but scarcely affect the protosulphate, and throw down copious precipitates with gelatine and concentrated sulphuric and muriatic acids, alum, nitrate of potassa, sulphate of magnesia, acetate of lead, tartar emetic, and several neutral salts. When the fine powder is washed, until the water, which comes off no longer, precipitates gelatine, what remains is extractive. It is of a pale reddish-brown colour, inodorous, and impressing a slightly astringent, sweetish taste on the palate. The aqueous solution of this extractive does not redden the tincture of litmus; thence the effect of the solution of the entire extract on this vegetable colour is due to the tannin: it renders the persulphate of iron green, throwing down a precipitate which becomes black on exposure to the air. From the effect of these reagents, it is evident that this is not pure extractive; and there is also some reason for believing, with Dr. Bostock, that Catechu contains gallic acid in small quantity. Alkalies and the carbonates destroy the astringent property of Catechu. According to the analysis of Sir H. Davy, the constituents of Catechu are of

Tannin, in Bombay Catechu,	109;	in Bengal, 97
Extractive . . .	68 . .	73
Mucilage . . .	13 . .	16
Impurities . . .	10 . .	14
	200	200

The mucilage may be separated by digesting the Catechu in strong alcohol, which takes up the extractive and tannin, and leaves the mucilage. The alcoholic solution is not precipitated by water.

As an astringent remedy, Catechu is one of the most valuable for internal administration. As the dark-coloured or Bombay Catechu contains most tannin, it is the best for medicinal use. It is proper in all cases in which the employment of Astringents is indicated; particularly in cases of chronic diarrhœa. As a local remedy, it is almost specific in those relaxations of the uvula which, from the irritation excited by the lengthened organ irritating the glottis, are attended with a teasing cough. This has not only been mistaken for phthisis, and treated accordingly, but, from the continued irritation kept up by it in habits predisposed to tubercular consumption, has been the exciting cause of that intractable and hitherto fatal disease. In the hoarseness of relaxation to which almost all the public singers are liable, nothing is more useful than Catechu. It is scarcely necessary to say that, in all cases attended with inflammatory symptoms, Catechu ought not to be prescribed. Its tonic powers are considerable; and in dyspepsia, attended with relaxed bowels, I know of no better remedy.

In diarrhœa, and similar diseases, Catechu may be given in infusion, combined with opium and aromatics; but, when it is to be given in combination with chalk mixture, or with opium, the infusion is a bad form of preparation; and the powder should be used. This is particularly to be attended to in prescribing tincture of opium, or any of the salts of opium, as with Catechu an insoluble tannate of morphia is thrown down. Emetina is precipitated when ipecacuanha is prescribed in aqueous solutions of Catechu; and as the emetina is the active principle of the ipecacuanha, and is thrown down as an inert tannate, they should never be prescribed together. The tincture, being free from mucilage, is more astringent than the infusion, and should be preferred to it when the nature of the case does not forbid the use of spirits. I need scarcely repeat that alkalies are incompatible with Catechu.

The London and Edinburgh Colleges order a compound infusion of Catechu with cinnamon bark; but the oil as an oleosaccharum would be a preferable addition. Both these Colleges also order a tincture into which cinnamon enters; and

here it is less exceptionable. The electuary ordered by the Edinburgh and Dublin Colleges contains opium, the utility of which may be questioned, particularly if the electuary be given in solution.

The dose of Catechu, in substance, is from gr. x to ʒi, or more: that of the officinal infusion, from fʒx to fʒii; and that of the tincture from fʒss to fʒii.

GALLÆ. *Galls.* L. E. D.—The leaves of the oak, of every species, display small excrescences on the petioles, produced by an insect, the Cynips *Quercifolii*, *Diplolepsis Gallæ tinctoriæ* of Geoffroy and Olivier, which wounds the part and deposites its eggs in the puncture. It is a small hymenopterous fly, with a fawn-coloured body, dark antennæ, and the upper part of the abdomen of a shining brown. The ovipositor, as it is termed, of the female, is long, slender, articulated, and so flexible that it is rolled up spirally, and concealed within the abdomen, when the insect is not using it: but it is so admirably constructed that it can be made stiff and firm at the pleasure of the insect. With this little instrument the insect punctures the leaf-stalk of the oak-leaf, and deposites, in the puncture, an egg too small to be seen by the naked eye, and probably, also, a drop of some irritating fluid. In a few hours, the irritation which is induced in the part causes an afflux of fluids to it: the Gall rises, and, in a day or two, attains its full size. It is puzzling to conceive how the insertion of so minute a body as the egg of the cynips should cause so singular a divergence from the ordinary growth of the part. The simple puncture, and the mere mechanical irritation, are not sufficient to explain the phenomenon in a satisfactory manner: I am, therefore, disposed to think that some acrid secretion is injected from the ovipositor along with the egg, which, acting locally, like any other acrid lymph which, in the animal body, produces a specific local change in the structure of the part, is the chief cause of the irritation. Not the least singular circumstance is the rapidity of the growth of the Gall, which, however large, attains its full size in a couple of days: and this is another reason for supposing that there is some fluid injected along with the egg, as the larva is not yet hatched. After a certain period, the egg enlarges, the larva is hatched, and, deriving its nourishment from the Gall, after some time, it eats its way out of its prison; which then becomes lighter, and contains much less of the astringent principle: the Galls, therefore, that have a hole in them, are less valuable than the entire Galls. The best Galls are gathered before the fly has issued from them; and from Galls of this kind the most perfect specimens of the insect are frequently procured*.

* A different insect, a species of the genus *Chalcis*, is also sometimes found in the Gall-nut; but this is the larva of a parasitic fly, which punctures the Gall in its green state, deposites its egg in the body of the larva of the Gall-fly, and destroys it.

The Oak on which the best Galls are formed is the Quercus *infectoria*, a small tortuous tree, a native of Asia Minor, which is well described by Olivier*. Never more than one ovum is deposited in the Gall; this fœtal habitation being what entomologists term monothalmous.

The best Galls are those of Aleppo, Smyrna, Magnesia, and Natolia: they are termed *black*, *green*, or *blue*, Galls: those through which the insect has eaten its way out, are called *white Galls*. The Galls formed on the Quercus *Robur*†, *Cerris*, and other species of Oak in this country, are small, smooth on the surface, polished, reddish, and are not used‡.

Galls are nearly globular in their form, varying in size, from that of a pea to that of a large hazel nut; and studded with tuberosities: they should be of a blackish-blue, or very deep olive colour, heavy, compact, brittle, breaking with a flinty fracture, and their internal structure crystalline. They yield the whole of their active matter to water; the residue being inert and insipid. Alcohol also takes up a considerable portion of the active principle. They contain a large quantity of tannin and perhaps gallic acid. The aqueous infusion reddens litmus. Sir H. Davy found 130 grains of tannin, 31 grains of gallic acid§ and extractive, 12 of mucilage, and 12 of saline and earthy matters, in 500 grains of Galls: but Royer states that he obtains 125 grains of pure gallic acid from 500 grains of the Galls: but Dr. Duncan thinks that Sir Humphrey has estimated the quantity of tannin too low: in one experiment, with 500 grains of Gall-nuts, Duncan obtained 220 grains, and, in another, 256 grains of soluble matter. Braconnot has discovered in Galls a new acid, which he has called *Ellagic*, a word derived from reversing the word *Galle*, in French, and adding the syllable *ic*—a singular and whimsical innovation in nomenclature. This acid possesses peculiar properties, is insipid, inodorous, white, with a slight tinge of red; and is insoluble in boiling water, on which account it is readily separated from gallic acid in the process of obtaining it. When ellagic acid is mixed with nitric acid, and gently heated, the mixture acquires a red hue, and ultimately becomes blood-red: it is owing to the presence of this acid, therefore, that nitric acid, added to the infusion of Galls and of oak bark, produces a blood-red colour. In the infusion of Galls, the application of heat causes the partial decomposition of the nitric acid,

* Woodville's Med. Bot. third edit. p. 23, pl. 10. Richard, Hist. Nat. Med. t. i, p. 444.

† Olivier, Voyage dans l'Empire Ottoman.

‡ Some Galls, on other plants, are formed by beetles; such, for example, is that formed on the wild mustard, Sinapis *Arvensis*, by the Curculio *contractus*. Others are formed by Tipulæ, as those on the ground ivy and wild thyme; and some by other insects.

§ Pelouze imagines that the gallic acid results from some change produced on the tannin by the process; and does not exist ready formed in the Galls.

nitrous fumes are emitted, and both the gallic and the ellagic acids are converted into the oxalic acid.

In preparing Galls for medicinal purposes, it is of importance to obtain the astringent matter as free from the other ingredients with which it is combined as possible: the Galls should, therefore, be simply infused in distilled water, of a temperature not exceeding 180°: this takes up little more than the tannin; but when the Galls are boiled, the tannin is oxidized and partly converted into a *tannate of starch*, which precipitates as the decoction cools*.

The incompatible substances with infusion or decoction of Galls are very numerous. Many substances form precipitates with these preparations besides those which indicate the astringent character of the Galls. Thus they are precipitated by infusion of cinchona, cusparia, and calumba root; solutions of opium, lime water; carbonate of potassa; the acetates of lead; sulphates of copper and of iron; nitrate of mercury and of silver; and tartrate of antimony; all of which are, therefore, incompatible in prescriptions with it. The sulphuric and muriatic acids produce flaky, white precipitates: nitric acid changes the colour, first to deep orange and then to pale orange or yellow; and the astringency of the infusion is also greatly weakened. Although the nitrate of mercury throws down a clotted, bright yellow precipitate, yet the bichloride, which is more likely to be ordered, in conjunction with the infusion of Galls, only renders the infusion milky. It is curious that so copious a decomposition of tartar emetic should take place on the addition of the solution of that salt to infusion of Galls, when no precipitate is produced in decoction of oak bark. No precipitates are thrown down with infusions of quassia, gentian, canella alba, orange peel, saffron, ammonia, sulphate of zinc, and bichloride of mercury, which may, therefore, enter into prescriptions with infusions of Gall-nuts. By distillation per se, Galls have been found to yield a concrete volatile oil, which Professor Branchi, the discoverer, regards as a component of Galls: but I am inclined to consider it the production of the operation†.

As an Astringent, Galls possess all the properties which can be expected from medicines of an Astringent character; they are, nevertheless, seldom used as internal medicines in this country. They enter the circulation, but produce a primary styptic influence upon the stomach, which, when the dose of the medicine is large, greatly incommodes the organ: thence, when internally administered, they are generally combined with other substances. In combination with aromatics, they are used in

* The infusion in cold water is a very delicate test of the presence of iron in any liquid; and it is also an excellent test of the presence of morphia.

† A solution of Galls in ether is the most delicate test of the presence of salts of iron.

India for curing intermittents; and have succeeded in cases in which the cinchona and sulphate of quinia have failed. As an external application, in the form of gargles, in relaxations of the fauces, in that of lotions, in leucorrhœa and similar discharges, and even as ointments, their use is most extensive. A tincture is ordered by the Edinburgh and Dublin Pharmacopœias, which may be regarded chiefly as a spirituous solution of tannin: it is a powerful Astringent. The Unguentum Gallarum of the same Pharmacopœia is an objectionable preparation. The Powder is certainly the best form of administering the medicine. The dose may be from gr. x to ℈i. It is almost unnecessary to remark, that Galls ought not to be powdered in an iron mortar.

Ruspini's Styptic, one of those medicines termed Patent, the preparation of which is kept secret, owes its powers to gallic acid. Whilst we may declaim against the principle which has withheld the formula from the public, we cannot deny the value of this preparation as a powerful astringent. I have often witnessed its influence both as an internal or general astringent, and in checking the most obstinate bleedings from leech bites in children, after all other things had failed. This styptic consists of gallic acid, a small proportion of sulphate of zinc and of opium, dissolved in a mixture of alcohol and rose water. In proof of this, the same reagents which affect Ruspini's Styptic, affect, nearly in the same manner, a simple solution of gallic acid in weak alcohol. It yields a bluish grey precipitate with lime water, which is redissolved by an excess of the lime water, and acquires a reddish hue: and it strikes a beautiful deep blue with the mixed sulphates of iron. As the quantity of sulphate of zinc and of opium is too small to influence the medicine, a simple solution of gallic acid in diluted alcohol will answer all the purposes of this celebrated and expensive styptic.

b. HEMATINE.—This substance, which cannot be regarded as a simple principle, was discovered by Chevreul. It is obtained in white, reddish, or pink crystals, which are inodorous, bitter, acrid, and astringent, soluble in water, but not in strong alcohol. Sulphuric acid and hydrochloric acid change the colour of the solution to yellow; nitric acid produces a yellow, which at last passes into red. Phosphoric, carbonic, acetic, and tartaric acids also produce a yellow colour in the solution; boracic a red; the mineral acids a reddish-purple, but, in excess, a violet-blue, which changes to a dull red, and finally to brownish-yellow, and the Hematine is decomposed. If sulphuretted hydrogen be mixed with the solution of Hematine, it produces a yellow colour, which disappears in the course of a few days. Gelatine throws down reddish floculi in the solution.

Chevreul procured Hematine by digesting logwood in water at 125° Faht. for several hours, then filtering the solution, and digesting the residue procured by evaporation in alcohol of sp.

gr. 837 for 24 hours. This alcoholic solution, filtered and concentrated to the consistence of an extract, is to be again dissolved in a small quantity of water, then evaporated in a gentle heat, until the solution become sensibly thick: it is then to be redissolved in distilled water, and left to crystallize. The crystals are to be washed in alcohol, dried on bibulous paper, and preserved in well-stopped phials.

HÆMATOXYLON* CAMPECHIANUM. *The Logwood Tree*, L. E. D.—is a native of South America, growing abundantly in the Bay of Campeachy, whence it derives its specific name. It belongs to the natural order Leguminosæ†. The wood is imported into this country chiefly as a dye stuff. It is hard, and susceptible of a fine polish; is of a deep reddish-brown colour, inodorous, and impressing a sweet taste on the palate.

The astringent and the colouring principles of Logwood are given out both to water and alcohol. The aqueous decoction is of a deep red-purple colour: it exhibits some singular effects on reagents, which are partly owing to the tannin and extractive it contains, partly to the Hæmatine. Persulphate of iron strikes a deep bluish-black, and slowly forms a precipitate of the same colour; sulphate of copper throws down a copious brownish-black precipitate; acetate of lead, a reddish black; the mineral acids produce slight reddish brown precipitates; the alkalies merely deepen the colour of the decoction; alum throws down a copious purple precipitate; lime water a deep purple. The aqueous solution of the extract ordered in the Pharmacopœias, forms precipitates with the solution of tartrate of antimony and potassa, and of sulphate of magnesia; thence both these and the reagents which form precipitates with the decoction are incompatible in prescriptions with it and the extract.

Such are the chemical properties of Logwood: as a remedial Astringent, it is mild in its action. It has been found useful in chronic diarrhœa, and in giving tone to the system in convalescence from dysentery. In the cholera of infants, the infusion is beneficially administered, in doses of a table-spoonful every third hour. Like some other vegetable infusions, containing colouring matters in combination with extractive, it passes through the kidneys, and may be detected by alkalies in the urine. It is almost unnecessary to say that, in prescribing Logwood as an Astringent, the decoction and the extract ought not to be united with chalk mixture, nor with lime water.

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* The genus Hæmatoxylon derives its name from the colour of the wood of this its only species, from the two Greek words αιμα and ξυλον, of which it is compounded, signifying *blood tree*.

† Woodville's Med. Bot. third edition, p. 455, pl. 163. London Dispensatory, art. Hæmatoxylon. Richard, Hist. Nat. Med. t. ii, p. 529.

The dose of the extract in substance is from gr. x to ʒss, that of the decoction from fʒiss to fʒiii.

** INORGANIC PRODUCTS OPERATING AS TONIC ASTRINGENTS.

These are chiefly acids and metallic salts.

Acids.

1. SULPHURIC ACID. *Acidum Sulphuricum.* L. E. D.—For medicinal purposes, as an Astringent, this acid requires to be largely diluted. In the proportions ordered by the London College, there should be eighty grains of the strong acid in one fluid ounce of the diluted acid; but these proportions vary according to the specific gravity of the acid employed—a fact which is too little attended to in making the diluted acid. The sp. gr. of the strong acid should be 1.845, and when it is weaker, it should be boiled in a flask, to dissipate the water and to bring it to this strength, before the diluted acid be made. The strong acid always contains a small quantity of sulphate of potassa, derived from the nitrate of potassa employed in manufacturing it; but sometimes sulphate of potassa is added to weak acid to increase its specific gravity. This fraud may be detected by testing with solution of Muriate of Baryta, and the quantity of the sulphate saturating a given quantity of the acid with ammonia, and then exposing the mixture, in a crucible, to a red heat: the sulphate of ammonia, being volatile, is expelled, whilst the sulphate of potassa is left in the crucible. As a medicinal agent, the acid is not injured by the small quantity of sulphate of potassa which it obtains in the preparation of the acid; nor is the salt of lead, which it also contains, any detriment; for as the acid cannot be administered in an undiluted state, the sulphate of lead is never retained in the diluted acid. Indeed the best mode of purifying sulphuric acid is to dilute it, and then to distil off the water from the decanted diluted acid. It should always be permitted to cool before the diluted acid be decanted from the precipitate.

The diluted acid is administered, in doses of from m. vi to m. xxx, or more, in fʒiss of water, or infusion of roses, or infusion of confection of roses, or in the same quantity of mucilage of acacia gum, or in any bitter infusion, to operate as an Astringent. In same cases—as, for examble, malignant erysipelas with a tendency to hæmorrhage—it may be carried to any dose that the patient can bear. I have given it to the extent of fʒss, in the space of twenty-four hours, in uterine hæmorrhage. Its action as an Astringent is not easily comprehended without referring to its operation as a local stimulant: when diluted sulphuric acid is locally applied to any part of the body, it contracts and condenses the living fibre; and it is in part by this action ex-

erted on the circular fibres of the blood vessels, into which it enters, that it operates in checking passive hæmorrhages: at the same time we must allow that its tonic influence on the stomach is extended to the whole habit; but this alone would be scarcely adequate to produce its astringent effect. There is no foundation for the opinion of Boerhaave, that this diluted acid coagulates the fluids when taken into the system.

Diluted sulphuric acid is prescribed in both active and passive hæmorrhages. In the former, it is given more largely diluted, and is supposed to act chiefly as a refrigerant; by lessening febrile excitement, allaying thirst, and diminishing vascular action: in the latter, by its tonic and astringent power. When combined with mucilage of acacia gum, it has been beneficially given in passive diarrhœas, which it checks by operating on the relaxed mucous coat of the intestine as an Astringent. In some individuals, however, it has an opposite effect in every state of the system, producing violent gripings and purging; which, however, may be moderated by the addition of aromatics and of opium. In using opium, it must be recollected that this acid, by uniting with the morphia, renders the opium more powerful as an anodyne. As a gargle, in combination with infusion of roses, it is a useful Astringent in relaxation of the uvula and fauces, in salivation. As it is injurious to the teeth, it should be sucked through a quill, when given in large doses.

It might be supposed that it could not, with propriety, be combined with some vegetable Astringents; for instance, Kino and Catechu; but in the degree of dilution in which it is employed as a medicinal agent, there is no objection to such combinations.

2. ACETIC ACID. *Acetic Acid.* L. E. D.—This Acid, in its pure and highly concentrated state, is colourless, limpid as water, highly volatile, exhaling a pungent, agreeable odour, and so acrid that it cannot be tasted: when applied to the skin, it inflames and blisters the part. When it is much concentrated, it takes fire at a high temperature in the open air. The sp. gr. of the most concentrated that can be procured is 1.063; but it is rarely obtained of a greater strength than that which indicates a sp. gr. 1.043. In this state, it consists of 23.67 of anhydrous Acetic Acid + 76.33 of water in 100 parts. It crystallizes when cooled down to a temperature of 28° Faht., and remains solid until the temperature rise to 50°; but it melts again and remains fluid at 40° Faht., unless a crystal of the acid be thrown into the fluid, when crystals instantly dart out from it on all sides, and the whole assumes the solid form. It crystallizes beautifully under a compression of 1100 atmospheres. The composition of the anhydrous acid, which exists only in dry acetates, is 3 prop. of Hydrogen (1 × 3) = 3 + 4 of Carbon (6 × 4) = 24 + 3 Oxygen (8 × 3) = 24. Equivalent 51.

Acetic Acid can only be procured from the dry acetates, or by means of charcoal. If acetate of soda be employed, it is to be decomposed by sulphuric acid; and the whole, being put into a retort, must be distilled. The acid thus procured readily crystallizes. When it is to be obtained by means of charcoal, according to the process invented by Lowitz, the charcoal must be put into a crucible, and, a cover being fitted, it should be brought to a red heat; and, when cold, mixed with common vinegar to the consistence of a paste, and distilled by a gradually raised fire. At first, an acidulated water comes over, which must be rejected; after which, the joints of the apparatus being well luted and the heat increased, the acid comes over in a concentrated, crystalline form.

Acetic Acid is also procured from the distillation of wood*. An impure, dark-coloured acid, containing tar and an empyreumatic oil, is first obtained: this is mixed with lime, which takes up the Acetic Acid and leaves the tar and oil; an acetate of soda is formed by decomposing this acetate of lime with sulphate of soda, and is purified by fusion in a high temperature insufficient to decompose the salt. The acetate of soda is lastly decomposed by sulphuric acid, which sets free the Acetic Acid.

Strong Acetic Acid oxidizes iron, zinc, copper, nickel, and tin. It readily combines with all the metallic oxides and the alkaloids, forming acetates. It dissolves resins and gum resins, camphor, and volatile oils; and, when mixed with alcohol and heated, it forms an ether, which is named acetic ether. During its union with water, heat is evolved.

In its concentrated state, Acetic Acid, taken internally, acts as a virulent poison; the best antidote is magnesia. The after-treatment should be the same as that for inflammation of the stomach.

Acetic Acid must be diluted with water, in the proportion of five parts of the acid and ninety-five of water. But diluted Acetic Acid, to render it useful as an astringent for medicinal purposes, is usually procured by the distillation of common vinegar. The best vinegar is made from wine not more than a year old. At Orleans, where much of it is made, the wine is kept for some time in casks with beech shavings, which clarifies it; after which it is boiled, and poured into casks, in quantity sufficient to fill one third of each cask, and left for eight days; and afterwards two gallons and a half of wine are added, every eighth day, until the casks are two thirds filled. Eight days after this time, the vinegar is fit for use; but a portion only is drawn off, and fresh wine is added to keep up the contents of each barrel to two thirds of its capacity. The casks are exposed to the

* Pyroligneous acid, mixed with water, in the proportion of two fluid ounces to four of the water, is nearly the same as distilled vinegar of 1009 specific gravity.

atmospheric temperature in summer; and in winter to a temperature of 75° Faht. maintained by means of stoves. In Holland and some other parts, the acetous fermentation of the wine is aided by having two double-bottomed barrels, one of which is kept only half full, the other always full. On the inner bottom of each, which is pierced with holes, the leaves of the vine and the footstalks of grapes are spread; and every twenty-four hours the half-full barrel is filled from the full one, so as to keep one of these barrels always full and the other half full. The fermentation proceeds most briskly in the half-filled barrel, and in fifteen days the vinegar is ready for use. In this country, vinegar is made from malt; but sugar and water, or any vegetable matter containing a saccharine principle, is sufficient.

The theory of the acetous fermentation is not so well understood as that of the vinous fermentation. When wine or any alcoholic fluid is employed, no acetous fermentation takes place, unless the liquor be exposed to the air and to a temperature between 65° and 80° Faht.: it is very evident that the affinities between the constituents of the alcohol and the other ingredients are broken, and new combinations formed; whilst carbon, combining with the oxygen of the air, is disengaged in the form of carbonic acid gas, although not in great quantity. When the process is conducted in close vessels, the quantity of carbonic acid formed exactly compensates that of the oxygen which has disappeared. All the malic acid originally contained in the wine, as well as the alcohol, disappears, and the glutinous matter undergoes some change. The chemical difference between alcohol and vinegar consists in the greater relative proportions of the oxygen to the carbon, and the smaller proportion of hydrogen in the vinegar than in the alcohol. The quantity of vinegar obtained is precisely proportional to the quantity of alcohol in the wine employed. Difficulties have been supposed to arise from the fact, that Acetic Acid is produced without the vinous fermentation having previously existed, as in making starch, and when gluten of wheat is fermented with sugar and water. Acetic Acid is also extricated when sulphuric acid is poured on some vegetable bodies, and in large quantity, when wood, free from turpentine, is distilled in close vessels.

Vinegar procured from wine or from malt is a fluid of an agreeable, penetrating odour, and a pleasant acid taste, varying in colour from a pale straw-yellow to a deep brownish red. It generally contains, besides Acetic Acid, a little undecomposed alcohol, mucilage, colouring matter, some sulphuric acid, which is added to it by the manufacturers, and water. In this state, vinegar is used as a condiment; but it requires to be distilled for the purposes of medicine. By the process, ordered in the Pharmacopœias, five fluid pints only are procured from a gallon of vinegar. The first pint is rejected as too weak; the two left in

the retort contain much Acetic Acid, saturated with carbonaceous matters, and so much bitartrate of potassa as to render it unfit for use.

Distilled vinegar has a less agreeable odour than common vinegar: the taste is also less pungent. It is limpid and colourless like water; but often contains some mucilage and extractive; independent of which, it is merely Acetic Acid largely diluted with water. At a sp. gr. of 1.007, distilled vinegar contains Acetic Acid 3.42 + water 96-58 in 100 parts; and should dissolve 13.8 grains of white marble. It is often adulterated. Nitrate of silver detects muriatic acid by affording a precipitate insoluble in any acid. If it contain copper, ammonia or the ferro-cyanate of potassa detects it. Solution of perchloride of gold discovers tin, by forming the purple colour of Cassius; and sulphuretted hydrogen the presence of lead, by the deep brown precipitate which it throws down. On account of these impurities, vinegar should always be distilled in a glass retort.

As a remedial agent, diluted Acetic Acid is a useful and agreeable Astringent; and produces a tonic effect, whilst at the same time it is refrigerant: on this account it has been given with advantage in phthisis pulmonalis; and it is still more valuable in this disease when hæmorrhage occurs, particularly conjoined with acetate of lead, or taken at the same time with that salt. This acid, largely diluted, was employed as a refrigerant in phthisis so early as the time of Galen, and it is still employed for the same purpose by the Oriental physicians. But it has been lately used, in its less diluted state, and in larger quantity, to obtain its astringent influence. M. Orban, who witnessed its use at Tunis, says that the quantity taken daily was seven fluid ounces diluted with forty-nine fluid ounces of rain-water; pills consisting of small doses of alum and sulphate of iron being taken at the same time. The Moorish physician gave no favourable opinion of the effects of the acid, until it produced a costive state of the bowels, when he spoke with confidence of a cure being effected. This fact is too little attended to in the treatment of phthisis: the disease appears arrested when the bowels are confined; the cough becomes less irritable, and the strength of the patient is maintained. M. Orban left this patient convalescent. He employed the same plan with considerable success in France. The only British practitioner who has recorded the result of his experience of the use of Acetic Acid in phthisis is Dr. Roberts, in whose hands the success of the practice was considerable*. It operates by restraining hæmoptysis, checking the hectic and morning sweats, and producing costiveness. Indeed, when we consider the nature of the disease, the debility that attends it, and its connection with the scrofulous diathesis,

* Med. Trans. of the College of Physicians, vol. v.

there is little doubt that the acid operates as a tonic astringent. It exerts also a powerful action on the absorbents; as the use of vinegar by young females, who wish to reduce themselves from a state of corpulency, has too frequently demonstrated. None of the cases in which I have employed it recovered; but all of them seemed to be benefited by its use. It diminishes action, checks night sweats, and restrains hæmoptysis and diarrhœa. It may be administered in conjunction with infusion of calumba or of cascarilla. The external use of this acid has not been confined to phthisis; it has of late been much employed in ordinary cases of debility, diluted in the proportion of one part of strong vinegar and five of water, for sponging the trunk of the body before the patient gets out of bed in the morning. In these cases its beneficial effects depend on its stimulant and astringent powers.

As an Astringent, vinegar has been administered internally, in combination with salt, in dysentery: it not only checks the purging, but corrects the fœtor of the stools. As a local Astringent, it has long been employed in relaxations of the uvula and fauces in the form of gargles, especially in those cases of ulceration attended with sloughing of the tonsils, such as occur in scarlatina and malignant or putrid sore throat. In such cases, however, it is not so frequently employed now as formerly, the aqueous solution of chlorine having been found more useful.

In the form of collyria, vinegar has been long and successfully used as a gentle Astringent in ophthalmic inflammation, and as a lotion in fœtid ulcers. As a local application, it has also been found useful in hæmorrhages. This effect, however, must not be confounded with that caused by the application of vinegar and water to the abdomen and thighs in uterine hæmorrhages, in which the acid acts as a refrigerant, simply by aiding the evaportion of the water.

d. Metallic Salts.

1. ALUM. *Sulphate of Alumina and of Potassa.* L. E. D.—Alum is a salt, which was known to the ancients as a mordaunt in dying; but its nature was not understood till 1754, when Margraff detected a peculiar earth as one of its essential constituents. Margraff named this earth *Argil*, but Morveau afterwards gave it the name which it now bears. *Alumina:* it is an oxide of a metal, Aluminium.

Alum is found ready prepared by the hand of Nature, in some places, as at Gotturg, in Austria, and at the Solfatara, a concealed volcano near Naples; but the greater part of the Alum of commerce is prepared from aluminous pyrites or schistus, which is roasted and exposed to the action of the air and the moisture of the atmosphere: the sulphuret of iron present in the schistus is oxidized by attracting the oxygen of the air

and that of the decomposed moisture; its sulphur, being thus converted into sulphuric acid, combines with the Alumina, and forms an efflorescence on the slate, which is separated by lixiviation, and the solution concentrated, until it acquire the sp. gr. 1.35, when some salt containing potassa is added. This addition, however, is not always necessary, as the schistus sometimes contains potassa. The solution, being boiled and run into coolers, crystallizes; but it undergoes a second crystallization after running off the mother water of the first; and as this takes place in casks, in which the salt forms into a solid mass, the operation is termed *roching*, and the Alum thus crystallized Roch Alum. The interior of the mass is generally in large regular octahedrons*.

There are various kinds of Alum: the Roman, which is very pure, is in irregular masses, covered with pink powder on the surface; the Levant, which is in small pieces also, of a pinkish or pale rose colour; and the English, which is in large masses. Alum, generally, slightly effloresces in the air; in a moderate heat it fuses, and, losing its water of crystallization, becomes opaque, and acquires a corrosive property when applied to the body: it is then termed *burnt* or *calcined Alum*. All the varieties are soluble in five times their weight of water at 60°, and in their own weight of boiling water. The solution generally reddens vegetable blues; and is decomposed by the alkalies, which precipitates the alumina. If the Alum contain iron, it is detected by first adding a little nitric acid in the heated solution, and then precipitating by ammonia, which renders the peroxide visible, of a yellowish-green changing to a red colour. Alum is precipitated also from its solution by many infusions which contain extractive and tannin; by all the salts containing bases which unite with sulphuric acid—for instance, lime and magnesia, the carbonates of the alkalies, ammonia, and the muriate of ammonia, tartrate of potassa, the acetate of lead, and the greater number of the metallic salts; all of which are, consequently, incompatible in prescriptions with Alum. But it may be combined with the chloride of mercury, and all the metallic sulphates. According to Berzelius, Alum consists of 4 sulph. ac. $(40 \times 4) = 160$ + 1 alumina 50.4 + 1 pot. = 47.25 + 24 water $(9 \times 24) = 216$, equivalent 473.65.

As a remedial agent, Alum is employed, in cases requiring

* There are several Alum mines in Great Britain; for instance, at Hurlett, near Paisley, where the aluminous slate lies above coal; and at Whitby, where it is disposed in strata, nearly upwards of one hundred feet in depth and twenty nine miles in breadth. On an average, one hundred and fifty tons of slate produce one ton of Alum.

The calcined salt is washed with four successive waters, and, when it acquires a sp. gr. of 1.45, kelp ley of a sp. gr. 1.025, is added to it: but the best Alum is made by the addition of soap-boiler's ley, which contains a muriate of iron, that does not crystallize with Alum.

the use of Astringents, both generally and locally. When taken into the stomach, it causes, often, a disagreeable and painful sensation at the epigastrium; and, if the dose be large, nausea, vomiting, colic, and purging; but, in small doses, constipation. When taken into the circulation, it is said to irritate the lungs and provoke coughing*; but my experience has not confirmed this remark. It is employed, generally, in internal hæmorrhages; in chronic diarrhœa; in leucorrhœa; and in diabetes. It must, however, be recollected, that in old diarrhœas, when ulcerations of the mucous membrane exists, Alum may be productive of mischief. In confluent smallpox, when the pustules are livid and filled with a bloody serum, Alum whey, prepared by boiling ʒii of Alum in a pint of milk, has been administered with much benefit.

Although Alum cannot be combined with the infusions and decoctions of astringent vegetables, yet it may be combined with opium and aromatics, which correct its tendency to disturb the bowels—a circumstance that sometimes proves detrimental in cases of uterine hæmorrhage, in which it generally operates beneficially. It was first given in this disease by Van Helmont; and the opinion of Cullen, in its favour, adds considerable weight to Helmont's recommendation. In pyrosis, Alum has been recommended as an adjunct to opium; but I am of opinion that a sedative, rather than an Astringent, is required in this painful affection; and that the benefit in this case is due to the opium. As a local Astringent, it is useful in relaxations of the uvula, and in apthæ; and no injection proves more useful than its aqueous solution in leucorrhœa and gleet. In chronic inflammation of the eye, it forms a good collyrium; and, in this case, the facility of uniting it with the sulphate of zinc is a great advantage. In ecchymosis of the eye, the cause of which is not always obvious, a very useful mode of applying it is in the form of coagulum, made by agitating a lump of Alum in white of egg: the acid coagulates the albumen, whilst the serous or watery part dissolves a certain portion of the Alum; and an excellent vehicle is thus formed for its application.

The dose of Alum for internal use is from gr. v to ʒii; for external use, the strength of the solution may depend on circumstances.

Although an Astringent, Alum has been justly vaunted as a remedy in colica pictonum. In this case, much of the benefit produced, if the remedy be early administered, is due to its chemical influence in converting the carbonate of lead, which has produced the mischief, into the sulphate, which is innocuous. Its further influence, as a stimulating Astringent, may prove useful in counteracting the paralysis of the intestinal

* Traité Elémentaire de Mat. Med. par J. B. C. Barbier, 3d edit. t. i, p. 521.

nerves, and mitigating the pain. Dr. Percival recommended fifteen grains to be given every third, fourth, or fifth hour; and, as far as his experience went, he affirms that its use was followed with unvarying success.

2. Sulphate of Iron. L. E. D.—Muriate of Iron.—The styptic nature of the Salts of Iron is well demonstrated by their external application: but it is only in states of great debility, and in hæmorrhages occurring in scurvy and purpura, that they can with propriety be internally administered; so that they are seldom employed as general Astringents. When it is essential to order them, the dose, at first, should be small and gradually augmented. They enter the circulation slowly; but, after some time, excite a febrile action in the whole system, cephalalgia, with weight in the head, and tingling in the skin. As a local application, the tincture of the muriate, largely diluted with water, is frequently used for touching cancerous and fungoid ulcers.

3. Sulphate of Copper. L. E. D.—This salt has been given with great advantage in obstinate chronic diarrhœa, and in Asiatic cholera, in doses of from one-sixth to half a grain, combined with opium. I can say little of its value in these complaints from my own experience, having seldom prescribed it: it undoubtedly has proved useful, and verified the accounts of its powers which Dr. Elliotson has published. Its astringent influence cannot be questioned: but, at all times, the salts of copper are hazardous when introduced into the stomach; and, therefore, I am not anxious to recommend this sulphate to notice, even in cases similar to those noticed by Dr. Elliotson, unless all other means fail. If it be given, and headache, vomiting, and pains of the bowels, with cramps in the legs, supervene, its use should be instantly discontinued, and a solution of the albumen ovi should be freely exhibited, giving at the same time from m. x to xv of the ferro-cyanate of potassa in water. As an external Astringent, it is less exceptionable; for although it has proved fatal when applied to wounds in dogs and some other quadrupeds, yet it is applied to ulcers in the human body with impunity, except in peculiar idiosyncracies. In the proportion of gr. i in f℥i of rose water, it is an excellent injection in incipient gonorrhœa, producing a new and more healthy action in the inflamed membrane. It should be employed on the first appearance of the symptoms, and continued twice a day, for a short time, after they have disappeared.

4. Sulphate of Zinc. L. E. D.—The salts of Zinc, although frequently given as tonics, yet are seldom administered with the view of obtaining astringent effects, except as external applications. In the form of collyria, or as lotions, both the sulphate and acetate are employed in ophthalmia and other inflammatory affections, after the excitement has been

partially subdued by local blood-letting and other depleting means. There is one case on record, quoted by Dr. Christison from Pyl's Memoirs, of the external application of Sulphate of Zinc proving fatal: it was applied to cure a scabby eruption on the head, and had not been long used before the child, who was six years old and healthy, complained of acute burning pain of the head, which was followed by vomiting, purging, convulsions, and death in five hours. As I have not seen Pyl's account of the case, and Dr. Christison's quotation contains little detail, I can form no opinion of the cause of this uncommon effect of the external use of the sulphate. It may have been owing to idiosyncracy, or to metastasis by the repulsion of the eruption causing meningitis or inflammation of the membranes of the brain—an effect of local applications, in Porrigo, which I have witnessed more than once.

A large dose of these salts of Zinc produces little effect on the habit, as they are constantly rejected by vomiting; but, should an overdose, to a less extent, produce pains of the stomach and bowels, retchings, and diarrhœa, these effects are best counteracted by carbonate of potassa and oleaginous mixtures.

5. NITRATE OF SILVER. L. E. D.—This salt has never been administered internally as an Astringent: but it has been successfully employed, externally, in ophthalmia. In ulceration of the cornea, and in obstinate inflammation of the conjunctiva, a solution of gr. ii of the nitrate in f℥i of distilled water, is of sufficient strength: but, when the ulcers are of a nature to threaten protrusion of the iris, the proportion should be ten grains to the fluid ounce of water: and the same strength is requisite in inflammation forming granulations of the palpebræ, and in ophthalmia from gonorrhœa. In these cases, a drop or two of oil of sweet almonds should be dropped into the eye immediately after the solution has been applied. The best mode of introducing both the nitrate and the oil is to take them up with a hair pencil and to introduce its point at the angle of the eye: the fluid leaves the pencil, and immediately spreads itself over the ball of the eye and the inside of the lids. As the smallest portion of animal matter instantly discolours the solution in distilled water, and leaves a permanent stain on the skin, the eyelids should be touched with oil before dropping the solution into the eye.

B.—ASTRINGENTS WHICH EXERT A SEDATIVE INFLUENCE ON THE SYSTEM.

e. Metallic Salts.

1. CARBONATE OF LEAD, *Plumbi Subcarbonas.* L. *Carbonas Plumbi,—Cerusa.* E. D.—When metallic lead is ex-

posed to the air, it soon acquires upon its surface a thin white coating, which is a carbonate of the metal: when it is exposed to the combined action of distilled or rain-water and air, a white insoluble powder forms, which is also a carbonate: rain-water, collected from the roofs of houses newly furnished with leaden spouts, or eave-droppings from lately erected leaden roofs, water agitated in leaden cisterns at sea, and many other conjunctions of lead and *pure* water, if air be present, produce Carbonate of Lead: and it is also formed when the acetate or the subacetate of lead in solution are exposed to the air, or when hard water or solutions of salts, containing carbonates of alkalies, are mixed with them.

Carbonate of Lead occurs native; but that employed in medicine is procured by exposing plates or coils of lead in pots furnished with a ledge, on which the coil rests, to the action of the vapour of vinegar, and, at the same time, to that of carbonic acid, by placing these pots in fresh stable litter. The vinegar oxidizes the surface of the lead, and converts the oxide into a subacetate of lead, which is again rapidly decomposed, and formed into the Carbonate by the carbonic acid extricated from the fermentation of the stable litter. The Carbonate is then detached from the surface of the lead, ground in water, and afterwards dried in stoves, heated by means of flues*. It is a white, heavy, inodorous, insipid powder, insoluble in water; very soluble in nitric acid and strong acetic acid; and partially soluble in a concentrated solution of pure potassa. According to the analysis of Berzelius, it consists of

Protoxide of lead	1 prop. =	111.5	or 83.5
Carbonic acid .	1 prop. =	22	16.5
	Equivalent	133.5	100.0

It is easily reduced to metallic lead by exposing it on charcoal to the action of the blowpipe; and is converted into the sulphuret by sulphuretted hydrogen gas, or its aqueous solution. When adulterated with chalk, this can be easily detected by putting the suspected Carbonate into distilled vinegar, filtering and testing the fluid with oxalate of ammonia: if chalk be present, an insoluble oxalate of lime will be precipitated.

This Carbonate is a powerful sedative Astringent; but it is never internally administered, on account of its poisonous properties. It even requires to be applied with caution to abraded surfaces. It is the preparation of lead from which colica pictonum, painters' colic, in every instance arises. The symptoms it produces, when taken into the stomach, are, at first, not unlike those of common dyspepsia: soon afterwards, obstinate costiveness, violent pain and tormina, or a sensation of twisting

* London Dispensatory, art. Plumbi subcarbonas.

at the navel supervene; the stomach becomes very irritable and rejects the food by vomiting; violent gripings succeed, which are temporarily relieved by pressure; the muscles of the abdomen are powerfully retracted, and the umbilicus drawn inwards. In general, there is obstinate costiveness; but sometimes diarrhœa occurs: the urine is diminished in quantity; the saliva assumes a bluish colour; and the expression of the countenance becomes dull, anxious, and gloomy. Along with these symptoms, the pulse is small, but hard; the respiration laborious; and, if relief be not soon obtained, the attack terminates either fatally in nervous apoplexy, or more frequently in paralysis of the extremities. The palsy attacks, at first, only the fingers, sometimes the whole hands, and then the lower extremities: it sometimes occurs simultaneously with the colic, although it is seldom noticed until the pain abate. In the hands, the extensors of the thumb, and those of the fore and the little finger, are most affected; the flexion of the wrist is a very characteristic symptom; and the arms cannot be raised, but hang dangling at the sides. When paraplegia supervenes, the patient complains of excruciating pains of the limbs. These symptoms may arise from the conversion of the Acetate into the Carbonate in the alimentary canal.

The best remedy, when colic only is present, is castor oil combined with opium; but when there is reason to suspect that a portion of the Carbonate remains in the stomach, the sulphates of magnesia and of soda should be administered: an inert sulphate of lead is formed by these salts, and this is carried through the bowels by the undecomposed portion of them. On the same principle, alum is also useful in colica pictonum. When paralysis of the extremities occur, the best remedies are the extract of nux vomica or acetate of strychnia, and the application of the galvanic influence. The dose of the acetate of strychnia should not, at first, exceed $\frac{1}{10}$ of a grain; and its augmentation should be very gradual, until tetanic twitchings appear.

2. Acetate of Lead. *Plumbi Acetas — superacetas.* L. E. D.—According to the Pharmacopœia of the London College, this salt is prepared from the carbonate of lead and acetic acid. But the salt, even for medicinal purposes, is manufactured in the large way in Holland, and also in England. In England, litharge is acted upon by pyrolignous acid, of a sp. gr. 8 of Beaumé: but the Acetate thus prepared often contains copper and other impurities, and ought not to be employed in medicine. Pure Acetate of Lead is inodorous, and has an astringent sweetish taste. It is generally in the form of small, glossy, needle-shaped crystals, which are flat, quadrilateral prisms, terminated by dihedral summits: when carefully crystallized, the crystals are large. Its sp. gr. is 2.345: it dissolves in 25 parts of distilled water; but, on being kept in solution, a white powder falls,

which is carbonate of lead, formed from the union of the oxide of the acetate with the carbonic acid attracted from the air; this is rendered evident by blowing through a clear solution of the Acetate;—the carbonate is formed; and this is also the case when pump or hard water is employed in making the solution. The solution of the acetate is also decomposed by all the acids which form insoluble salts with the oxide of lead, the sulphuric, muriatic, carbonic, oxalic, and tartaric; by lime water and all the alkalies; but pure potassa and soda, if added in excess, redissolve the precipitates. Sulphuretted hydrogen precipitates it in the form of the black sulphuret. It is also precipitated by infusion of galls, and all astringent vegetable decoctions and infusions; and by almost all animal fluids, with the exception of gelatine.

The components of this acetate are—

Acetic Acid .	26.45	1 prop.	=	51
Oxide of Lead.	59.25	1 prop.	=	111.5
Water. . . .	14.30	3 prop. (9×3)	=	27
	100.00	Equivalent		189.5

As a sedative Astringent, this salt is a valuable medicine, and may be given with much greater safety than is generally supposed. It acts directly upon the nerves of the stomach as a sedative, gradually extending its influence to the entire system. After its employment has been continued for some days, the pulse falls in frequency and force; and, if the dose be too rapidly increased or be too large, pains of the stomach, nausea, a diminished secretion of high-coloured urine, turgidity of the gums, constriction of the throat, and vertigo, supervene. When these symptoms occur, the use of the acetate should be immediately suspended. The writings of Sir George Baker and of Dr. Heberden did much to confirm the bad repute of this salt of lead; but subsequent experience has demonstrated that it may be administered, not only with safety, but with the greatest benefit, in all cases of active hæmorrhage. I have given it in doses of five grains, and occasionally in larger doses, washing them down with diluted distilled vinegar, for several successive weeks, without perceiving the smallest deleterious result from its employment. This mode of administering the Acetate of Lead was suggested by me from having ascertained that the only direct poison of lead is the *carbonate*, and that acetic acid checks the formation of that salt from the decomposition of the acetate in the intestines. Mr. Laidlaw, a surgeon, who made a series of experiments on himself with this Acetate, without using vinegar, took it in the solid form to the amount of gr. xii in twenty-four hours, for several successive days, without producing colica pictonum. When griping pains occurred, they were speedily allayed by increasing the proportion of the opium in the pills.

Mr. Laidlaw took it also in the fluid form, in smaller doses, until gr. lxx were taken, without any deleterious result. One curious effect of its continued use was the excitement of ptyalism: but, notwithstanding this effect, it has been recommended, by Mr. Daniels, for the purpose of allaying violent salivation, in doses of gr. x to ℈i, in conjunction with gr. x of compound powder of ipecacuanha. How are these contending opinions to be reconciled? When administered in moderate doses, it is certainly sedative, and locally astringent. The fauces and pharynx are constringed in swallowing it. Its employment in hæmorrhages is of very ancient date; and it has been advantageously used, whatever may be the organ or part of the body in which the hæmorrhage appears. Dr. Latham introduced the use of it in colliquative diarrhœa, and in tubercular consumption, attended with ulceration; and, although I cannot say that my experience has induced me to place any confidence in it as a remedy for phthisis, yet, it certainly lessens the irritability and corrects the tendency to diarrhœa which usually accompany that intractable disease.

In prescribing this salt of lead, and all the other salts of this metal, we must keep in view the influence of idiosyncracy in modifying the operation of medicines; as some individuals are peculiarly susceptible of impressions of the most hurtful kind from the smallest doses of the salts of lead. When it happens that it proves hurtful, it may be detected by several reagents: thus, it is precipitated white, as a carbonate, by the carbonates and the sulphates of soda or of potassa; bright yellow by hydriodate of potassa, which forms an iodide of lead; and black by the solution of sulphuretted hydrogen, forming a sulphuret of the metal. If the precipitate, by any of these reagents, be mixed with charcoal and submitted to the blowpipe, a button or globules of metallic lead will be procured.

As an external application, the acetate has been extensively employed in collyria and lotions, in all cases requiring the aid of local astringents. The dread of its deleterious properties, at one time, extended to its external employment; and it must be admitted, that instances have occurred in which the bowels have been affected even by the external application of the acetate: thus, in a case mentioned by Dr. Wall, in the first volume of the Transactions of the College of Physicians, colic was produced by immersing the legs twice a day, for ten days, in a bath of the solution of Acetate of Lead. But such instances are rare.

Acetate of Lead may be given in doses of from gr. iii to gr. vi, combined with a quarter or half a grain of opium, and made into pills with the crumb of bread. In hæmorrhagic diseases, where its sedative or astringent effects are rapidly required, the solution should be preferred. Its sedative influence is augmented by the use of distilled vinegar, largely diluted, as ordinary beverage.

3. *Subacetate of Lead. Plumbli Subacetatis Liquor.* D.—This salt is formed by boiling 100 parts of the acetate and 150 of litharge deprived of carbonic acid, and crystallizing. For medicinal purposes, however, it is generally prepared in a fluid form, by boiling litharge in diluted acetic acid until the mixture be concentrated more than one half. The filtered liquor, after the dregs have subsided, is the Liquor Plumbi Acetatis of the London Pharmacopœia. According to the analysis of Dr. Bostock, it is a solution of a subacetate; or, in more correct language, it is a diacetate, which consists of

Oxide of Lead	81.75	or 2 prop.	(111.5 × 2) = 223.
Acetic Acid .	18.25	1 prop.	= 51
	100.00		Equivalent 274

When prepared with common vinegar, it has a greenish-yellow colour; but if the acid be pure, it is colourless. It has a sweetish astringent taste; and, when prepared with vinegar of a sp. gr. 1.007, the solution of the subacetate should have a sp. gr. 1.220 It is decomposed by the smallest quantity of carbonic acid contained in any water with which it is mixed. Even exposure to the air converts it rapidly into the carbonate, and a few bubbles of breath thrown into it produces the same effect. It is distinguished from the acetate by its precipitation of a solution of gum, for which it is a very delicate test. It is affected by the same reagents as the acetate.

The Subacetate of Lead is never internally administered, and is the preparation of this metal, next to the carbonate, which is most poisonous; but this property depends on its conversion into the carbonate which occurs in the stomach. I have seen more than one instance of death resulting from a large dose of the Subacetate of Lead having been taken by mistake. It induces colica pictonum; the appetite becomes impaired, whilst nausea, and a discharge resembling that of ptyalism, supervene, accompanied with great restlessness. There is often bilious vomiting, during which the colic pains come on and recur at intervals, affecting chiefly the umbilical and iliac regions, the parietes of the abdomen feeling knotted and being drawn inwards: there is also obstinate costiveness. Headache, pains of the limbs, particularly of the ankles and soles of the feet: there is generally no fever; but the expression of the countenance is indicative of the greatest distress; the cerebral functions become disturbed, and the patient sinks. The immediate cause of the fatal termination is nervous apoplexy: the more common termination, however, is in palsy. This attacks first only the fingers, sometimes the whole hands, and then the lower extremities. The palsy occasionally occurs at the same time as the colic; but is seldom noticed until the pain abates. When it affects the hands, it is the extensors of the thumb and fore and

little fingers that are most affected: the flexion at the wrist is very characteristic of the disease; and the arms hang dangling at the sides. When paraplegia supervenes, the patient complains of excruciating pains in the limbs: nevertheless it is evident that the poison of lead acts as a sedative on the motor nerves; for the pains which are felt demonstrate that its sedative influence does not extend to the nerves of sensation.

The only disease which is caused by the poison of lead is colica pictonum; and in almost every writer upon the subject it is stated that this colic is the result of lead taken into the habit, in whatever form it may be introduced. Litharge is stated to be a poison; because wines, in which it has been put to overcome acidity, have produced colica pictonum. In the writings of Sir George Baker and others, instances are related of that disease having arisen from the prolonged use of the Acetate of Lead; and cases are detailed in which its external application has produced similar effects. Dr. Wall has given two cases in which this colic could be unequivocally traced to the application of *Goulard*'s extract to open ulcers; and one, already noticed, in which it was produced by immersing the legs in a bath of the acetate. Now, although I do not deny the accuracy of any of these facts, and admit that colica pictonum may result as a sequence to the use of any oxide or any salt of lead, yet, I trust that I shall be able to prove that whatever may be the form in which the lead exists when taken into the stomach or applied to the surface, still that it is one only of the salts of lead, the *carbonate*, which is really adequate to the production of colica pictonum.

To prove this point, in the first place let us enquire, what are the occupations of those persons most liable to this disease? It will be found that miners, who dig the ore, and the sulphuret, who must necessarily inhale some of the dust of these states of lead and take it into their stomachs, are not liable to colica pictonum; whilst those workmen who smelt the lead frequently suffer. It would not be a difficult task to prove that the fine exhalation of oxide of lead, formed in smelting, inhaled into the lungs, is rapidly converted into carbonate of lead when exposed to the carbonic acid of the pulmonary tubes, in combination with their heat and moisture. Next to smelters of lead, we find that manufacturers of sheet lead, plumbers, glaziers, painters, and compositors in printing offices, are most liable to colica pictonum. It is scarcely requisite to say that it is with white lead or the carbonate that these tradesmen, except the compositors, are occupied; and that it is most commonly conveyed into their stomachs with their food, owing to their uncleanly habit of taking their food without washing their hands. The compositors are not affected with colica pictonum, but with partial paralysis; and I have heard of an instance of a man, who was in the daily

custom of handling pigs of lead and loading carts with them, having twice suffered with this disease. Now, I have already mentioned that the whitish efflorescences collected on the surface of metallic lead exposed to the air is carbonate of lead; and it might not be difficult to trace this into the stomachs of those who are constantly handling lead, or to trace it into that organ in painters; but it is probable that it also acts locally on the cutaneous nerves, as compositors are merely affected with palsy in the hands. Of all artisans, however, the manufacturers of white lead are the most liable to colica pictonum. This was particularly the case when the grinding of white lead was performed in the air; the grinding houses were generally full of dust of Carbonate of Lead, and the men, consequently, received it into the lungs and into the stomach. For many years I had the medical management of a very large white lead manufactory on the Thames' bank, and, before the process of grinding white lead under water was adopted, I had frequently to prescribe for two or three of the workmen labouring under colica pictonum: but, after the use of water, in the grinding part of the process, was adopted, very few cases indeed of the disease occurred. In every instance in which white lead has found its way into the stomach, colica pictonum has followed; whereas the acetate, as I have already stated, has been taken in large doses, and for a long period, without any injurious consequences. There is, therefore, sufficient reason for affirming that carbonate of lead is the most poisonous of the salts of lead; but I have also ascertained, by a series of experiments on rabbits*, that it is actually the only poison among the salts of lead.

The question next occurs, in what manner is the lead which is taken into the stomach in wine, cyder, and other means, rendered poisonous, if the carbonate only operate as a direct poison? I reply, that these liquors, when rendered poisonous by admixture with litharge or with sugar of lead, contain the poison in the form of the citrate, which is converted into the protoxide by being reduced by the animal juices of the stomach, and that the attraction of this oxide for carbonic acid is so great that it is rapidly converted into the carbonate:—in this state it acts upon the nerves of the intestinal canal and its muscular coat, producing the disease in question. If we trace the history of the cases of poisoning by salts of lead, we shall find that the danger is in the direct ratio of the facility with which the salt of lead, that has been swallowed, can be converted into the carbonate. It is on this account that the subacetate is so much more poisonous than the acetate; for, next to the carbonate, it is the most poisonous of the salts of lead. In some habits, and in the same person at different times, a greater quantity of car-

* See Medical Gazette, vol. x, p. 689.

bonic acid than usual is evolved in the intestines. These conditions of the habit indicate a lower state of vitality in these organs than is requisite to maintain the healthy condition of the system; consequently I presume that the same quantity of the acetate, or of any other of the salts of lead, will be more quickly changed into the carbonate under such circumstances, and act with more power than in the opposite states of the system and in more healthy individuals. This supposition is partly confirmed by the following anecdote. A gentleman returned twice from the West Indies, suffering under palsy, the sequel of colica pictonum, or dry bellyache, as it is termed in the West Indies, produced by drinking daily a beverage made of rum distilled through a leaden worm. Many others had partaken of the same rum without being afflicted with the colic; I was, therefore, anxious to ascertain the cause of his being so particularly its victim; and, on making strict enquiry into the facts, I discovered that he was in the habit of taking soda powders, containing bicarbonate of soda, at the time of taking his toddy—a fact which at once fully elucidated the cause of his sufferings. Another fact which supports the theory which I have ventured to advance is this, that those who take the Acetate of Lead medicinally, in the liquid form, in combination with distilled vinegar, or who drink diluted distilled vinegar, to wash down pills of the acetate, are able to take it in larger doses, and for a much longer period of time, with impunity, than those who take it without this adjunct.

The manner in which the carbonate acts upon the habit is not so easily explained. As an Astringent, it corrugates the circular fibres of the intestine; whilst, at the same time, it exhausts the energy of the motor nerves, producing paralysis of both the upper and lower extremities. The fact of the action of the carbonate of lead on the muscular fibre is demonstrated by post-mortem dissections: the colon is generally much contracted; and, when the disease has been of long continuance, or has frequently occurred to the same individual, the intestines are found almost exsanguine, tender, and with an evident disposition to run rapidly into putrefaction. The mesenteric glands, also, in such cases, have been found enlarged. In experiments made upon the lower animals, when the paralysis is not of long standing, the whole muscular system is found pale, bloodless, and flaccid: but no other part indicates the presence of disease. In this respect, therefore, the salts of lead act through the nervous system in the same manner as narcotic poisons, exhausting the motor nerves of their energy; but, in the majority of cases, in a degree adequate only to the production of paralysis. In fifty cases dissected by Seuve, of individuals who had died of colica pictonum, no morbid appearances could be traced. Gmelin asserts that salts of lead may be de-

tected in the bodies of those who have died of colica pictonum: but no other person has been able to find any traces of them, either in the intestines, liver, lungs, blood, urine, or fæces of the animals destroyed by them. The experimentalists, however, of the Veterinary School of Lyons, found the blood in the veins of a dog, who had been poisoned by litharge, of a vermilion colour, and that in the arteries brighter than usual. Having destroyed a dog by injecting a solution of the acetate into the jugular vein, the pink colour described by the veterinarians of Lyons was perceived in the blood. From these facts, it is evident that, in cases of poisoning by salts of lead, when the issue is fatal, little satisfaction can be obtained from the post-mortem inspection of the body; and the whole of the evidence must be drawn from the nature of the symptoms and the analysis of any portion of the poison which remains.

With regard to the practical inferences to be drawn from the theory which I have ventured to advance, I would say—1, that the acetate of lead is the least poisonous of all the salts of lead *medicinally* employed; 2, that its safety is increased by the addition of as much diluted acetic acid as can prevent its decomposition by the animal matter and the carbonic acid of the contents of the stomach and bowels; 3, that the directions to give alkaline carbonates in cases of poisoning by Acetate of Lead are highly improper, inasmuch as these salts facilitate the formation of the carbonate; 4, that the subacetate, under no circumstances, should be internally exhibited; 5, that the carbonate should be applied with caution, even to external sores.

The first thing to be done in cases of poisoning by any salt of lead is to evacuate the stomach by means of the stomach pump or the acetate of zinc; then to exhibit sulphate of magnesia or phosphate of soda, both of which, by reason of their acid bases, decompose the salts of lead, and convert them into insoluble inert compounds, which are carried through the bowels by the undecomposed portions of the sulphate and the phosphate. The remainder of the treatment consists in the repeated exhibitions of oleaginous purgatives, particularly castor oil, in conjunction with anodynes: whilst, at the same time, the warm bath should be used. In the early stage of the disease, when the pulse is full and hard, bleeding has been resorted to: but I have never seen a case in which it was required. When the paralysis of the extremities has already commenced, the treatment with acetate of strychnia, and passing a current of electricity, either by the ordinary machine or by the Galvanic apparatus, through the abdomen, are the best remedial means that can be adopted. It is of great importance to caution workmen, who from the nature of their employment are constantly handling white lead, or even metallic lead, never to take a meal

without washing their hands; and to endeavour to convince smelters and other manufacturers of salts of lead or preparations of the metal, from which fumes may exhale, to have some means of carrying off these exhalations, which prove so injurious to their health.

The custom of prescribing infusion of roses, acidulated with sulphuric acid, at the same time with pills containing the acetate of lead, in hæmoptysis and other hæmorrhages, is very absurd: the salt of lead is decomposed, as soon as the infusion enters the stomach, by the sulphuric acid; and, consequently, in these cases, if any benefit be received, it can only be justly ascribed to the sulphuric acid, and in no degree to the salt of lead. Indeed, a more decided method of destroying the action of any salt of lead could not be adopted.

f. COLD.

Cold is a negative property, being the mere absence or obstraction of a positive quality, *Caloric*.

The same power which enables the body to sustain very high temperatures, enables it equally to maintain its inherent warmth in very low temperatures.

Cold, when applied to the living body, or rather the sudden abstraction of caloric from the living body or any part of it, causes a peculiar sensation, which is accompanied with paleness and corrugation of the skin. This is the result of a contraction of the capillaries; and so far it operates in a manner somewhat resembling that in which it acts upon dead animal matter. In the living body, however, its effects are not confined to the surface; they are propagated to internal and distant parts; and it is owing to this sympathetic action that the entire system feels the influence of Cold when applied only to a part. The effect of this sympathetic influence is well illustrated in epistaxis, which is often checked by cold bodies applied to the neck, the back, or even to the genital organs. In reference to the surface, the first effect of Cold is truly astringent, in the strict meaning of the term; but this is only transient; a reaction occurs in the system, during which a hæmorrhage that has been checked is very apt to return with redoubled violence. To render Cold, therefore, beneficial as an Astringent, its application must be continued for some time: in this case, its power of checking hæmorrhages is to be ascribed as much to its sedative as to its astringent influence.

The effects of cold vary according to the nature of the medium employed. Thus, cold, humid air abstracts caloric more quickly from the body than dry, cold air, which is a worse conductor: and the effects of cold water, applied under exactly the same circumstances of the body, differs according to the

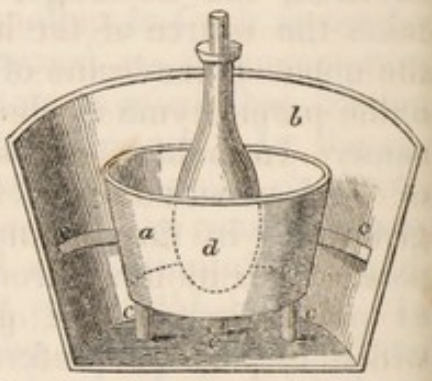
purity of the water. Count Rumford states that the conducting power of moist air to that of dry air is as 330 to 80; and it is even greater than that of water, which is only 313. I might here suggest a question which has often presented itself to my mind in reflecting upon this effect of moist air—"What influence has this depressing power of a humid atmosphere in the production of agues?" This is a question which I cannot pause to investigate; but it is one of much importance in a practical point of view. The following experiment demonstrates that much of the diversity in the sedative or astringent influence of cold water depends on its purity. Dr. Currie immersed one person in sea water and another in fresh water for thirty-five minutes: the sea water caused no inconvenience, whilst the fresh water lowered the system so much that friction was necessary to restore the natural temperature. In the application, therefore, of Cold, as the means of stopping or checking hæmorrhages, we must bear these facts in remembrance, and not less so, that it is the continued application of the Cold, by whatever medium it is applied, that effects the benefit. In the management of hæmorrhages, if the flow of blood be from the vessels of the bronchiæ, producing hæmoptysis, it has been customary to expose the body to the free action of cool air, and to give ice internally; keeping, at the same time, the lower extremities warm, to produce a more equal distribution of the blood, and to prevent it from accumulating upon the pulmonary vessels. Hæmoptysis occurs especially at that period of life when the animal frame has just acquired its full growth. Before this period "the impetus and determination of blood are greater in the aorta and its extreme ramifications than in the pulmonary system;" but when the necessity of a further elongation of the aortic system ceases, the bias is thrown upon the pulmonary vessels, in which there is a tendency to accumulate from their shorter extent; and if these vessels be not equal in the strength of their coats to the additional burthen, they may give way from a variety of causes; as, for example, violent muscular exertion, sudden exciting passions of the mind; vomiting; coughing; a suppressed discharge from the hæmorrhoidal veins in bleeding piles; or from whatever suddenly throws an additional jet of blood on the already overloaded vessels. The obscurity in which the causes of hæmoptysis are often involved is very great. I attended the late Charles Mills, the Historian of the Age of Chivalry, who was attacked with hæmoptysis when walking very leisurely in the street. The application of Cold, in the manner which I have already described, the administration of ice internally, and the free exposure of the trunk of the body to cool air, with the internal exhibition of acetate of lead, soon checked the flow of blood. He recovered, and lived upwards of twelve years after this attack, although the spitting of blood occasion-

ally recurred. This is one of the many instances which have come under my care, in which the flow of blood, evidently from exhalation, not rupture of the vessels of the lungs, has been staunched by the proper application of Cold, under the form of ice and cold air. In these attacks, when the blood-vessels are overloaded, and the system not in an exhausted state, if rupture be suspected, the use of Cold should be delayed for a short time, to permit the vessels to unload themselves; after which, rest, cold air, ice, or the immersion in water nearly at the freezing temperature, will be found the most effectual means of checking the discharge. It is of little consequence to determine the source of the hæmorrhage, whether it proceed from the mucous membrane of the bronchiæ, from a tubercular cavity, or the parenchyma of the organ; the effect of Cold is in all the same. In melæna, or bleeding from the intestines, the effect of Cold, as an auxiliary, is equally efficacious. If a vessel have given way in the rectum, Cold can be directly applied to the part, either by the introduction of a piece of ice, cut round so as not to irritate the gut, or by the injection of iced water, which is perhaps preferable to the ice itself, as something is also effected by the distension of the gut. In hæmorrhages proceeding from the uterine vessels, Cold can be most effectually applied by means of the stomach pump, sending a continued stream of cold water upon the surface on which the vessels are pouring out their blood. In this case, we act in the same manner as in stopping hæmorrhage from a bleeding stump after amputation, when a number of small vessels have not contracted and continue oozing out blood. I may here mention a useful fact—that, in cases of uterine hæmorrhages, the most advantage is obtained when the Cold is applied in a peculiar manner. Thus, Dr. Gooch mentions a case in which ice applied to the abdomen was of no use, but cold water, dropped from a height of several feet upon the abdomen, produced an instantaneous contraction.

The hæmorrhages in which Cold exerts the greatest influence are, undoubtedly, those of an active description: and thence the necessity of its continued application for some time after the flow of the blood has ceased. I refrain from noticing the effects of Cold as a general refrigerant, and also its application locally, in inflammatory cases, as this will come more properly under our notice when we treat of refrigerants. In summer, when ice and cold water cannot easily be procured, it is of importance to know the best frigorific mixtures where snow or ice is not necessary.

1. Five parts of muriate of ammonia + 5 of nitrate of potassa + 16 of water, sink the thermometer from 50° to 10°: —2. The same, with the addition of 8 parts of glauber salts, sinks it to 4°:—and, by various combinations of this kind, great

artificial Cold may be procured. When ice can be procured, an excellent frigorific mixture is obtained by mixing equal parts of pounded ice and fused muriate of lime. In making frigorific mixtures, it is necessary to cool down the vessels and the water to be used, in the mixtures, and to envelope the whole in flannel or some other non-conductors. This is well understood in warm climates where ice is regarded as a necessary of life. Thus, the Neapolitan peasants, who carry snow from Vesuvius to Naples, during the heat of summer, envelope the vessels in wool and cloth. The vessel containing ice should be placed within another, containing ice also, the inner one being supported by corks, which are bad conductors (see marginal figure:—*a* the inner vessel, *b* the outer, *c c c* corks to support the inner, *d* the bottle containinig water). A temperature of 32° Faht. is adequate for every purpose which can be expected from the influence of Cold in checking hæmorrhages.



EVAPORATING LOTINS operate also as Astringents by reducing the temperature of the part to which they are applied: but as the effect is both more slowly produced and less permanent, they are not so frequently employed as cold water and ice; although the stimulant nature of some of their components—alcohol, acetic acid, and ether, for example—add greatly to their astringent influence. They are more employed as direct refrigerants than as Astringents.

Such are those Astringents that exert a sedative influence on the living system: a few brief remarks will suffice, for those that operate as chemical agents.

c. SUBSTANCES OPERATING CHEMICALLY AS ASTRINGENTS.

g. AQUA CALCIS. CARBONAS CALCIS; CRETA. *Carbonate of Lime; Chalk.* L. E. D.—As an Astringent, pure Lime, in solution as lime water, operates, both by its chemical property of uniting with acids, and also by its sedative influence on the irritability of the living animal fibre; but it neither corrugates nor condenses that fibre; and, therefore, in strict language, it is not an Astringent. Nevertheless, as diarrhœa frequently depends upon the presence of too much acid in the stomach and intestinal canal, connected with an increased susceptibility of impression of the mucous membrane of the intestines, it is obvious that lime water may prove useful. From the small quantity of Lime, however, which lime water contains, it is more likely to operate, by its sedative influence, in the acute form of the disease. It is probable that, in the chronic state of diarrhœa, in which, from

the general relaxation and debility of the habit, the secretions poured into the intestines are in an imperfect state, that some part of the benefit resulting from the use of lime water is to be attributed to its combining with these fluids and diminishing their acrimony. It is supposed that the Lime in lime water enters the system: but this is not very likely to be the case, when we consider the quantity of carbonic acid which it meets with in the bowels; and that, as a carbonate, it is insoluble, and consequently inert. It is true that it meets with muriatic acid in the stomach, and forms a very soluble salt: but if this be absorbed, the Lime can no longer be regarded as Lime. Lime water is also supposed to exert a stimulant and tonic influence on the habit; but I am inclined to attribute the results which have led to this supposition to its power of allaying general irritability by the sympathy of the system with the intestinal canal. Lime water may be taken to the amount of several pints in a day. Barley water with a small portion of sugar is the best vehicle for its administration.

Carbonate of Lime, or Chalk, is found abundantly in many parts of the world; and, in particular, in the southern portion of this island, in massive beds, traversing it in a range which commences at Flamborough Head, in Yorkshire, and passes through Lincolnshire and the midland counties to Surrey, Kent, Sussex, Hampshire, and Dorsetshire. It is generally yellowish-white, or snow-white, opaque, of a dull lustre, friable, inodorous, insipid, and adhering slightly to the tongue; it effervesces with acids, forming salts of various kinds, and generally contains about 56 per cent. of Lime.

Chalk operates solely by uniting with the acid in the stomach and intestines, which often produces and keeps up diarrhœa. It is formed into mixtures with mucilage, which suspends it; and is usually combined with opium and aromatics. It is incompatible in prescriptions with medicines containing tannin, as, for example, infusions of galls or other astringent vegetables, or acidulous salts which cotain an acid that forms an insoluble compound with Lime, alkaline carbonates, borates, oxalates, and all the metallic salts. After Chalk has been used for some time, the bowels should be cleared out, as it is apt to form into hard balls, and to lodge in the folds of the intestines.

USE OF ASTRINGENTS IN THE CURE OF DISEASES.

With regard to the practical application of astringent substances to the cure of diseases, the view which I have taken of this genus of medicines points out the class of diseases in which they are most likely to prove curative.

In *febrile* diseases, Astringents have been extensively employed. In intermittents, most of the vegetable astringents have

occasionally proved successful. It then becomes a question, how do they operate in these diseases? We can form no other idea of the manner in which Astringents prove salutary in ague, than by supposing that they obviate the relaxation and debility which favours the formation of that disease: and on the supposition that this idea is correct, we can readily conceive that tone must be the result of their action on the extremities of the motor nerves; by the effect which this must necessarily produce in the moving fibre, bestowing on it a greater cohesive property and a higher corresponding degree of tone. It is, nevertheless, questionable whether much of the power of vegetable tonics be due to the astringency which they possess; since we find that sulphate of quinia, which is not astringent, cures agues: but whether its powers would be augmented by the addition of Astringents is a point still to be determined. This theory, however, applies to those Astringents only which exert a tonic influence on the system; and it cannot, therefore, explain the manner in which all Astringents cure these diseases. Astringents, however, are seldom given alone; and, therefore, they are to be regarded rather as adjuncts than as primary remedies in intermittent fever. They are not employed in continued fevers, unless to check incidental diarrhœa.

In *inflammatory* diseases, which assume a chronic character and are kept up by debility with increased nervous excitability, such as occur, in some instances and habits, in the eye and the tonsils, Astringents, as local remedies, are of great value. The best Astringents in such cases are the metallic salts of the first division of the Table; but, when this kind of inflammation attacks the tonsils, or when they are debilitated after acute inflammation, gargles, composed of astringent vegetable infusions and decoctions with the addition of the diluted sulphuric acid, are to be employed. Indeed, after the inordinate action in every inflammation is subdued by the use of the lancet, calomel, and purging, nothing tends more to restore the healthy condition of the part than cold and astringent applications: the first and most important effect of which is to contract the diameters of the vessels, and thereby permit the blood to be again freely transmitted through the inflamed part.

In *hæmorrhages*, Astringents are peculiarly indicated, and have been much and successfully employed. Let us endeavour, however, to discriminate under what circumstances they are to be regarded as decidedly fitted to relieve these affections. Hæmorrhages are properly divided into *active* and *passive*. In the first, the habit is in a state of increased tone; the bleeding which occurs arises from a plethoric state of the vascular system, and indeed may be regarded as an effort of nature to relieve this condition, inasmuch as it unloads the distended vessels; and when this occurs, the plethora being reduced, the hæmorrhage

generally spontaneously ceases. It must, however, be clearly understood that hæmorrhage in this state of habit does not imply a rupture of vessels: the blood is exuded from the coats or orifices of the ultimate vessels of the capillary system; how it occurs is not clearly understood; according to Bichat, it depends on what he terms exhalation. Most idiopathic active hæmorrhages are of this kind; and some, also, which are symptomatic of diseased structure—such, for instance, as occur in incipient scirrhus of the stomach, or which proceed from mucous membranes affected with violent inflammation. In this state, the tonic Astringents are undoubtedly improper, and even those exerting a sedative influence should not be employed until the vessels are relieved either by blood-letting or by the spontaneous bleeding, if rupture have taken place. In the second state, passive hæmorrhage, the animal fibre is lax and weak; the blood contains few red particles, compared with those which afford it the florid hue which characterizes its healthy condition; and these are diffused in a superabundant proportion of serum. This change in the relative proportion of the compounds of the blood is demonstrated in sea scurvy, and that singular disease which so closely resembles it, Purpura *hæmorrhagica:* in both cases there is great general debility of the system. In this state of the habit, tonic astringents are most advantageously employed to check hæmorrhage, and may be liberally administered.

In description, these opposite states of the system appear perfectly obvious; but much judgment and attentive observation are often required to distinguish between them in practice. What, for instance, are the circumstances under which Astringents are to be employed in Epistaxis, or bleeding from the nose? When this flow of blood occurs in persons about the age of puberty, and especially those of plethoric habits, it may be critical, or connected with particular congestions, or with a determination to the head. It must not be checked by Astringents; unless it have been so profuse and long continued that the pulse has become weak, the face pale, and the strength is much exhausted. On the contrary, when bleeding from the nose occurs in debilitated habits, in old persons, when it is of an atonic character, or when it is symptomatic of some diseased organ—as, for instance, the liver—then Astringents, although they may be employed to check the direct loss of blood, yet, they cannot be relied upon for removing the exciting cause of the hæmorrhage. The best Astringents in these cases are those that produce a general sympathetic influence, such as cold water applied to the face and back of the neck; solutions of the metallic salts and of alum, snuffed up the nostrils or applied by means of dossils to the bleeding vessels; and, for internal administration, infusion of roses or of kino, or some other of the astringent vegetable substances, acidulated with diluted sulphuric acid. In

hæmoptysis, if the excitement be considerable, after bleeding at the arm, cold water and ice, with binacetate of lead in combination with diluted acetic acid, are indicated. When the effusion of blood from the lungs is considerable, no circumstances should interfere to prevent us from endeavouring immediately to check it: but when it is moderate, and there is no obvious predisposition to tubercular consumption, especially if it be the consequence of a suppression of the menstrual discharge, it should not be checked suddenly, which might induce a congestion in some organ less capable of supporting it with impunity. The kind of Astringent most resorted to in this form of hæmorrhage is, as I have already said, the binacetate of lead; and I have no hesitation in recommending it either alone or in conjunction with opium, in much larger doses than it has hitherto been given. Two drachms of it have been swallowed accidentally, instead of lump sugar, without any inconvenience, except a constriction of the œsophagus and costiveness. It is necessary to remark, that, when it is given in the fluid state with laudanum, vinegar should be added to redissolve the morphia, which is thrown down with the meconate of lead. Indeed, in every case, the remedy is more safe when given in conjunction with diluted acetic acid, which prevents its conversion into the carbonate of lead.

The same practice and cautions are requisite in the employment of Astringents in hæmatemisis and melæna. But there the Astringents can be more immediately applied to the bleeding vessels: cold water, either alone or containing the tincture of muriate of iron or a solution of gallic acid, may be administered by the mouth or per anum. In treating vomiting of blood, however, we must always bear in remembrance that this hæmorrhage is seldom idiopathic, and consequently that the propriety of the administration of Astringents must depend on the nature of the primary disease. The exhaustion which occurs in hæmatemisis also requires some caution in prescribing sedative Astringents, such as the binacetate of lead; and it is even necessary to combine cordials with the Astringent when the sinking is considerable. Solutions of the gallic acid, in combination with an oleo-saccharum, are highly serviceable in this state of the stomach.

In hæmorrhoids, the propriety of employing Astringents depends altogether on the remote cause of the disease. The most common of these is a confined state of bowels; thence purgatives, or rather laxatives, are indicated: when there is heat, hardness, and much pain, leeches should be applied; but after these symptoms are removed, or where they are absent, when the piles are large and the bleeding excessive, then Astringents should be employed. A pint of cold water thrown into the rectum every morning, by means of a gum elastic bag, an ointment composed of powdered gall nuts, or of kino or catechu and

lard, or the solution of the sulphate of zinc with alum, may be administered. When hæmorrhage proceeds from a ruptured vessel high up in the rectum or in the colon, the stomach pump should be used, either to throw in cold water, or infusions of the astringent vegetable bodies, or solutions of the saline Astringents. Whatever be the nature of the astringent solution or infusion, the quantity should not be such as to irritate by distension or to cause too rapid an evacuation of the injected fluid. Accompanying this state of the hæmorrhoidal vessels, we not unfrequently find prolapsus ani, or falling down of the fundament: it also occurs occasionally in children and in old people, from mere debility, on the slightest effort to relieve the intestines of their contents. The return of the gut in this state is easily effected; but it is only by bracing and invigorating the loose and relaxed membrane that we can expect it to remain in its proper place. This is best accomplished by astringent injections; and nothing is better than the infusion of the pomegranate bark, or that of balaustines.

Hæmaturia, or bleeding from the bladder, generally depends upon some organic affection of the urinary organs; but in attending to the primary disease, much immediate advantage is derived from the use of Astringents. I have seen great benefit, in such cases, from the use of uva ursi, which appears to pass unaltered through the kidneys. Since the discovery which I made of the composition of Ruspini's styptic, I have employed a combination of gallic acid with an infusion of the leaves of uva ursi, obtained by rubbing them in cold water.

In mænorrhagia, the use of Astringents is to be regulated by the nature and cause of the disease. They are most beneficial where there is general debility, with relaxation of the uterine organs. Nothing is so useful as cold water, injected, per vaginam, by means of the stomach pump.

In every instance of general hæmorrhage, it must be recollected that more or less hazard exists; that, even whilst the hæmorrhage tends to relieve plethora, it may induce as dangerous a disease; and that, whenever it proceeds to excess, it either endangers life, or a state of debility follows which requires much time to repair. It has also, as Dr. Cullen remarks, "a tendency to increase the plethoric state it was meant to relieve; and thereby to induce a habit which may be attended with much danger. In active hæmorrhages, when Astringents are required, the preparations of lead are to be preferred: in passive hæmorrhages, on the other hand, the vegetable and fossil Astringents; and, among these, alum is both powerful and safe; and it has also another quality which renders its employment preferable to many other Astringents: it can be combined with some of the metallic salts and with some aromatics, without decomposition, if the exhausted state of the patient demand such props.

For external application, or where a medicine can be applied to the bleeding vessels, cold water is undoubtedly the most powerful Astringent. Whatever, however, may be the agent employed, the great object of the application, if rupture of vessels exist, is the formation of a clot or coagulum over the bleeding orifices; and, when this is once formed, rest should be enjoined, all applications suspended, and every pains taken to prevent the clot from being disturbed. When Nature has performed her curative process, and the vessel is again a continuous tube, the clot will fall off and leave the part, although not so entire as at first, yet comparatively sound and sufficient for its function.

The use of Astringents is indicated in dysentery; but their employment requires great caution. Whatever may be the cause of the attack, whether contagion, cold, or vitiated food, dissections of fatal cases have displayed traces of inflammation in the mucous coat of the larger intestines; and there is every reason for believing that no case of dysentery, which has run on beyond the first stage, has ever occurred in which inflammation was absent. If Astringents be indiscriminately employed, they increase the inflammatory tendency, with all its consequences, and produce meteorismus. The principle on which the disease is most advantageously treated is the evacuant; while opiates are given to allay the inordinate irritation, and ipecacuanha to determine to the surface, and maintain the due balance of the circulation. When diarrhœa occurs towards the termination of the disease, and threatens to produce a dangerous debility, and when at the same time the powers of the stomach are much weakened, mild Astringents may be administered; such as small doses of kino or of extract of logwood, with the compound powder of ipecacuanha: but these must not be given together, as is too frequently done; for the astringent vegetable extracts completely destroy the efficacy of the ipecacuanha. When given whilst the griping and tenesmus are present, Astringents have generally been found to augment these symptoms. There is indeed but one circumstance which can authorize their exhibition under such circumstances; namely, when there is a copious discharge of blood; in which case, the diluted sulphuric acid and alum are the remedies to be relied upon. In the latter stage, that period of the disease in which Astringents are admissible, alum and rhubarb, in small doses, in combination with opium, will be found beneficial. In the decline of the disease, also, those substances that produce an astringent effect by their chemical influence, in neutralizing acidity, may be advantageously employed; and with these, as well as with the other Astringents, opium may be beneficially combined, particularly when the patient is still harassed with gripings. Great advantage is also obtained, in this stage of the complaint, from the use of the mineral acids, with sulphate of zinc, or sulphate of copper, or alum and

opium: and a medicine is thus obtained which, at the same time that it exerts a powerful astringent influence on the sanguineous and secerning systems, tends to increase rather than to diminish the peristaltic motion of the bowels. Nitric acid, in combination with double the quantity of muriatic acid, largely diluted with some astringent vegetable infusion, that of simaruba bark, for instance, is also highly proper and very beneficial in this stage of dysentery. Where there is reason for suspecting ulceration of the rectum, weak solutions of a grain of sulphate of zinc or of copper, in three or four ounces of water, may be thrown into the gut as an injection.

Astringents may be administered with much greater freedom in diarrhœa: but even in this disease some attention is requisite to the period of the disease, and also to the choice of the Astringent; the increased peristaltic motion depending on very different causes. Thus, diarrhœa may arise from diet, the aliments being of a too acescent or otherwise indigestible nature; or it may proceed from a vitiated state of the secretions—as, for instance, of the bile or the pancreatic juice, or that furnished by the coats of the intestines themselves—or it may depend on cold applied to the surface, checking perspiration and determining an inordinate quantity of fluid to the intestines; or, finally, diarrhœa may be the result of a laxity in the simple and moving fibres of the whole canal. From the consideration of these causes, the practice in diarrhœa is very obvious. When an acescency is the cause, those Astringents that neutralize acid present themselves; if the acrimony proceed from vitiated secretions, after removing these by the operation of a purgative, we should employ the sedative Astringents in combination with opium; whilst those Astringents that contain tannin and gallic acid, especially infusions of the krameria and tormentilla, or the pomegranate bark, in combination with aromatics, may be freely administered, when the irritability of the intestines depends upon a loss of tone, whether arising from general debility or from causes acting on the intestines alone. It is curious to notice the difficulty of ascribing effects to their proper causes: Dr. Fordyce thought he had improved the practice in diarrhœa by combining Astringents and diaphoretics; and therefore recommended a combination of ipecacuanha and tormentil. We now know that no effect could be ascribed to the ipecacuanha in this combination, as an inert tannate of emetina is formed; consequently that the whole of the benefit must have resulted from the tormentil, which is an excellent Astringent in this disease.

In diabetes, Astringents have been much employed, from the idea that the disease depends upon the laxity of the renal vessels. They were recommended by Celsus, and are supposed to

act by constricting the extreme vessels of the kidneys: they diminish the quantity of the urine, but do not alter its saccharine quality. Sydenham recommends the *malecorium;* whilst kino, catechu, uva ursi, alum, and sulphate of zinc, have each its eulogists. Astringents have occasionally proved beneficial; but they are not to be trusted to in this intractable malady.

In that state of the habit which has been termed Ephidrosis, in which there is immoderate sweating, Astringents are beneficial. It is only, however, when this affection is idiopathic, or the accompaniment of great general debility, that they prove very useful; in which case the diluted sulphuric acid, combined with the decoction of krameria, or some other of the vegetable Astringents, is indicated. When the disease is not chronic, more benefit is likely to accrue from moderating the temperature of the surface and determining the fluids to the abdominal viscera by diuretics and purgatives.

In gonorrhœa virulenta, Astringents sometimes appear to check the usual course of the disease; at others, they apparently increase both it and the inflammation. Thus, in the incipient stage of the disease, when there is slight turgescence only of the lips of the urethra, without any increased secretion, the employment of an astringent injection, sufficiently stimulating to produce some irritation of the internal membrane, will sometimes arrest the disease: and equal advantage results from the same application when there is no pain or scalding in making water, but merely a discharge. The most effectual injections for this purpose, are solutions of the metallic salts, particularly the sulphate of zinc, in the proportion of two grains of the salt to f℥i of distilled water; or the sulphate of copper in the proportion of half a grain to f℥i of water. When the pain and scalding are sharp, the best injection is the binacetate of lead, decomposed by the sulphate of zinc and opium, rubbed up with mucilage to suspend the precipitate, which should not be separated: the vehicle may be either rose or common distilled water, according to the quality of the patient. Another useful injection is formed by dissolving from 5 to 10 grains of alum in a f℥i of water; or an infusion of galls or of kino may be employed. Such are the best Astringents for incipient gonorrhœa, when the symptoms are mild. When, however, on the other hand, the ardor urinæ is considerable, the chordee frequent and painful, when there are sympathetic pains in the loins, groin, and thighs, with much general excitement in the habit, then the employment of Astringents proves injurious: but as soon as the tenderness of the urethra has somewhat subsided, Astringent Injections may be resorted to. Besides those already mentioned, another Astringent Injection has been much vaunted, the solution of twenty minims of the liquor Cupri ammoniati in

four ounces of distilled water: but this solution of the ammoniaret of copper, however, possesses no superiority over the solution of the sulphate of copper.

The use of Astringent Injections, in any stage of gonorrhœa, is objected to by some practitioners, under the idea that they tend to induce strictures of the urethra—an opinion, however, which is not at all supported by experience: on the contrary, it is the long, uncontrolled inflammatory action which is productive of these states of the urinary canal. When gonorrhœa, under any form, occurs in the female, Astringent Injections may be stronger and more freely used than in the male. In both sexes, as the effect of the Astringent on the diseased membrane is transitory, the use of the injection should be repeated at short intervals; for it is by maintaining the artificial action which the injection induces, for a time sufficient to overcome the morbid action, that the cure is effected. But, sometimes, with the utmost care and attention in their application, and with the most judicious discrimination as to the circumstances under which they are employed, Astringents prove either injurious or utterly inefficient in relieving gonorrhœa.

In leucorrhœa, in which the natural mucus of the vagina is greatly augmented, and often connected with a peculiar chronic state of inflammation of the part, Astringent Injections have been freely used. In these cases it is essential to discriminate between mere laxity, inducing an increase of the natural excretion from deficient action in the absorbents, and the discharge of excitement, which differs from the natural mucus both in quantity and quality. In the first, the decoctions of the vegetable astringents, or the solutions of the metallic salts, or the solution of alum, will be found to prove most beneficial: in the second, it is often useful to apply leeches over the pubis, or on the groins, previous to the employment of any Astringent Injection; and, when the period to use one arrives, to select those which operate by exerting a sedative power on the habit.

In all cases of calculi in the urinary passages, the use of Astringents has been followed by beneficial results. It has even been affirmed that calculi have been dissolved by Astringents taken into the stomach; and those who maintain this opinion contend that all lithontriptics possess astringent properties. This opinion may have arisen from observing the effects arising from the administration of uva ursi; but this is not always successful in relieving the pain attending calculus in the kidneys: and when it succeeds, the effects can be explained on more rational principles than those which suppose the solution of the calculus. It is probable that the benefit is to be ascribed to their action upon the first passages, giving tone to the stomach; and, by allaying irritability, favouring a more healthy secretion of the gastric juice, thence a more complete conversion of the

aliment into healthy chyle. The derangement of the stomach, and the formation of acid in that viscus and the intestines, favour the deposition of uric acid in the kidney: whatever, therefore, tends to maintain the tone of the stomach, must necessarily tend to lessen the predisposition to the formation of calculi; and, in this manner, Astringents operate in relieving calculous affections. In many local diseases, Astringents are beneficial; and in some, we solely depend on their influence for a cure. Thus, in whispering *hoarseness*, the result of that weakness which follows repeated inflammatory attacks in the vocal organs, a combination of stimulants and astringents is highly serviceable: for instance, a moderately strong syrup of horse raddish, slowly swallowed, with gargles of solution of alum, or the infusion of the bark of the krameria root, seldom fail to relieve this distressing affection.

Astringents are of much importance in the operations of the surgeon. They are particularly adapted for that species of ulcer which is connected with laxity of vessels: such as is characterized by a livid aspect of the surface, a thin, acrid discharge; and which has existed for a considerable length of time. In such cases, the solutions of the metallic salts, and the powders of the vegetable Astringents, in conjunction with compression, are of the utmost benefit. Strong decoction of oak-bark has been found effectual in curing the tendency to inguinal hernia in children. In many local inflammations, as burns, scalds, and excoriations, the application of astringent lotions is beneficial; nor are they less so in those symptomatic, superficial inflammations attendant on certain febrile states of the habit; namely, erysipelas, erythema, and herpes. In ophthalmia, and in aphthæ, much of the benefit derived from nitrate of silver depends on its astringent power: and in the latter I recommend its adoption in preference to litharge water, in combination with opium, which Dr. Latham has eulogised. Upon the whole, Astringents form a very important class of remedial agents; meriting attention, not only on account of the frequency of their application, but of the nature of many of the diseases which they are fitted to relieve.

SECTION IX.

VITAL AGENTS WHICH OPERATE ON THE SECERNING SYSTEM.

THE description both of the classes and the substances in this division of our subject, will be much better understood by prefacing it with a brief sketch of the functions of the Secerning System.

In the most extended meaning of the term, the Secerning System is that part of the animal frame which separates from the blood, the general nutrient pabulum, the various substances of which the body consists, as well as those necessary for aiding the functions of many of the organs, and those poured out or ejected from the body as excretions. In this definition, however, both nutrition and assimilation are comprehended, and the nutritive and secreting functions confounded. The term *secretion* is better understood when it is confined to imply the separation from the blood of certain fluids, intended either to aid the functions of the same organs—as, for example, the saliva, gastric juice, bile, and pancreatic liquor, which aid those of the mouth, the stomach, and the digestive organs—or to lubricate parts, as the mucus of the urethra; or to prevent the attrition of parts upon one another, as the serous fluid in the abdomen, and the synovial in the joints. Secretion also implies the separation of fluids from the circulating mass, the retention of which would prove detrimental to health—as, for instance, the urine and the cutaneous perspiration. For these various purposes, the Secerning System consists of distinct or dissimilar kinds of organs—*pores*, *capillary vessels*, and *glands*.

It would be out of place here to examine the structure of these organs; and a knowledge of the structure of glands does not elucidate, so much as might, a priori, be expected, the cause of secretion; although it is probable that the intimate structure of the secreting organ influences the nature of the secretion. Secretion is a *vital property;* and there is foundation for the remark, "that the glands possess a peculiar species of vitality, a *vita propria*, distinct from contractility, irritability, and sensibility: for, without admitting this, we can form no idea of the power of organization to produce such varied fluids from the same pabulum; and we must suppose that the elements of the different secretions are spontaneously developed in the blood during its circulation, and only require the aid of the capillary vessels in the glands for their complete elaboration."—This opinion is undoubtedly supported by some facts, but at variance with others. Thus, according to the observations of MM. Prevost and Dumas, when both kidneys are removed, the animal survives for several days, during which the characteristic element of the urine, *Urea*, accumulates in the blood—a fact which strongly supports the doctrine of the spontaneous development of the secretions in the blood: on the other hand, the secretion of milk can only proceed from the peculiar vital action of the gland itself; and other facts tend to favour the opinion, that the secretions are effected solely by the capillaries of the glands. A query here occurs—how far is glandular secretion influenced by the nerves? Every gland is supplied with nerves; but this seems rather for affording that

energy to the organ which is necessary for its healthy condition and its nutrition, than for influencing its function. If a nerve, for example, passing to a gland, be divided or paralyzed, the nutrition of the gland is disturbed; but the secretion is perceptibly diminished: the inference therefore is, that the nervous energy has little influence on glandular secretion. Besides, it has been ascertained that the secretion is carried on in fœtuses devoid of brain and spinal marrow; and it is a function in vegetables, in which no nerves have yet been detected*. Neither are glands possessed of much sensibility, except in a state of disease. There are, nevertheless, some circumstances which countenance the notion that nervous energy influences secretion. Thus, in various affections of the mind, the lachrymal gland is powerfully excited and tears flow: the recollection of savory food will greatly augment the flow of the saliva; and libidinous desires produce seminal discharges. The effect of local excitants, medicinal or mechanical, in increasing secretion, may be also adduced in support of nervous influence on the action of the glands. Thus, the presence of food in the mouth increases the flow of the saliva; the irritation of a bougie in the urethra, that of the urine; the friction of the glands penis in coition, the secretion of the seminal fluid; the passage of the food in the duodenum, that of the bile, and causes an increased flow of it; and every one who has conversed with nurses must be aware of the fact, that the suction of the infant augments the secretion of the milk. Glands sympathize with other organs:—thus, the liver sympathizes with the brain; the mammæ with the uterus; the testicle with the parotids; the kidney with the stomach; and it is from a knowledge of this fact, that, on the occurrence of vomiting, in conjunction with acute pain in the kidney, we are enabled to ascertain the presence of a calculus impacted in its pelvis or its ureter.

Some curious and important facts are connected with the influence of rest, age, sex, climate, health, and disease, on the development and functions of glands.

Rest seems necessary for the function of secretion to be perfectly effected; and this is not confined to man and the warm-blooded animals, but it extends to insects. It is well known that bees, before swarming, suspend themselves for days like a curtain before the hive; the intention of which, as Huber ascertained, is a greater than usual secretion of wax for the foundations of the combs of the new hive. When they first

* In plants, the only distinction between the secreting and other tissue is the closeness of the cells, and their diminished size in the secreting tissue. The simplicity of this structure is no argument against the fitness of it for the secreting function. The wax in the bee is secreted in an hexagonal cellular tissue which lines the wax pockets: but, in the humble bee, it is found occupying the anterior part of the base of the segments where the wax is found, the humble bee having no wax pockets.

form this curtain, the wax pockets of the bees are empty; but if a bee be caught when they take their flight, before beginning to work in the new hive, the wax pockets are more turgid with wax than at any other time.

With respect to *age*—in the fœtus, the liver and the kidneys are comparatively larger than these glands in adult age; they are also more easily separated into lobes, and more largely supplied with blood; but yet they possess no activity, scarcely exerting any secreting power until after the birth of the infant. After birth, the kidneys secrete a large quantity of urine, and the lachrymal gland, which is excited at this period of life by every passion, secretes tears. In adult age, the testicles, which were inert in boyhood, become active: in females, the mammæ swell, and the nipple becomes erectile on the slightest touch. From thirty to forty years of age and upwards, in both sexes, the liver is in great activity, and those diseases which are termed bilious are most common. It is true that mental affections of a distressing kind, such as ambition, hatred, jealousy, tend greatly to induce an irregular action in the liver: but, independent of these mental influences, age powerfully affects it. The salivary and the mesenteric glands are frequently diseased in old age; the spleen and the kidneys become more liable to take on a morbid action as life advances; in old age, the glands become hard, and the secretions are altered; the action of some glands, as the testicles, the mammæ, and the uterus, cease; whilst that of others—as, for example, the mucous glands —is greater than ever; thence the rheums and catarrhs of old age. The secretions also become more sapid and odorous, and communicate these properties to the glands; the kidney has always, at this period, an urinous odour; and many glandular parts of young animals, that are eaten and relished as food, become perfectly unfit for the table in old animals.

Sex, even independent of those glands which characterize the sexes, influences glandular secretion: in women the lachrymal glands are more easily excited than in men; women consequently weep more frequently, and for slighter reasons, than men.

Climate influences glandular secretion: it is more regular and active in temperate climates than in either very cold or very warm parts of the globe.

Season also influences secretion: that of the cutaneous system is increased in summer, whilst that of the kidneys is diminished; and, in winter, the cutaneous excretories are, as it were, shut up, and the action of the kidneys is augmented, and the quantity of urine increased.

It is also unnecessary to remark that, during health, the functions of the secerning system are uniform and regular; but disease varies them in a thousand forms and destroys the organ-

ization of the glands themselves. In hysteria, the kidney being affected, the urine is limpid, yet, as soon as the paroxysm is over, it returns to its natural state: in epilepsy the saliva is more abundant, yet it is thicker and more frothy than it is in a state of health: and some glands, in a diseased state of the habit, are excited by every change in the system, both corporeal and mental. In disease, also, one gland has its secretion sometimes augmented at the expense of another: in the same state, great local and even general excitements diminish glandular activity: thus, in extensive ulcerations, and in dropsy, it is asserted that the system is affected by mercury with great difficulty: but my experience is contrary to this opinion.

With respect to the secretions themselves, they have been arranged by chemical physiologists according to the substance most predominant in each secretion; thus, Dr. Bostock arranges the perspiration and pulmonary exhalation under the head of *Aqueous;* the membranous parts of animals under *Albuminous;* and the saliva, gastric juice, tears, and semen, as *mucous* secretions. He has also formed classes of *gelatinous*, *fibrinous*, *oleaginous*, *resinous*, and *saline* secretions. It is not my intention to criticise this or any other arrangement of secretions. The excreted fluids are, generally speaking, of a more compound nature than those which are retained for the purposes of the system. According to Berzelius, they all contain a free acid, the *lactic;* and in the urine this is united with the *uric*. Urine, he remarks, contains only a single peculiar characteristic matter; but milk has three; i. e. butter, curd, and sugar of milk; which, however, seem to be produced by different organs, that mingle their fluids in the same receptacle. "The perspired fluid appears to have no peculiar matter, but to be a very watery liquid, with scarcely a vestige of the albumen of the blood; and, in short, is the same as all the other excretory fluids would be, if deprived of their peculiar matter." To proceed further with these remarks is unnecessary: I have only to add that, whatever is the cause of secretion, or whatever the nature of the secreted fluid when once separated from the blood, it cannot be again introduced into it without being productive of disease and danger. Bichat injected bile into the jugular veins of a dog, and found that it quickly proved fatal: he also injected urine into the same vessel; the dogs were rendered ill, but did not die. When the secretions are reabsorbed, the same striking effects do not follow, but the health is impaired. Now, the question may be asked, what is the application of this information to our subject —the operation of Vital Agents, as remedies, on the secerning system? One answer only can be given, that which must naturally suggest itself; that the action of no agent upon the animal body can be correctly understood without a knowledge of the functions of the part to be acted upon, as well as of the qualities

of the agent to be employed. To illustrate this by an example —suppose a patient, in whom the complexion is sallow, the albuginea of the eye tinged with yellow, the urine of a deep orange colour, the pulse labouring, and the mental faculties oppressed: I conclude that some cause has either obstructed the excretion of the bile, or that this secretion has overloaded the biliary ducts, and is again absorbed into the circulating mass. How is this to be overcome? If I know that, by stimulating the orifices of the gall-ducts, I shall not only excite that action in these canals which is necessary to empty them of their immediate contents, but also communicate a new action in the gland itself—which, by the increased activity of its secreting powers, will produce a thinner or more fluid bile, less likely to remain in the ducts, and better adapted for the ultimate purposes of the economy—and, if no pain be present to indicate that the obstruction is a biliary calculus, I can proceed with a rational expectation of success in relieving the disease. It is upon this knowledge also that is founded the theories of the modus operandi of eight of the orders of remedies in this class of our arrangement.

To influence the secretions, medicinal agents must exert an excitant power; but every stimulant will not affect, indiscriminately, the whole of the secerning system. Thus, if turpentine be taken into the stomach, its operation will be most apparent on the kidneys and urinary organs; if mercury be introduced into the system, the salivary glands show most decidedly the extent of its action; and, if the remedy be an antimonial, it is upon the cutaneous exhalants that we expect it to operate. This action is also much modified by the extent of the dose; for, as the first effect of every stimulant is local, if the dose be sufficiently large to stimulate locally to a certain extent, the result is seldom that secondary effect which is the consequence of smaller and repeated doses of the remedy. Thus, if turpentine be given in doses of six fluid drachms or a fluid ounce, instead of twenty or thirty minims, the kidneys and urinary organs are not affected, because the remedy, stimulating powerfully the motor nerves of the intestines, is carried through the bowels without being absorbed, and never arrives at the kidney: and the same is the effect of mercurials and other excitants; which, in moderate doses, pass into the circulation and operate on particular glands, or generally on the secerning organs.

As the effect of every stimulant which operates on glands secreting an excrementitious fluid is to increase the activity of the gland, it is evident that the effect of every stimulant of this description must be evacuant; and, consequently, although excitement be the first result of the action of such remedies, yet their secondary effect is undoubtedly that of an opposite kind.

SECTION X.

ERRHINES.—MEDICAMENTA ERRHINA.

Syn.—Sternutatories.

ERRHINES are substances the application of which to the pituitary membrane of the nostrils causes an increased discharge of the natural mucous secretion of that membrane; and frequently of a thinner fluid than natural from the nostrils and the frontal, the sphenoidal, and the maxillary sinuses. Errhines, also, occasionally affect the lachrymal gland, and excite a copious excretion of tears; and, in many instances, they operate as sternutatories. They were formerly called Apophlegmatica; and, when they caused sneezing, Ptarmica.

The pituitary membrane* being the organ on which Errhines exert their influence, it is necessary, in order to understand the nature of their action, to enquire in what manner the natural secretion of the nostrils is effected. It is differently organized in its various parts. It is continuous with the skin, and resembles, in part, this general integument. It is composed of two layers, the exterior-mucous, the interior-fibrous; it is the former only that has any analogy to the skin; the interior being, in fact, merely the periosteum of the nasal bones and cavities. The exterior resembles the skin in its structure; it consists of a very evident *chorion*, about the thickness of that which covers the gums and the palate, serving to support a net-work of exhaling and absorbing vessels, blood-vessels, and nerves, and is covered with an extremely thin and delicate epidermis. In the nostrils, and especially where this membrane covers the turbinated bones, it is softer, thicker, redder, and consequently more vascular than in the sinuses, where it is covered by a more limpid secretion than in the nostrils, which are the principal passages of the air which we breathe, and which, consequently, require to be kept constantly refreshed with moisture: the mucous secretion is supplied by follicles, the simplest of all glands. The supply is required to be constant; and, in the healthy state of the body, to be of a certain spissitude, and bland in its nature; after some time, however, it thickens, concretes, and, irritating the sensitive surface of the membrane, requires to be removed; for, although this fluid is secreted in the membrane, yet, after its aqueous particles are evaporated by the constant passage of the

* This membrane is also named Schneiderian, after a distinguished anatomist of the 17th century, whose work, "De Osse Cibriforme et Sensu ac Organo Odoratus," published in 1665, put an end to the absurd doctrine that this membrane is an emunctory of the brain.

air through the nostrils, it becomes as great a source of irritation to the membrane as if it were an extraneous body. Habit has taught us to relieve ourselves of this source of uneasiness by blowing the nose; but it is probable that the intention of Nature, in the irritation caused by this state of the mucus, is to produce an increased secretion; which, being in a more fluid state, would loosen and throw off that which has become too thick. This points out the means of increasing this secretion by applying something irritating to the membrane that supplies it. Such substances, whatever may be their nature, are Errhines.

Every excitement of the mucous surface produces a corresponding increased action in the glands, which are situated beneath it, and the ducts of which open upon it; for the irritating matter is not applied to the glands themselves, but to their excretory ducts; and this effect in the nostrils is only in accordance with the law which regulates the whole glandular system—that the susceptibility of the gland always corresponds to the irritation of its excretory ducts. Thus we find, that the irritation of the mucous membrane of the nostrils stimulates the excretory ducts of the secreting follicles, and not only increases the flow of the natural mucus, but produces a thinner and more acrid secretion than that which is more slowly and naturally secreted. Every mucous surface has its peculiar sensation necessary to excite the unloading of its mucous secretion; that of the organ under our present consideration is a titillation, which either obliges us to blow the nose, or which loosens the mucus in the manner which I have described, or produces sneezing and ejects the concreted mucus in a forcible manner. In whichever mode it is effected, the object is the removal of the thickened mucus, now unfit for the lubrication of the air passages, and the maintaining the olfactory nerves in a proper state for receiving the impression of odorous bodies to constitute smelling.

Every unusual excitement causes in the pituitary membrane a state of vascular action approaching to inflammation; and when this extends beyond a certain degree, actual inflammation is produced, which for some time contracts the excretory ducts of the glandular cullender, "les couloir glanduleux*," and stops the secretion. This is obvious in the commencement of catarrhal affections: the nostrils become dry, and it is a symptom of the resolution of the inflammatory action in the part when the nostrils begin to discharge freely. It is probable that these membranes are more susceptible of inflammation than other mucous surfaces, from their constant exposure to the action of the atmospheric air in every act of inspiration. The vascular webb, if I may employ such a term, which is spread

* Bichat.

over them is full of blood, and, being separated from the air only by a very thin pellicle, the membrane is always red. It is not improbable that it derives this colour, as Bichat has suggested, from its either separating a portion of the carbon of the blood or absorbing oxygen; or, as more modern physiologists suppose, from the alkaline character of the secretion: thus, in a certain degree, acting as an accessory to the lungs. Be this as it may, the red colour of the pituitary membrane depends on the abundance of arterial blood with which it is supplied; and it is the increased action of the arteries to a degree short of positive inflammation which augments the secretion of the mucous follicles and the consequent flow of the mucus. In the adjoining communicating sinuses the membrane is thin and supplied with few arterial vessels; but it is covered with vessels of a peculiar nature, that exhale a watery vapour, that, condensing, is poured into the nostrils, in every position of the body. This affords the very copious supply of watery discharge which proceeds from the nostrils in catarrh, amounting in some cases to several fluid ounces in the course of a day; it is from the same portion of this membrane, also, excited by its continuity with that part of it which covers the nostrils, when stimulants are applied to them, that the greater part of the discharge caused by the use of Errhines is derived.

All excitants act by the impressions which they make upon the nervous energy. Now, as the first pair of nerves is spread upon the membrane covering the septum of the nostrils and the turbinated bones, it is reasonably supposed to be the nerve of smelling. It does not terminate in papillæ like the gustatory nerve; but its twigs deliquesce, as it were, in the spongy pituitary membrane, and consequently render every point of it sensitive of odours. From its exposed nature rendering it liable to irritative impressions, we might, a priori, suppose that those substances which are most odorous would prove the most powerful Errhines: but this is not the case: some of the most powerful are altogether devoid of odour. This is readily explained: although the first pair of nerves bestows the sense of smelling, yet the simple sensibility of the nostrils depends upon branches from the fifth pair distributed on the Schneiderian membrane, both in the nostrils, and in the sinuses where none of the twigs of the olfactory nerves extend. It is the impression of Errhines upon the filaments of the fifth pair, that induces the augmented secretion, and the consequent discharge from the nostrils and the adjacent cavities. Pungent odours, it is true, increase the flow of the pituitary secretion; but their acrimony irritates the mucous membrane of the nose, upon the same principle as it irritates the conjunctiva, or outer membrane of the eye, when it is exposed to such odours—an effect altogether independent of the odorous principle, which is perceived

through the medium only of the first pair of nerves. Were the first pair of nerves, therefore, destroyed, as in some experiments made by M. Majendie, pungent odours would still affect the nostrils, although no odour would be perceived*. It is almost unnecessary to say that inflammation augments greatly the sensibility of the pituitary membrane; and the application of acrid matters to it, in such a condition, is not only painful, but in some degree dangerous. It is, nevertheless, true that habit exerts its influence in modifying the impressions upon this organ more than upon any other; many impressions which are at first not merely unpleasant, but painful, become pleasurable by repetition; so that Errhines—snuff, for example—at length, from this cause, lose the power of exciting either vascular action or sensation. It is singular, however, that age, which renders the pituitary membrane less vascular and less sensible, should not in general diminish the secretion of the mucous follicles; on the contrary, the mucous discharge increases as age advances, and constitutes a chronic catarrhal affection, or snivelling, which is not uncommon in the last years of a long life.

Sympathy exerts a considerable influence upon the pituitary membrane. If hæmorrhage occur in it, cold applied to the skin of the neck contracts the exhaling overloaded vessels of the membrane and stops the bleeding. In inflammation of this membrane, also, fomentations applied to the face allay the excitement; and, in some diseases of the skin—for example, scarlet fever in its severest form—this membrane becomes inflamed and ulcerated.

With regard to the nature of the discharge which the pituitary membrane secretes, the experiments of Berzelius have ascertained that the ingredients in one thousand parts are

Water	933.7
Mucus	53.3
Muriates of Potassa and Soda . . .	5.6
Lactate of Soda with Animal Matter . .	3.0
Soda	0.9
Albumen, with a trace of Phosphate of Soda	3.5
	1000.0

It thus appears that the chief ingredients are water and mucus; yet, in disease, the secretion is so much altered, that it becomes grey and green, and so acrid as to excoriate the upper lip; and to taste saline. That this arises from the action of the vessels, and not from any alteration in the components of the blood affording the secretion, is probable, when we reflect that the greatest changes are produced by the inflammatory process

* The want of attention to this particular led the French physiologist into an error in attributing the sense of smelling to the fifth pair of nerves.

in other mucous membranes; the discharge sometimes assuming the character of pus without any abrasion of the mucous surface. In ordinary health, the vicidity of this mucus seems to depend on the evaporation of the watery portion; thence, in hurried states of the respiration, the nostrils become dry and the mucus viscid and concrete.

From a knowledge of these functions of the pituitary membrane, we perceive clearly that the effects of Errhines result from their increasing the natural vascular action of the part within a certain limit; and we learn, also, that beyond that limit, instead of promoting the flow of a watery discharge from the nostrils, they tend to check it, by causing inflammation: thence the necessity for moderating the acrimony of Errhines by uniting them with inert powders. We can also more readily comprehend the manner in which Errhines relieve inflammatory affections of the brain, the face, and other adjacent parts, for which they are chiefly employed as remedies. And, with this knowledge, we arrive at these conclusions: 1°. that Errhines are stimulants acting immediately upon the sensibility and irritability of the Schneiderian membrane: 2°. that they relieve inflammation in the neighbouring organs, partly by the counter irritation which they produce, causing an afflux of fluids from the neighbouring congested or inflamed parts into the excited membrane, and partly by the permanent diminution of the quantity of the blood, caused by the augmented secretion which is induced and the continued emptying of the mucous follicles. To elucidate this position, let us suppose an instance of ophthalmia, or inflammation of the eyes: there can be no difficulty in conceiving that in this case the diseased organ is as likely to be relieved by exciting an artificial discharge from the nostrils as by a blister behind the ear, or on the temples, or by any other counter-irritant.

As the first effect of several substances employed as Errhines is the excitement of sneezing, I cannot, with propriety, omit noticing this result of their action before proceeding to describe the particular Errhines.

The act of sneezing is produced by irritating the sensitive extremities of the branches of the fifth pair of nerves distributed to the pituitary membrane, which, by the connection of that nerve with the eighth pair, the great sympathetic and the phrenic nerves, calls into simultaneous action the diaphragm and the whole of the respiratory muscles so suddenly, after a full inspiration, as to expel the air from the lungs forcibly through the mouth and nostrils. It tends to clear the nostrils of concreted mucus, and so far is productive of benefit; but in some cases it is productive of serious mischief. Thus, in a case which lately came within my knowledge, a lady was afflicted with violent headache, accompanied with that sensation which is termed

stuffing of the head. Many means tried for her relief proved ineffectual. A physician was called in, who prescribed snuff as a sternutatory: it produced violent sneezing, and ejected from one of the nostrils a plug of hardened mucus, nearly an inch in length; after which she felt immediate relief, and in twenty-four hours was perfectly recovered. On the other hand, in a young lady, who had an affection of the ethmoid bone, an attack of sneezing, in a few hours, proved fatal. Many instances, also, are recorded in which sneezing has produced immoderate bleedings from the nose, epileptic fits, and apoplexy; and, consequently, those errhines which were formerly regarded as sternutatories are now seldom prescribed*.

Every substance that can stimulate the pituitary membrane may be employed as an errhine; and, consequently, numerous examples might be selected from the animal, the vegetable, and the mineral kingdoms; but a few only are employed as errhines, and to these it is necessary to direct our attention. They may be used either in the state of fine powder, or in infusion or decoction, or in vapour: in all these states the desired effect is obtained.

TABLE OF ERRHINES.

* ORGANIC PRODUCTS.

a.—VOLATILE OIL, in combination, in

Roots	—Iris *Florentina*	3 . 1 .	Irideæ.
Herbs	—Origanum *Marjorana*	14 . 1 .	Labiatæ.
Leaves	—Asarum *Europæum*	— . – .	Aristolochiæ.
Flowers	—Lavandula *Spica*	— . – .	Labiatæ.
	Rosmarinus *Officinalis*	— . – .	———

b.—ACRID RESIN, contained in the secreted juice of

Euphorbia *Canariensis*	11 . 3 .	Euphorbiaciæ.
Nicotiana *tabacum*	5 . 1 .	Solaneæ.

c.—VERATRIA, contained in

Veratrum *album*	23 . 1 .	Melanthaceæ.

* * INORGANIC SUBSTANCES.

d.—Hydrargyri subsulphas.

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* The following singular fact came under my observation. A lady, liable to periodic attacks of gout, was always apprized of the approach of the paroxysm by successive fits of sneezing, which generally continued for ten or twelve hours previous to the commencement of the attack, and terminated when the pain was felt in the foot. I can account for this circumstance only by supposing, that the gouty diathesis so altered the usual state of the pituitary membrane as to render it susceptible of the impressions even of the air; and thence it is possible that, although the mucous follicles are not excited sufficiently to enable them to empty their contents, yet, the passage of the air, in a highly irritable state of the membrane, may induce the paroxysm of sneezing, previous to the attacks of gout.

* ORGANIC VEGETABLE SUBSTANCES WHICH OPERATE AS ERRHINES.

a. VOLATILE OIL. *Oleum Volatile.*

On account of the solubility of volatile oil in air, the plants containing it might be supposed to be well adapted for stimulating the pituitary membrane; but, in these, the oil is so much sheathed, that it does not exert the necessary influence on the secreting surface of the nostrils; therefore, most of these plants are better adapted as vehicles for more efficient errhines, than for exerting errhine properties themselves.

* *Roots.*

1. IRIS FLORENTINÆ RADIX. *Root of Florentine Iris.* E. —The root of the Florentine Iris contains volatile oil in combination with fecula. It is a native of Greece; and it is probable that this species was that which the ancients employed. Its specific name points out the place in which it is most abundantly found in its native state. The plant holds a place in the natural order Irideæ*. It is found wild in Carniola and the island of Rhodes and Laconia; and is cultivated in our gardens. The roots are imported from Leghorn, denuded of the cuticle and of the radical fibres. They break with a rough fracture, are easily pulverized, have a sweetish, bitter taste, with some degree of pungency, and the agreeable odour of the violet. Besides volatile oil and fecula, they contain a portion of gum or mucus, some saccharine matter, malic acid, and, according to the analysis of Vauquelin, a fixed oil. The volatile oil is crystallizable.

The Errhine properties of the Iris root depend wholly upon the volatile oil; none of the other ingredients having any stimulating qualities. Judging, however, from the analogy of the effects of the recent, expressed juice of the root of the Iris *Pseud-acorus*, which is employed by the peasantry in the south of Scotland as a sternutatory, and is violent in its effects, we may suppose that the Florentine Iris Root, in its recent state, is also active, and contains some acrid principle, which is dissipated in drying; and this is the more probable from the fact that, in the recent state, the root nauseates and purges violently; neither of which effects is produced by it in the dry state. Even as an Errhine, it operates mildly; therefore, the pulverized root is employed merely as a vehicle for more powerful Errhines.

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* Woodville's Med. Bot. third edit. p. 776, pl. 262. London Dispensatory, art. Iris. Richard, Hist. Nat. Med. t. i, p. 409. According to Dioscorides, the name Iris is derived from the variety of colours in the genus. "Iris a cælestis arcus similitudine nomen obtinuit."

* * *Herbs and Leaves.*

1. ORIGANI MARJORANÆ HERBA. *Sweet Marjoram.* E. D. —This plant, which belongs to the natural order Labiatæ*, although a native of Syria, yet is now naturalized to our variable climate: it has an agreeable odour and a warm bitter aromatic taste, depending on the volatile oil which it contains. It possesses scarcely any errhine properties; and is chiefly useful as an agreeable addition to the compositions termed cephalic snuffs, pulveres sternutatorii.

2. ASARI EUROPŒI FOLIA. *Leaves of Asarabacca.* L. E. D. —Asarabacca is an indigenous plant, found in woods and shady places, flowering in May. It belongs to the natural order Aristolochiæ†. Besides volatile oil, it contains an acrid fixed oil, and a peculiar principle termed *Cytisine*, a substance resembling an extract, of a dark yellow colour, bitter, nauseous, and attracting humidity from the air. Cytisine is very soluble in water and in weak alcohol; and nearly insoluble in strong alcohol and in ether. It possesses neither acid nor alkaline properties; is not precipitated by those tests which usually affect vegetable products, namely, the acetate of lead, the nitrates of silver and of mercury, the sulphates of copper and of iron; nor by the hydrochlorates of baryta, lime, tin, and strontian. With tincture of galls it forms an insoluble tannate. Notwithstanding these negative properties, *cytisine* acts with violence on the animal œconomy, producing vomiting, purging, and inflammation of the intestinal canal. M. Chevalier, who discovered this principle in the seeds of the Laburnum, Cytisus *Laburnum*, was nearly poisoned by taking only eight grains of it; and children have been killed by eating the seeds of the Laburnum.

M. J. L. Lassaigne and M. Feneulle analysed the roots of Asarabacca, and found in it—1. a concrete volatile oil, apparently camphor; 2. an acrid fixed oil; 3. cytisine; 4. fecula; 5. gum; 6. ulmin; 7. citric acid, besides citrate of lime and malate of lime; 8. an acetate; 9. a salt with an ammoniacal base and some mineral salts. Several of these substances are not found in the leaves. In the decoction, persulphate of iron detects the ulmin by throwing down an olive-coloured precipitate; the gum is rendered evident by subacetate of lead; but no fecula is detected by iodine: cytisine is demonstrated by infusion of galls; and the salts of lime by oxalate of ammonia. The taste and odour of the plant undoubtedly depend on the acrid fixed oil, which both tastes and smells like pepper; on which

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* Woodville's Med. Bot. third ed. p. 346, pl. 124. London Dispensatory, art. Origanum. Richard, Hist. Nat. Med. t. ii, p. 57.

† Woodville, p. 170, pl. 66. London Dispensatory, art. Asarum. Richard, t. i, p. 433.

account, although the French physicians ascribe the Errhine properties of this plant to cytisine, yet I am induced to believe that more is due to the volatile and acrid oils. Be this as it may, Asarabacca is a good Errhine. In the recent state of the plant, it operates too powerfully, inducing not only a greatly augmented mucaginous discharge from the nostrils, but frequently a discharge of blood. It loses much of its acrimony by keeping; but it retains enough for the purposes of an Errhine: heat dissipates the volatile, and alters the fixed, acrid oil; on which account the plant should be dried without the aid of fire.

The recent plant has been employed as an *emetic* and a *diuretic;* but, it is not used except as an Errhine*. The powdered leaves form the active part, and one half, of a compound errhine powder, ordered by the Edinburgh and Dublin Colleges, under the name Pulvis Asari compositus. Dr. Cullen has justly remarked that Asarum is one of the most useful and convenient of the Errhines. The effect is not immediate, but takes place after some time has elapsed. In doses of a few grains, snuffed up the nostrils, for several successive evenings, it causes a copious watery discharge from the nostrils, which continues to flow for several days together.

*** *Flowers.*

1. LAVANDULÆ SPICÆ FLORES. *Lavender Flowers.* L. E. D.—The plant yielding these flowers is a native of the south of Europe, naturalized to our climate: it belongs to the natural order Labiatæ†. On account of the fragrancy of their volatile oil, the flowers enter into the composition of cephalic snuff.

2. ROSMARINI OFFICINALIS FLORES. *Rosemary.* L. E. D.—This plant is also one of the Labiatæ‡. It possesses excitant and tonic properties, and is sometimes prescribed, in the form of infusion, to relieve headache and hysteria. It is an agreeable addition to cephalic snuff.

c. ACRID RESIN.

This is found in two plants, Euphorbia *Canariensis* and Nicotiana *tabacum.*

1. EUPHORBIÆ GUMMI RESINA. *Euphorbium.* L.—Eu-

* M. Thiebaud, of Berneaud, and M. Tenore have recognized the *Baccaris* of Virgil, which was formerly used in making crowns, to be this *Asarum:* it is found in great abundance in all the mountainous districts in Italy.

† Woodville's Med. Bot. 3d edit. p. 321, pl. 114. London Dispensatory, art. Lavandula. Richard, Hist. Nat. Med. t. ii, p. 45.

‡ Ibid, p. 329, pl. 117. London Dispensatory, art. Rosmarinum. Richard, Hist. Nat. Med. t. ii, p. 29.

phorbium is the concrete proper juice of the Euphorbia *Canariensis*, a plant belonging to the natural order Euphorbiaceæ*. In the London Pharmacopœia it is improperly stated to be the product of the Euphorbia *officinarum;* for, although the proper juice of this species, as well as that of all the species of this very extensive genus, is nearly the same, yet the Euphorbium brought to this country is the product of the *Canariensis*†. It is, as its name implies, a native of the Canary Islands. It rises with a straight, articulated, quadrangular stem, which gives off lateral, similarly jointed branches, devoid of leaves, but furnished with hooked prickles on the angles: the *officinarum* has eight or more angles; the *antiquorum*, which yields the Euphorbium chiefly used on the Continent, has only three.

With regard to the manner in which the juice concretes into the forms in which it is sent to this country, there are various opinions. Bruce, in his Travels in Abyssinia, describes the *officinarum* under its Abyssinian name, Kollquall. In speaking of the flowers, which shoot out on the tops of the branches, he says, "The trees, that stood thick together, appeared to be covered with a cloth or veil of the most vivid crimson colour." He remarks that, on cutting two of the finest branches of a plant in full vigour, four English gallons of the milky juice issued from the cut surfaces, and made an indelible stain upon his sabre, although he immediately washed it. On striking a withered branch, the dust which flew out "seemed to threaten," he says, "to make me sneeze to death;" and touching the milky juice excoriated his finger as if scalded with boiling water. He denies that the juice ever exudes spontaneously; and, therefore, justly concludes that this is not the plant which supplies the Euphorbium for Europe. Mr. Jackson, in speaking of one species, apparently the *antiquorum*, says that slight incisions are made into the plant with a knife, and the juice that exudes concretes into tears of an oblong or roundish form. On examining the form of the pieces in the Euphorbium brought to this country, I am of opinion that the juice must exude spontaneously from the *Canariensis;* for it is almost all of the same form, as if it had been moulded upon the capsules, which are often found imbedded in the Euphorbium. It is in small, hollow, somewhat forked pieces; inodorous; and, when chewed, at first nearly insipid, but soon impressing a hot sensation to the

* Woodville's Med. Bot. third edition, vol. v, p. 74. London Dispensatory, art. Euphorbia. Richard, Hist. Nat. Med. t. i, p. 575.

† The name was bestowed on the genus in honour of Euphorbus, the physician of Juba, king of Lybia. The brother of Euphorbus, Antonius Musa, was physician to Augustus Cæsar, who raised a statue to his merits. In noticing this anecdote, Linnæus quaintly remarks on the evanescent character of the productions of art, compared with the permanency of those of Nature: Ubi jam Musæ statua? Periit! avanuit! Euphorbii autem perdurat, perennat, nec unquam destrui potest." *Crit. Bot.* 39.

mouth, and gradually giving to the tongue, the palate, throat, and pharynx, an acrid or burning feeling, which is almost insupportable. When retained for some time in the mouth and masticated, it inflames, corrodes, and ulcerates.

Euphorbium is mentioned in the London Pharmacopœia as a gum-resin; but chemical analysis has demonstrated that it contains no gum. It has been analysed both by Braconnot and Pelletier, who have found the same substances, although in different quantities. The products of the analysis and the quantities given by each are—

	Braconnot.	Pelletier.
Resin	37.0	60.80
Wax	19.0	14.40
Malate of lime	20.5	12.20
——— of potassa	2.–	1.80
Woody matter and bassorine	13.5	2.00
Water and volatile oil	5.0	8.00
Loss	3.–	—.80
	100.0	100.0

When alcohol is poured over powdered Euphorbium and boiled and filtered, a quantity of wax is deposited on cooling, and resin remains in solution. The wax, when well washed with alcohol, is insipid; the resin is acrimonious, and burns when applied to the tongue. The insoluble residue, when acted upon with pure water, independent of waste from morsels of wood and other extraneous bodies, is mostly malate of lime. The resin is slightly deliquescent, owing to its containing malate of potassa, which can be separated from it by boiling it with distilled water: when pure, it is transparent, reddish, idio-electrical when rubbed; and is the active part of Euphorbium. This resin is insoluble in alkalies, but soluble in sulphuric and nitric acids; thence it differs from most other resins.

Euphorbium, applied to the skin or to the mucous membrane, quickly produces the most painful and violent irritation. It is so acrid, that those who pulverize it are obliged to defend the nostrils, the eyes, and the mouth. I shall have a future opportunity of explaining the effects of Euphorbium when taken into the stomach. Orfila, who made numerous experiments on dogs with it, found that, by applying it to the thigh of a dog denuded of the cuticle, it produces so intense an inflammation in the part, extending to the adjacent parts, as to cause death; but, on opening the body, neither the lungs nor the primæ viæ presented any marks of having suffered. It is a powerful Errhine, but requires to be largely diluted with some bland powder, either starch or liquorice root powder; in which state it operates effectually and beneficially.

2. Nicotianæ Tabaci Folia. *Tobacco.* L. E. D.—To-

bacco, as has been already stated (p. 326), owes its efficacy to acrid oil, in combination with a peculiar alkaline principle named *Nicotina*, which was discovered by Vauquelin in 1809.

Every part of Nicotiana *Tabacum* is acrid, and contains the active principles for which the leaf is prized.

In Virginia the Tobacco is gathered before it flowers, when the leaves have attained their full size, and have a dark green colour, and feel crisp. The plants are cut over at the surface of the ground, and suspended under an open shed, two and two, tied together, but sufficiently apart from each other so as not to touch. In this state they remain till the leaves are perfectly dry; when stripped from the stalks they are tied in small bundles, a leaf serving to tie them together. These bundles are then laid in heaps, in sheds, to favour fermentation; and, to forward it still more, the heaps are covered with blankets or layers of straw. To prevent them from overheating, they are occasionally opened and spread abroad in the air: and, as soon as all danger of this is past, the bundles are packed in casks for exportation to Europe. Dried Tobacco leaves have a brownish-yellow colour; a strong and not very agreeable odour; and a bitter, acrid taste. When burned, they emit sparks, and continue to burn like paper which has been soaked in nitrate of potassa, on which salt, indeed, the deflagration of Tobacco depends. Distilled, without the addition of water, they yield a green volatile oil, which is a virulent poison. At the Cape of Good Hope and Van Dieman's Land, this oil, accumulated in the tubes of old smoking pipes, is employed for killing snakes. "A Hottentot," says Mr. Barrow, "applied some of it, from the short end of his wooden tobacco pipe, to the mouth of a snake, while darting out his tongue. The effect was instantaneous as an electric shock: with a convulsive motion that was momentary, the snake half untwisted itself, and never stirred again; and the muscles were so contracted that the animal felt hard and rigid, as if dried in the sun." Tobacco yields its properties to water and to alcohol. The expressed juice of the fresh leaves, analysed by Vauquelin, were found to contain a considerable quantity of vegetable albumen or gluten; supermalate of lime; acetic acid; nitrate and muriate of potassa; a red matter, soluble in alcohol and water, which swells considerably when heated, but the nature of which is unknown; muriate of ammonia; a peculiar, acrid, volatile, colourless substance, Nicotina, which has the odour of Tobacco, and is the principle that distinguishes it from every other vegetable product. Some of these principles are detected in infusion of Tobacco by reagents: thus, the gluten is precipitated by infusion of gall-nuts; oxalate of ammonia decomposes the supermalate of lime, and

throws down an oxalate of lime; and that the salt is a malate, is proved by the persulphate of iron precipitating a brown malate of iron.

The history of the introduction of Tobacco into Europe, and its use as a luxury, is so curious and interesting, that I will make no apology for presenting a brief sketch of it.

There is no record of the period when Tobacco was first used in South America. Humboldt says it has been cultivated from time immemorial by the natives of the Oroonoko; and it was smoked over all America at the time of the Spanish conquest. It was also used in the religious ceremonies of the Indians; the smoke of a few Tobacco leaves thrown upon the fire, produced the same effects on the officiating Piachè as the mephitic vapours on the Pythean priestess of Delphos; the smoke was received into the open mouth of the priest, who thus became intoxicated, and fitted to utter the mystical jargon which was regarded as oracles by the misguided multitude. Tobacco was found by Cortes in use in Yucatan, in 1519; but it had been seen smoked on the occasion of an amicable interview between Gonsalvo, a Spaniard, and the Cazique of Tabasco, which took place in the previous year. In Asia, where it is now an almost absolute necessary of life, it was unknown until after the discovery of America. It was first sent to Europe, to the court of Portugal, by Hernandez de Toledo, in 1559; and Jean Nicot, being then the French ambassador at the court of Lisbon, having sent some of the seeds to Catharine de Medicis, they grew; and the plant was named Herba Reginæ: it was, however, afterwards called Nicotiana, after *Nicot*. The specific name, *Tabacum*, according to some, is derived from Tabasco*, the name of the place where the Spaniards first saw it smoked; according to others, from Tabac, the name of the instrument or reed used by the Americans in smoking the leaf: the first derivation is the most probable.

Although Linnæus honoured Nicot with the generic name of the plant, yet some species were discovered in the island of St. Domingo, before 1518, by a Spanish hermit, Roman Panè. It was cultivated before 1580, in Spain, France, Italy, and Portugal; and was introduced into England by Sir Walter Raleigh, who certainly, by his example, and that of his crew, brought smoking into use. It had, however, a royal opponent in James the First, who published a philippic against it, "The Counterblaste to Tobacco," in which he remarks that smoking is a custom "loathsome to the eye, hateful to the nose, harmfull to the braine, dangerous to the lungs; and, in the black stinking fume thereof, neerest resembling the horrible Stygian smoake

* Tabasco was indiscriminately called Tabaco.

of the pit that is bottomless*:" a sentiment in which although some might accord, yet from which many would strongly dissent. The same monarch proposed, "as a banquet for the devil, a loin of pork, and a poll of ling and mustard, with a pipe of Tobacco for digestion:" he endeavoured to abolish its use by a heavy penalty, and enacted that no planter in Virginia should cultivate more than 100lbs. of it: but the advantage derived to his revenue soon produced the abolition of these restrictions. An edict had been previously published against its use in the time of Elizabeth, in which the reason for prohibiting it is a fear lest Englishmen should become like the barbarians from whom its use was derived—"Anglorum corpora in barbarorum naturam degenerasse, quum iidem ac barbari delectentur†." But it was not in England alone that war was waged against Tobacco: in the 16th century (1590), Shah Abbas prohibited its use in Persia; but, as the punishment was penal, many of his subjects, rather than discontinue smoking, fled to the mountains: in 1624, Urban VIII excommunicated all who committed the heinous sin of taking a pinch of snuff in church; in 1653 all smokers in the Canton of Appenzel were cited before the council and punished: in the year 34 of the same century, the Russians, whose peasanty now smoke all day long, were forbidden to smoke under the penalty of having the nose cut off: and Amurath VII also rendered smoking a capital offence. In Russia, indeed, the animosity against the use of Tobacco, in any form, was so great, that a particular tribunal was instituted for punishing smokers, the Chambre au Tabac; which was not abolished until the middle of the 18th century. So late as 1690, Innocent XII excommunicated all who took snuff in St. Peter's; and, in Constantinople, where the use of Tobacco, in every form, is now as common as eating, every Turk who was found smoking was paraded in the streets, with a pipe transfixed through his nose and seated on an ass with his face towards the tail; one reason for which was, that it was supposed the use of Tobacco rendered the men impotent; and, certainly, if taken in excess, such a result is likely to follow from its use. But, like many other bad customs, Tobacco triumphed over all its opponents; and has become almost universal: even in the islands of the Pacific, where it was introduced by Europeans, its use is carried to the most ridiculous excess. "In the Sandwich Islands," says Kotzebue, in the narrative of his Voyage of Discovery, "it is so generally used, that children smoke before they learn to walk; and grown-up people have carried the practice to such an excess, that they have fallen down senseless, and often died in consequence."

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* Apophthems of King James, 1671. † Ann. Eliz. p. 143.

But if smoking be carried to an excess, snuff-taking is still more so*. Nothing would be more curious than a collection of snuffs from various parts of the world; and their history would form a singular specimen of the ingenuity idly exercised in varying the form and quality of a powder intended for the titillation of one set of nerves. The snuffs of this country, like the varieties of sheep and of geraniums, may all be regarded as proceeding from one stock; or, as cross breeds, if the term can be tolerated, from the Rappé, which is nothing more than snuff ground from all the Tobaccoes that are grown, mixed together and fermented. Rappé derives its name from having been originally produced by rasping what is called Carrot Tobacco; that is, the leaves of tobacco freed from its stems, fermented, and pressed closely together into the form of a carrot, or rather spindle. Scotch snuff, which is also the basis of many varieties of snuffs, is ground from Tobacco, with the stalk left on the leaf: it is first fermented, then dried before a strong fire, and afterward ground in mills resembling a large pestle and mortar. It would be impossible to mention one half of the snuffs in use. In their manufacture, it has been asserted that salt, urine, sal ammoniac, and even ground glass, are added to the Tobacco: but I am informed by a large manufacturer that nothing of the kind is employed, and that all depends on the preparation of the Tobacco leaves, by drying, and the degree of fermentation which they have undergone.

Upon the animal œconomy, Tobacco operates as a local stimulant, and a narcotic; it is the former only that we have now to consider. Applied to the petuitary membrane, it augments the flow of mucus, on those principles which, as I have already explained, regulate the action of Errhines. Applied externally, it, however, causes inflammation in parts susceptible of it: but, like other stimulants, the repetition of the impression diminishes the sensibility and irritability of the part to which it is applied. Thus, snuff-takers lose the susceptibility of impression on the Schneiderian membrane, and therefore are forced to increase the power of the stimulant by increasing the quantity snuffed up at once, as well as the frequency of its application. Snuffing is the most frequent and the least injurious mode of using Tobacco; although, in those unaccustomed to it, it causes nausea and vertigo. In great snuffers the stomach frequently suffers; dyspeptic symptoms supervene, with pains and a sensation of twisting in the bowels—effects which may result from the snuff passing into the pharynx and being swallowed; although it is also possible

* An amusing fact, connected with the opposition to the general use of Tobacco, is related of Fagon, physician of Louis XIV. In the midst of an oration on its pernicious effects, the orator made a pause, and, taking his snuff-box from his pocket, refreshed himself with a pinch, to enable him to renew his argument.

that they may proceed from sympathy. Instances daily occur in which quantities of snuff are coughed up by great snuff-takers; and Dr. Alston says that some persons have thrown up balls of snuff*. It is generally injurious in weak and what are termed nervous subjects: some practitioners, indeed, among whom is the celebrated Lorry, has ascribed the more frequent occurrence of nervous diseases to the daily excessive use of snuff. Upon the whole, however, it is probable that the statements respecting the baneful effects of snuff are greatly exaggerated. In the manufactories of snuff in France, in which upwards of 4000 persons are employed, it has been ascertained that the workmen become habituated to the atmosphere of the manufactory; that they are neither subject to special diseases, nor to disease generally; and that they live, on an average, as long as other tradesmen.

Tobacco, as an Errhine, has been used in epilepsy supposed to proceed from a full or plethoric state of the vessels of the head. From the quantity of fluid discharged, a depletion of the whole of the vessels of the head is supposed to result: but, from its narcotic property, it ought to be employed with caution, and not at all when there is any tendency to apoplexy. We certainly, sometimes, see great snuff-takers seized with apoplexy and palsy, when they suddenly leave off the use of snuff. From its narcotic properties, also, it is certainly less proper than some other substances as an Errhine: and it has this disadvantage, that its effects are very transient. Upon the whole, it is a much less valuable Errhine than several of the substances that we have already described.

c. Veratria.

This alkaline principle, discovered by Pelletier and Caventou, has been already described.

Veratria is procured from the seeds of at least two species of Veratrum, V. *album* and V. *sabadilla;* and also from the Colchicum *autumnale.* It exists in greatest quantity in Veratrum *sabadilla;* and may be readily procured by precipitating a decoction of the seeds of that plant by means of acetate of lead, filtering, and washing well the precipitate on the filter with distilled water. These washings and the filtered solution united are next to be treated with sulphuretted hydrogen and filtered, to separate any acetate of lead that it may retain in solution. The solution now contains only an acetate of Veratria, to decompose which it must be boiled with magnesia, which, uniting with

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* In the Counterblaste already quoted, we find the following sentence on this subject —"It makes a kitchen, also, oftentimes in the inward parts of man, soyling and infecting them with an unctuous and oily kind of soote, as has been found in some great Tobacco takers, that after their death were opened."

the acid, leaves the insoluble Veratria to be precipitated with the excess of magnesia. This precipitate, collected on the filter, is to be well washed with distilled water, dried, and then treated with boiling alcohol to take up the Veratria, and leave the magnesia. The former is obtained by precipitation as the solution cools, and partly by evaporation.

Veratria is a most energetic Errhine; an almost imponderable quantity applied to the nostrils provoking the most violent sneezing. In small doses, internally administered, it vomits and purges violently, acting first locally on the mucous membrane, and then generally through the nerves. It is a virulent poison.

VERATRI ALBI RADIX. *Root of White Hellebore.* L. E. D. —This plant is the ελλεβορος λευκος of the ancients. The name Hellebore has led to some doubts respecting the plant; but, from the testimony of Celsus, it is evident that two species of Veratrum were employed by the ancients. Speaking of insanity, he says, "In tristitia, nigrum Veratrum objectionis causa; in hilaritate, album ad vomitum excitandum dari debet*."

The genus Veratrum belongs to the natural order Colchicaceæ†. It grows abundantly on the mountains and elevated pasturages of the south of Europe; on the Alps, the Pyrenees, the mountains of Jura and Auvergne, and those of Greece. It is sometimes cultivated in the gardens of this country. The root in its recent state has a strong, unpleasant odour, which is lost in drying. The taste is at first soft, then bitter, and at length acrid and corrosive. When light and spongy, the roots are bad: they are sometimes adulterated with the roots of asparagus; which, however, are easily distinguished, from the conical form and compactness of the roots of the Veratrum, and likewise by the absence of the acrid taste in those of asparagus. M. Pelletier and Caventou analysed this root, and obtained—1. a fatty matter and a volatile acid, forming a fatty compound; 2. a yellow colouring matter; 3. fecula; 4. gum; 5. an acidulous gallate of Veratria. Of these principles, four are inert as far as its errhine qualities are concerned, and two active—the volatile acid and the gallate of Veratria. When the root is incinerated, it yields carbonates of potassa and of lime, sulphate and phosphate of lime, and silica. I am disposed to doubt the existence of an acidulous gallate; as neither of the sulphates of iron are affected by infusion of Veratrum.

Veratria, as I have already said, stimulates powerfully the mucous membrane wherever it is applied, producing inflammation; and, although absolutely inodorous, yet, if the smallest quantity be carried into the nostrils, it causes sneezing so violent

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* De Med. lib. iii.

† Woodville's Med. Bot. third edition, p. 753, pl. 257. London Dispensatory, art. Veratrum. Richard, Hist. Nat. Med. t. i, p. 358.

as to become dangerous. We see, in these properties, a proof that it is the presence of the Veratria which gives the root of White Hellebore its Errhine properties; and we possess the means of making a certain Errhine, always of the same strength, by combining Veratria with a portion of starch sufficient to cover its acrimony. In the powerful action of an inodorous substance, also, when applied to the nostrils, we have a demonstration of the fact, that the action of Errhines is not exerted upon the olfactory nerves, but upon those of the fifth pair, on which the irritability of the mucous membrane depends. Even as it exists in the roots of Veratrum, the Veratria is so acrid as to require farther dilution before it can be employed with safety; the powdered root, therefore, is mixed with three parts of starch, or the powder of liquorice root, for Errhine purposes. Three grains of it, diluted with nine grains of starch, snuffed up the nose for three successive evenings, produce a copious watery discharge from the nostrils. Great caution is required not to apply it to an ulcerated surface; for, besides producing griping and purging, and other poisonous symptoms, the ulceration assumes a phagedenic character.

INORGANIC SUBSTANCES WHICH OPERATE AS ERRHINES.

SUBSULPHATE OF MERCURY. *Subsulphas Hydrargyri flavus.* E. *Sulphuricum Oxydum Hydrargyri.* D.—This salt is prepared by boiling three parts of sulphuric acid on two parts of pure mercury, until the whole is dissolved: by afterwards continuing the heat until the acid is partially decomposed, the sulphate is converted into a bisulphate. Boiling water, poured upon this bisulphate, acts by a powerful affinity for sulphuric acid, and abstracts the greater part of it, precipitating the subsulphate of a bright yellow colour. When the heat is not continued until the whole is perfectly dry, besides the precipitation of the yellow subsulphate, the water holds in solution sulphuric acid and a portion of supersulphate, and waste is the consequence.

This subsulphate is the Turpeth mineral of the old chemists: when well prepared, it is inodorous and acrid; is nearly insoluble in water, requiring 2000 parts for its solution. Its sp. gr. is 6.444. Its constituents are 15.0 of acid; 84.7 of peroxide; or $1\frac{1}{2}$ prop. of sulph. acid = 60 + 2 of peroxide of mercury = 432; equivalent 492*. It is an extremely useful Errhine, and possesses the property of being always of the same degree of strength. It requires to be sheathed with five parts of starch,

* That it is a subsulphate is proved by exposing it to the action of a solution of pure potassa, which unites with the sulphuric acid, and leaves the peroxide of a brownish-yellow colour. If the solution be separated, acidulated with nitric acid, and tested with nitrate of baryta, the presence of the sulphuric acid is readily detected by the formation of sulphate of baryta.

or any farinaceous powder; a dose of which, containing one grain of the subsulphate and five of starch, snuffed up the nostrils, generally produces a discharge which continues for several days. It has been found very useful in ophthalmic affections; and, as it possesses no narcotic property, there can be no doubt that it is superior to every other Errhine in affections of the head.

Therapeutical Employment of Errhines.

The first use of Errhines is to increase the natural mucous discharge of the nostrils when this is deficient; and here we can always depend on them: their secondary effects are not so certain. In chronic affections of the conjunctiva they prove useful: but in amaurosis, in which they have been extolled, I have never seen any advantage derived from them: indeed, when we reflect upon the variety of causes that produce this affection of the optic nerve, we can scarcely wonder at their failure. In that species of the disease, however, which Sauvage describes under the name of Amaurosis *plethorica*, which, in particular, sometimes affects females labouring under suppressed catamenia, or proceeds from transitory congestions, they may prove useful. Deafness arising from some states of the Eustachian tube, as, for instance, thickening of its lining membrane, has been relieved by the use of Errhines. The celebrated Boyle reports a case of absorption by the counter-irritation of Euphorbium as an Errhine; but little weight can be given to any solitary case. Errhines have been recommended in chronic affections of the head, of a rheumatic character; but there are preferable remedies, which supersede their employment in such diseases. The complaints in which they are most evidently beneficial are headache connected with a debilitated frame of body. In these cases their stimulant properties are beneficial, while at the same time, by the discharge which they solicit, they prevent congestion from occurring in the weakened vessels of the brain. Upon the whole, Errhines are not remedies of much power, and consequently are seldom prescribed.

SECTION XI.

SIALAGOGUES.—MEDICAMENTA SIALAGOGA.

Syn.—Salivantia. Apophlegmatismata.

THE term Sialagogue is derived from the Greek words σιαλος, saliva, and the verb αγω, I lead forth. Sialagogues are "medicines that increase, to a considerable degree, the excre-

tion of the saliva, and cause it to be discharged in a thinner state than usual." Besides increasing the discharge of the salivary glands, they also greatly augment the excretion from the mucous follicles of the mouth and fauces; operating as local stimulants when topically applied to the excretory ducts of the salivary glands and to those of the mucous follicles.

The mucous membrane of the mouth produces, independent of the secretions of the salivary glands, two distinct fluids—one, albuminous and aqueous, which exhales; the other, a mucous fluid, which is secreted in numerous follicles, seated in the substance of the membrane. These follicles have the characters of glands, and pour out unceasingly, through imperceptible orifices, the mucus which lubricates the mouth, and supplies to its surface the place of the epidermis on the skin, operating as a defence against the too powerful action of substances taken into the mouth on the nervous fibrillæ. These glands have a roundish form and a covering of cellular membrane. When cut into, they appear vascular, and are penetrated by nervous fibrils, twigs of the ganglionic portion of the third division of the fifth pair of nerves, which furnish sensibility to the mouth, independent of the function of taste. There are three orders of salivary glands. The *parotids*, which occupy the hollow between the mastoid process of the temporal bone and the angle of the lower jaw, betwixt the ear and the jaw, immediately over the massiter muscle, stretching up towards the zygomatic process. The surface of these glands is unequal, from their being composed of lobules, united by a cellular membrane. Each lobule is supplied with an excretory duct, which passes into a common trunk; which, beginning near the upper part of the gland and piercing the buccinator muscle, opens upon the lining membrane of the cheek, opposite to the second or third molor tooth. It is supplied with blood vessels or nerves; and when exciting substances are taken into the mouth, the stimulus, being communicated from its orifice to each glandular lobule, an increased secretion of saliva is the result; and this is poured through the secondary ducts into the trunk, or, as it is termed, *duct of steno*, and thence into the mouth.

The next glands secreting the saliva are the *submaxillary;* they are of an irregular oval form, lie under the lower jaw, over the tendon of the digastric muscle, and generally involve the facial artery as it passes over the lower jaw. The ducts of these glands form common ducts, which have been named Whartonian, and open on each side of the frænum, or bridle of the tongue, near the gums of the incisor teeth. When these ducts are excited by any stimulating or acrid substance taken into the mouth, they become erected, and their open mouths are seen distinctly: in this state they pour out freely the saliva secreted in the glands.

The glands of the third order, from their position under the tongue, are termed *sublingual*, and are separated from the mouth only by its lining membrane. They open by the small lateral Rivinian ducts upon the lower surface of the tongue.

From these glands the saliva is poured out, to the amount, according to the statement of Nuck, in his *Sialagraphia*, of a pound in twelve hours; but, as this is swallowed, the calculation of Nuck must be regarded as arbitrary. The quantity is greatly augmented by stimuli, whether corporeal or mental. The saliva in its natural state is a watery, somewhat viscid fluid, insipid, inodorous, and consisting of the following constituents:

Water	992.9	
A peculiar Animal Matter	2.9	
Mucus or Albumen . .	1.4	or seven parts of solid
Alkaline Muriates . . .	1.7	contents in 1000.
Lactate of Soda . . .	0.9	
Pure Soda	0.2	
	1000.0*	

When mixed with distilled water, a flaky matter subsides. Besides the salts noticed by Berzelius, permuriate of iron detects the sulpho-cyanate of potassa; muriate of baryta, a sulphate; and subacetate of lead, a carbonate. According to Tiediman and Gmelin, the solid matter in saliva is $\frac{1}{2\frac{1}{2}}$th per cent.; the soluble salts in it are acetate, phosphate, sulphate, hydrochlorate, and sulpho-cyanate of potassa; the insoluble salts, the phosphate and carbonate of lime, and a minute portion of magnesia. Some physiologists imagine that the three glands afford each a different kind of saliva; and that, as the sublingual greatly resemble the mucous glands, the fluid furnished by them is a modification of the common mucus of the mouth. During mastication, the excretion of saliva is certainly greater than might, a priori, be suspected. In a case of wounded œsophagus, Dr. Gairdner asserts that from six to eight ounces were discharged during a meal. Besides the saliva, the mucus of the labial and bucal glands, and that also of those of the tongue, is poured into the mouth and mixes with the saliva; and it is the combined action of these on the food during mastication which prepares it to be acted on in the stomach by the gastric juice. Thence the necessity for a due supply of this fluid; and the care which Nature has taken to secure it by not entrusting it to one organ.

Now, such being the nature of these glands, and the orifices of their excretory ducts being irritable, the mode of action of Sialagogues is readily understood. They are taken into the mouth and masticated; by which means their acrid and other

* Berzelius.

stimulating components are separated and dissolved in the saliva and mucus: in this state they stimulate the orifices of the salivary ducts; the excitement is extended to the glands and *their* vessels, in a manner analogous to the action of Errhines on the pituitary membrane, and the same result follows. The impetus of the blood vessels passing into the glands being augmented, a greater quantity of blood is carried through them in a given time; the quantity of the natural secretion is thus greater in proportion to the supply of blood; and the excretories being full, and at the same time stimulated to exert their proper function, a greater quantity of saliva is poured into the mouth. The *thinness* of the fluid which is excreted from the glands, under the influence of Sialagogues, is in part owing to the hasty and imperfect manner in which it is secreted; partly, when the quantity is great, from its not being long enough retained in the mouth to permit the absorption of the aqueous part, and consequently its natural inspissation does not take place. It must, however, be also recollected that all *direct* Sialagogues are masticated, and that this process produces an increased flow of the saliva; the preternatural flow, therefore, is owing partly to mastication, partly to the stimulating qualities of the substance employed as a Sialagogue. The influence however, of the movement of the jaws is combated by Borden and others; who deny that the parotids are compressed in this movement, and maintain that such compression would rather impede than promote the secretion and excretion of the saliva. Indeed, if we consider the effect of speaking on the secretion and excretion of this fluid, we shall then be satisfied that little results from the mechanical pressure which is supposed to attend the movement of the jaws. That stimulants are necessary to produce the flow of the salivary glands, experience has taught to Asiatic nations, who employ masticatories daily, consisting of a mixture of the Piper *betel*, tobacco, quicklime, and the leaves of the Areca *catechu*.

Sialagogues, by this superabundant discharge of the natural secretion, exert some influence on the whole of the carotid system of vessels, and thence on those generally of the habit, and diminish the quantity of the circulating fluid in a degree equal at least to that of some other evacuants. This is rendered evident by the emaciation which follows the continued use of Sialagogues. It is therefore obvious that, although their immediate operation extends only within a limited sphere, yet that their influence is general.

As all Sialagogues are acrid matters, and influence the nervous energy, they cause pungent sensations on the organ of taste; and it is not improbable that some part of their influence depends on this impression. It is indeed only upon this principle of action that we can explain their efficacy in paralysis of

the tongue and other organs of deglutition; for although the motor nerves are those chiefly affected, yet those of sensation are always, also, in fault in cases in which stimulant masticatories are likely to prove serviceable. I have already had occasion to remark the force of habit, in changing sensations which are at first highly disagreeable, and even painful, into those which are pleasurable. Thus, the use of tobacco, as a masticatory, is at first nauseating and painful; but, by continued use, it becomes so agreeable as to be prized as a luxury, and in many instances is regarded almost as a necessary of life. Like opium, it seems to invigorate the frame and to rouse the corporeal strength to extraordinary exertion. To those unaccustomed to its stimulus, the privation of it is an evil which they cannot appreciate. An anecdote which an old man, a collector of furs in North America, detailed to me, is highly illustrative of this fact. He had lost his way in the woods, and had not tasted food for two days, when he met with a party of Indians, who, like himself, had been unsuccessful in the chase. As they had no food, he requested, as the next greatest favour that could be granted to him, a small quantity of tobacco; but there was only one quid remaining in the party, and that was already half masticated. A man, however, suffering under hunger and fatigue, is not nice: he begged it so earnestly that the Indian took it from his mouth, and, dividing it, gave him one half; he received the gift thankfully; it recruited his exhausted powers, and, to use his own language, "preserved his life by supporting him until he reached his quarters and obtained some substantial nourishment."

Sialagogues, properly employed, produce salutary effects, which are extended to the œsophagus, the bronchial tubes, and even the stomach. Thence they are administered successfully in rheumatism of the throat and the jaws; in toothache; in chronic cephalalgia; lethargy; a tendency to apoplexy, and similar affections. They are also used in paralytic affections of the tongue: and to restore and maintain the cohesive power of the fibrous tissue of the gums, in a spongy state of these parts. As far as paralysis is concerned, it is only in the local state of the disease that they can prove beneficial; and certainly this is a form of paralysis which is comparatively rare.

TABLE OF SIALAGOGUES.

a. VOLATILE OIL—contained in—			
Cochlearia *Armoracia.*	15.	1.	Cruciferæ.
Acorus *Calamus.*	6.	1.	Aroideæ.
b. FIXED ACRID OIL—contained in—			
Anthemis *Pyrethrum.*	20.	2.	Compositæ
Nicotiana *Tabacum.*	5.	1.	Solaneæ.
c. ACRID RESIN—contained in—			
Zingiber *officinalis*	1.	1.	Scitamineæ.
Daphne *Mezereum.*	8.	1.	Thymeleæ.

SUBSTANCES WHICH OPERATE AS SIALAGOGUES.

a. VOLATILE OIL. *Oleum Volatile.* — The nature and chemical properties of Volatile Oil have been already sufficiently explained (p. 136). It is in its natural combination that it is employed as a Sialagogue. Why it is not used for this purpose in its uncombined state I am not aware; as it is well known that Volatile Oils, applied on cotton in toothache, augment greatly the flow of the saliva.

1. COCHLEARIÆ ARMORACIÆ RADIX. *Horse Raddish.* L. E. D.—This species of Cochlearia, a native of Brittany and other parts of France, is extensively cultivated in this country. It belongs to the natural order Cruciferæ*. The plant is an annual, but the root perennial and viviparous. The root is employed as a Sialagogue in the recent state, as it loses much of its acrimony by keeping. It has been used in paralysis of the tongue; but is very seldom prescribed as a Sialagogue.

2. ACORI CALAMI RHIZOMA. *Sweet Flag.* L. E.—This Rhizome, as has been already stated (p. 146), owes its properties also to an essential oil, which is readily procured in a separate state; and, if combined with starch in the form of a lozenge, might be advantageously employed as a Sialagogue. The Rhizome, however, is preferred; but it is rarely used.

FIXED ACRID OIL.

In denoting fixed oil as an acrid substance, adequate to stimulate the salivary glands and operate as a Sialagogue, it is necessary to mention that the oil may be merely the vehicle of some acrid matter, which, it is probable, exists as a distinct principle. The combination, however, is so complete, that the latter

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* Woodville's Med. Bot. third edition, p. 400. pl. 145. London Dispensatory, art. Cochlearia. Richard, Hist. Nat. Med. t. ii, p. 655.

has never been procured separate from the former; and consequently the appellation *acrid fixed oil* is fully authorized.

1. ANTHEMIS PYRETHRI RADIX, *Pellitory Root*, L. E. D. has also been already noticed as an excitant; and its properties demonstrated to depend on an acrid fixed oil, which M. Gauthier discovered in it, in combination with volatile oil, gum, inulin, and muriate of lime*. It is to this oil that we are to ascribe its Sialagogue effects. It impresses a peculiar pricking sensation on the tongue, which is not very perceptible at first, owing to its little solubility; but it soon increases and excites salivation. The root has been long employed as a Sialagogue, and is more relied upon than any other in paralysis of the tongue and the organs of deglutition.

2. NICOTIANÆ TABACI FOLIA. *Tobacco.* L. E. D.—From what was formerly said respecting Tobacco and its chemical constituents, it is scarcely necessary to state, in mentioning it as a Sialagogue, that, although its primary action be stimulant, and it is thereby calculated to increase the flow of the saliva, yet as it exerts also a narcotic influence, it therefore requires to be employed with caution; and particular care should be taken not to swallow the saliva. This is a circumstance less likely to occur when the Tobacco is chewed by one unaccustomed to its use, as the nauseous taste tends greatly to prevent the saliva from being swallowed; the narcotic influence, therefore, of the Nicotina on the heart and arterial system is only partially felt. The *Nicotina* is separated by the action of the saliva in chewing; and, although this ought not to be swallowed, yet much less mischief is likely to result from its entering the stomach, than from the volatile oil which is separated in smoking, and which, as I have already stated, acts more directly on the nervous energy than the Nicotina, exciting convulsions and coma, without affecting the heart, whilst this displays its influence chiefly on the heart and arteries. Now, when Tobacco is chewed to relieve toothache, the acrid oil which it contains stimulates powerfully the salivary glands and their excretory ducts; and something is due to this effect; but the relief from pain is doubtless owing to the sedative influence of the Tobacco; and, on this account, we find that this is more rapidly procured from smoking than from chewing. The first effect in both cases, on those unaccustomed to the use of the plant, is transient excitement, with an accelerated pulse; this is followed by collapse, giddiness, fainting, and sickness, and accompanied with a weak, quivering pulse, and, not uncommonly, some degree of somnolency. Gmelin has recorded two cases of death from excessive smoking; but in one of these cases seventeen pipes, and in the other eighteen, ere smoked at one sitting. Few accidents, however, except in peculiar idiosyn-

* Journal de Pharmacie, 1818, p. 33.

cracies, occur from Tobacco used as a Sialagogue. The Tobacco should be in that state in which it is prepared for the purposes of chewing, which is done by merely freeing the leaf from its midrib, moistening and rolling it up, by the aid of a machine, or, as it is termed, spinning. It is contraindicated in cases of paralysis of the organs of deglutition.

ACRID RESIN.

Pure Resin is insipid and inodorous: it is therefore probable that the Acrid Resin to which the activity of some Sialagogues is due, is a compound of Resin and a distinct acrid principle.

1. ZINGIBERIS OFFICINALIS RADIX. *Ginger.* L. E. D.—The Acrid Resin in Ginger is involved in a large quantity of fecula: it acts powerfully on the nerves of the mucous membrane; and, therefore, possesses Sialagogue powers. It may be advantageously employed in paralysis of the tongue and muscles of the gullet; but, for the reasons which were formerly stated (p. 148), the saliva ought not to be swallowed by those afflicted with stricture of the urethra.

2. DAPHNES MEZEREI CORTEX. *Mezereon Bark.* L. E. D.—The Mezereon, or Spurge Olive, is an indigenous plant, belonging to the natural order Thymeleæ*. The bark of this plant contains an acrid resin, which owes its acrimony partly to a peculiar principle, that may be separated from the resin. Vauquelin, who discovered this principle, in 1808, named it *Daphnine*†. It is procured by digesting the bark in alcohol, evaporating the tincture to the consistence of syrup, and then mixing the residue with water. The resin is precipitated and the Daphnina dissolved in the water: the solution, after filtration, is to be precipitated by acetate of lead; and the precipitate being suspended in water and freed from any excess of acetate of lead by means of sulphuretted hydrogen gas, what remains in solution is the Daphnina. On evaporation, it crystallizes in small, prismatic, colourless, brilliant, transparent crystals, very soluble in hot water, from which, however, they are deposited on cooling; very soluble in alcohol, and acquiring a yellow colour on the addition of a little solution of potassa or its carbonate, or of baryta or lime. Their solution is not precipitated by acetate of lead. It impresses a permanent acrimony on the organ of tasting.

If direct Sialagogues are to be confided in, the bark of the root of Mezereon is a local stimulant of this description of great power. It has a smooth olive-coloured epidermis, covering a

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* Woodville's Med. Bot. third edition, p. 717. London Dispensatory, art. Daphne. Richard, Hist. Nat. Med. t. i, p. 493.

† Ann. de Chim. tome lxxxvi, p. 174.

thin, green, cellular web, and a yellowish-white, tough, fibrous liber: when chewed, it tastes at first slightly sweetish, and then becomes hot and corrosive to the mouth. It contains, according to Gmelin, wax, resin, Daphnina, a red colouring matter, an uncrystallizable sugar, a brown colouring matter, malates, gum, and lignine. In a case of difficulty of swallowing, from paralysis of three years' standing, Dr. Withering prescribed Mezereon root as a masticatory. In less than a month his patient recovered the powers of deglutition. A small portion of the bark should be kept constantly in the mouth; and the saliva should be as assiduously rejected as when tobacco is employed. Its injurious influence when taken into the stomach is well illustrated by the following fact. When the French army was in Corsica, the soldiers often dried their meat by smoking it with wood fires: some of them having used the Mezereon for this purpose, they were attacked with erosions of the mouth, stomach, and intestines, and died in great torture*.

Such are the few substances usually employed as direct Sialagogues—an order of remedies now rarely prescribed, but which, nevertheless, like Errhines, require to be known. There is one affection, not much understood and not described in the writings of medical authors, in which I am of opinion they may prove useful. I refer to a peculiar *dry* state of the fauces and soft palate, which is not an unfrequent sequel of inflammation of the mucous membrane of these parts. It appears to depend on a chronic subacute inflammation, which, from its habitual influence, interrupts the natural action of the mucous glands; and is to be relieved by inducing in the vessels of the part a new action, sufficient to overcome the diseased action.

SECTION XII.

EXPECTORANTS.—MEDICAMENTA EXPECTORANTIA.

Syn.—Pectorales.

It is not easy to frame a satisfactory and comprehensive definition of this order of medicines: they are said to be "medicines which promote the excretion of mucus and fluids from the lungs and trachea." Were the correctness of this definition fully determined, considering the great importance of the lungs to the well-being of the animal œconomy, there is no class of

* Sage sur le Moyen de Remèdes aux Poisons Végétaux—Paris, 1811.

medicines that would so much merit our attention. But any theory which can be given, not only of the mode in which Expectorants operate, but of their existence *at all* as promoters of the excretion of the mucus from the lungs, *is doubtful;* we must, therefore, receive *every thing* that can be said regarding them with some degree of distrust.

The mucous membrane lining the trachea and bronchial tubes is *supposed* to be the *only* part upon which Expectorants act; but in whatever manner the mucus, *either morbidly secreted or augmented in quantity*, is removed, it is essential to know the manner in which either its acrimony or its over abundance *can prove injurious* to the functions of life, before we can fully understand the necessity for removing it, or form any opinion of the manner in which it is excreted.

The whole system of pulmonary tubes is lined by a vascular and highly sensible membrane, an extension of the lining membrane of the fauces, denominated the mucous membrane, from the nature of the secretion with which it is constantly moistened. Each lung is a tissue of air cells, into which the branches of the windpipe lead, and upon which the capillaries or ultimate divisions of the pulmonary arteries terminate. These air cells, it has been ascertained, are smaller in infants than in adults; in middle-aged adults, smaller than in older persons: the average in a middle-aged man may be estimated to be about $\frac{1}{90}$ of an inch in diameter. The form of the cell is nearly a hollow sphere; it does not communicate with any other cell, except by means of the *minute twigs* of the bronchial tubes, which terminate in them. Besides the mucous membrane which lines the air tubes and the bronchial cells, each distinct cell is supplied, exteriorly to the mucous tissue, with *white, elastic* fibres; and over these a muscular coat. These cells are supplied, also, with two sets of arteries; the one intended for the nourishment of the lungs, proceeding from the descending aorta, and named the bronchial arteries; the other designed to expose the blood to the action of the air in the cells, and forming the ultimate branches of the pulmonary artery, the trunk of which commences in the right ventricle. To effect this change from the state of venous into arterial blood, the air must be received into the lungs; but it is no sooner admitted into the bronchial cells, than it is completely changed in its chemical character, and would prove hurtful and fatal to animal life were it retained there; it is, consequently, as rapidly expelled as it was received: and this alternate reception and expulsion of the air *into* and *from* the lungs constitute inspiration and expiration, or, conjointly, the function of respiration.

When the air is admitted into the lungs, the thorax is enlarged *laterally* and *inferiorly*, the ribs are elevated, the diaphragm descends, and the recti muscles of the abdomen, with

the oblique and the transverse muscles, are forcibly extended by the pressure downwards of the abdominal viscera. During this process the air rushes into the lungs, owing to the greater gravity of the external air than that contained in the lungs, in addition to the diminished resistance afforded by the enlargement of the cavity of the thorax, and distends the whole system of bronchial cells. Such is the mechanism of inspiration. Now, what follows ?—In a few seconds the mastoideus, the trapezeus, the serratus, the diaphragm, and intercostal muscles, cease to act, and the abdominal muscles recover their ordinary state of contraction; whilst, at the same time, the substance of the lungs, contracting by its natural elasticity, resumes its former dimensions, and expels the additional volume of air which had just been admitted. But, in *addition* to these changes of condition in the respiratory muscles and in the lungs, generally speaking, the *muscular* and *elastic* fibres which surround the bronchial cells *now contract* and aid in the more effectual emptying of the lungs. This, however, is *never* complete; as the retention of a certain portion of air is necessary to maintain some degree of distension of the air cells after expiration. When the contraction is so great as almost wholly to expel the last portion of air from the air cells—a circumstance which occurs in the spasmodic cough of hooping-cough—as soon as the spasmodic contraction yields, the external air *rushes* into the lungs with a wheezing noise, resembling that which occurs when the air is admitted into the exhausted receiver of an air pump: but *no such sound* is heard in natural and healthy respiration. It is, therefore, obvious that this elasticity of the lungs is a very important agent in expiration; and, so little are the muscles of the abdomen concerned in this part of the respiratory process, that children who have been born without them, have lived for some time and breathed naturally; yet it would be an error to assert that respiration is not the operation of the conjoint action of the mastoideus, trapezeus, serratus, and intercostal muscles, the diaphragm, the abdominal muscles, and the muscular contraction of the air cells of the lungs themselves, by which, as I have already stated, the last portions of the air are expelled. Such, then, is the mechanism of the respiratory function. The nerves engaged in effecting respiration arise from a distinct column or fasciculus of the spinal marrow, lateral as regards the anterior and posterior columns: and it is from the par vagum, one of the nerves receiving its origin from this fasciculus, that the nerves of the bronchial cells are derived. The excitement of these nerves, therefore, causes the function of respiration; that is, an alternate inspiration and expiration of the atmospherical air. That this function or breathing is absolutely necessary for the maintenance of animal life, every day's experience proclaims; and it is equally certain that the air expired differs from that

inspired, not in the volume of the air only, but in its chemical constituents; and thence the function of respiration includes not only the renewing of the air in the lungs, but the changes which it undergoes there, and also those effected in the blood. Without entering into the examination of this chemical change, it is sufficient for our purpose to know that the air must be admitted into the air cells for the preservation of life; and, therefore, that whatever obstructs its passage to these, is an obstacle which must be removed. When this is accumulated, or when the mucus is inspissated, or viscid and adhering to the sides of the bronchial tubes, or when the secretion is rendered acrid by inflammatory action being excited in the mucous membrane of these tubes, so as to impede in any manner the function of respiration, then Expectorants become useful, inasmuch as they can contribute to the removal of these morbid causes of *impeded*, or *interrupted*, or *irregular* respiration. A question naturally arises—how can they effect this removal? Do the substances taken as Expectorants proceed to the lungs, and there act?

Before answering these questions, it is proper to state, that many substances, when introduced into the system through the stomach, escape by the lungs. This is the case with various *gases*, *ether*, *alcohol*, *phosphorus*, and *camphor*, which, soon after they are taken into the stomach, are perceived in the breath; and this is the case with oil of turpentine also, which, if injected in small quantity into the crural vein, as in the experiment of Dr. Breschet and Dr. Edwards, is strongly exhaled from the lungs, although no odour of it is perceived on exposing the peritoneum; and, what is very singular, if a cupping glass be applied over any denuded part, the odour is not perceived in the lungs. But while we are convinced that the lungs act as an emunctory, and afford exit to many things which have entered the circulation, yet, supposing that every medicinal article exhibited with the view of producing expectoration enter the circulation, and be thrown off by the medium of the mucous membrane of the lungs, it would not aid much in explaining the theory of Expectoration. We must therefore have recourse to some other method of accounting for the manner by which the lungs are freed from offending matters; that is, by which expectoration is effected.

In the table of Expectorants, those medicines which are supposed to operate as such are arranged into *two* divisions: 1, *those* which affect the excretion of mucus or other fluids from the lungs by *topical* means: 2, those which effect it by *general* means.

I. *Topical Expectorants* may operate in two ways. 1. They may act upon the nerves of the bronchial cells, and, exciting all the respiratory muscles into strong action, and rendering expiration more forcible, may *facilitate* the expulsion of matters

from the air tubes of the lungs. 2. They may operate by mechanically compressing the thoracic viscera, so as to induce a sudden and forcible expiratory effort, so as to effect the expulsion of matters from the lungs.

1. *a.* Medicines which stimulate the respiratory muscles, effect the excretion by coughing.

The effect of coughing is a short and forcible expiratory effort frequently repeated; the inspirations in the intervals being trifling in comparison to the expirations. It is, in a great degree, a voluntary effort; and the effect of the air in traversing the trachea and its branches, in the forcible exit of each portion, as thrown out by the sudden contraction of the abdominal and other respiratory muscles, detaches any mucus, or whatever else is contained in the air tubes, and expels it. Any irritation immediately applied to the glottis, acting upon a branch of that series of nerves which are particularly intended for the function of respiration, excites involuntary coughing; but the action excited may, in a great measure, be moderated, if it cannot be altogether checked and terminated, at the will of the individual. Coughing is, therefore, an effort either of the will or of the system, from the irritation of a certain set of nerves acting on the respiratory muscles to relieve the trachea and bronchial system of some offending cause: it is therefore a salutary phenomenon. In those weakened by disease or other causes, the difficulty of exciting the action of coughing, with force sufficient to produce the effect intended, is so obvious as to strike the ordinary as well as the professional observer. The distress arising from this circumstance, the *uneasiness* excited by the irritating matter that coughing forcibly would readily remove, and the *sense of suffocation* experienced from an accumulation of mucus in the bronchial tubes obstructing the free passage of the air to the bronchial cells, are very considerable. In such states of the chest, the topical application of a stimulant to the bronchial nerves may so far rouse the exhausted excitability as to enable the muscles to undergo the necessary exertion; whilst, at the same time, the substances employed to excite this, may be of a nature to prove also beneficial, by imparting a renewed healthy action to the diseased mucous membrane. Under this head of the table, therefore, will be found several stimulants well adapted to fulfil this intention.

The whole of the substances arranged under this head stimulate so powerfully as to require the utmost caution in their administration; but, as the atmospherical air is the vehicle by which they are conveyed into the lungs, there is no difficulty in apportioning the degree of dilution to the quantity of stimulus required or admissible.

2. *a.* The second set of topical Expectorants are emetic substances. In the operation of vomiting, by the sudden and

violent contraction of the abdominal muscles, in order to force the contents of the stomach upwards, an impulse is communicated to the whole bronchial system; and, by this means, the expiratory effort being rendered more forcible, the expulsion of the mucus lodged in the pulmonary tubes is effected. Whether this explanation be satisfactory, others must determine: the fact of the beneficial result of the action of emetics, in clearing away mucous accumulations from the lungs, is well known; and frequent recourse is had to them in the diseases of children, with uniform advantage.

It might be supposed that the best emetics for expectorant purposes would be those which operate by directly stimulating the nerves of the stomach, and which call the muscles, necessary in the mechanism of vomiting, into immediate action by sympathy with that organ: but experience has demonstrated that the antimonial preparations are, perhaps, better suited for this purpose than any other; not only because their action is more forcible, and therefore likely to aid in expelling the mucus of the air tubes, by the communication of the mechanical impulse which it produces, but also by the power which they possess of controlling inflammatory action. Expectoration procured by emetics was at one time in much vogue as a remedy in Phthisis *Pulmonalis*. The emetics for this purpose, however, were seldom selected upon any principles: at *one time* we find sulphates of zinc and of copper employed; in *another*, antimonials, chiefly in the form of the antimonial wine, or vinous solution of the tartrate of antimony and potassa, given to the extent of f℥vi in a solution of the extract of liquorice root. This antimonial was supposed to produce vomiting, accompanied with copious expectoration, whilst the force and frequency of the pulse were materially diminished. I have had opportunities of witnessing the effects of this mode of treating tubercular consumption; and certainly it must be acknowledged, that it has relieved many of the most urgent symptoms; yet, like every other remedy in that merciless malady, its frequent failure to produce the desired effect weakened my confidence, and I have long since discontinued prescribing it. Ipecacuanha and all other emetics act in a similar manner to those I have just mentioned, and promote expectoration. If the lungs be loaded with mucus, and little or no febrile action be present, the *direct* emetics are to be preferred; because it is only the mechanical impulse which is then required.

Squill and sulphuret of potassa have also been employed to excite vomiting in aid of their expectorant property.

II. *General Expectorants.*—These operate either by entering the circulation or through sympathy with the stomach: the *first* directly stimulate the pulmonary exhalants; the *second* affect the excretories by the nausea which they induce.

a. There is sufficient evidence that some medicinal substances, when taken into the stomach or applied to the surface, are absorbed, and, entering the circulation, are exhaled by the lungs. No explanation can be given of the reason why these substances, passing through the circulating system, are thrown off by one emunctory rather than by another; but the fact is well ascertained. Now it is probable that these matters, in passing through the exhalant vessels, stimulate them directly to increased action, and thence to the performance, in an augmented degree, of their proper function; so that, by the production of a greater quantity of aqueous matter by the mucous follicles, their contents are poured out in a less viscid state. In admitting this explanation, to a certain extent, we must not lose sight of the fact, that the most easily excreted mucus from the trachea and bronchial tubes is not that which is in the most fluid state, but in that peculiar state which, independent altogether of simple consistence, is requisite to enable it to be readily excreted. In asthmatics, a thin or watery excretion is always more distressing and more difficult to expel, requiring a greater effort of coughing than one which is more consistent, and, as the term is, well concocted. The expired air passes partially through the thin fluid, giving it a frothy character; while that of a thicker description, which seldom adheres very firmly to the sides of the tube, is driven before the propelled air, and thus easily rejected from the trachea.

b. In explaining the operation of these general Expectorants, which affect the pulmonary excretions by the nausea which they induce, we must take into consideration the similarity between the function of the skin and that of the mucous membrane of the bronchial tubes. Both are exhalant organs; and both, in febrile and inflammatory states of the habit, are liable to constriction, which impedes the exhalant function, and gives origin to a train of morbid phenomena connected with the deficiency of the natural lubricating mucous secretion. In this condition of the mucous membrane, nauseants taken into the stomach, either by the sickness which they induce, or by simply allaying irritation, relax the constricted capillaries and promote expectoration.

TABLE OF EXPECTORANTS.

A.—TOPICAL EXPECTORANTS,

1. *which stimulate the respiratory muscles;*

a.—BENZOIC ACID,

Styrax *Benzoin* 20. 1. Styraceæ.

b.—ACETIC ACID,
c.—CHLORINE.

2. *which stimulate the pulmonary exhalants;*
d.—TOBACCO,
Nicotiana *Tabacum* 5. 1. Solaneæ.
e.—STRAMONIUM,
Datura *stramonium* 5. 1. Solaneæ.
f.—VAPOUR OF BOILING TAR,
g.———— BURNING WOOL,
h.—AMMONIA,
i.—CARBONATE OF AMMONIA.

3. *which mechanically compress the thoracic viscera;*
k.—EMETIC SUBSTANCES.

B.—GENERAL EXPECTORANTS,

1. *which stimulate the pulmonary exhalants through the circulation.*

* *Organic Products.*

a.—EMETINA,
Cephæëlis *Ipecacuanha* 5. 1. Cinchonaceæ.
b.—SCILLITINA,
Scilla *Maritima* 6. 1. Asphodeleæ.
c.—GUM RESINS,
Ferula *Assafœtida.* 5. 2. Umbelliferæ.
Dorema *Ammoniacum* 5. 2. ————
Galbanum *officinale* 5. 2. ————
Sagapanum
Balsamidendron *Myrrha.* 8. 1. Burceraceæ.
d.—BALSAMS,
Myroxylon *Peruiferum* 10. 1. Leguminosæ.
Styrax *officinale* 10. 1. Styraceæ.
Styrax Benzoin 20. 1. ————
e.—OLEO-RESINS,
Balsamidendron *Gileadensis* 8. 1. Burceraceæ.
Copaifera *officinalis* 10. 1. Leguminosæ.
f.—BITTER EXTRACTIVE,
Marrubium *vulgare* 14. 1. Labiatæ.
Tussilago *farfara* 19. 2. Compositæ.
Cetraria *Islandica* 24. 3. Lichenes.

** *Inorganic Substances.*

g.—AMMONIA.
h.—CARBONATE OF AMMONIA.

2.—*by exciting nausea.*

* *Organic Products.*

a.—EMETINA,
Cephæëlis *Ipecacuanha*. 5. 1. Cinchonaceæ.

** *Inorganic Substances.*

b.—ANTIMONIALS.
c.—POTASSÆ SULPHURETUM.

A. TOPICAL EXPECTORANTS.

1. *Substances which operate as Expectorants by stimulating the Respiratory Muscles.*

a. BENZOIC ACID. *Acidum Benzoicum.* L. E. D.—This acid is procured by the mere application of heat to Benzoin, a concrete balsam, the produce of the Styrax *Benzoin*, a tree growing in the island of Sumatra, belonging to the natural order Styraceæ*. The Benzoin is procured by incisions in the tree; the exuded juice concretes in the air, and, from being white, it becomes a *variously coloured* mass. The odour of Benzoin is agreeable; its taste is at first sweet and aromatic, but it leaves a sensation of acrimony in the throat; it is brittle; melts when heated; and, when charred, exhales copious white fumes, which are found to be an acid, the *Benzoic*. According to the analysis of Bucholz, Benzoin consists of resin 20.50 + Benzoic acid 3.7 + a substance analogous to balsam of Peru 0.25 + an aromatic principle soluble in alcohol 0.8 + impurities, in 25 parts. When Benzoin is thrown upon a hot iron, or exposed to heat in a crucible, it first melts, and then Benzoic Acid is exhaled in conjunction with an aromatic oil which gives it odour.

Benzoic Acid is a white crystallized acid, in oblong, soft prisms, with a glossy lustre: inodorous when pure; but genenerally having a slight, peculiar odour, owing to the abovementioned volatile oil; and a sweet, pungent, somewhat bitter taste. Its specific gravity is 0.657. It reddens litmus paper: is sparingly soluble in cold water, and requires even $24\frac{1}{2}$ parts of boiling water. Alcohol dissolves it readily, and, when left to evaporate spontaneously, prismatic crystals of the acid are formed: boiling alcohol takes up its own weight of the acid. It is, according to Liebeg, an oxide of a peculiar inflammable body, named Benzule; and is composed of hydrogen 5 prop. = 5 + Carbon 14 prop. (6×14) = 84 + Oxygen 3 prop. (8×3) = 24, equivalent 113. Its affinity to the resins is very obvious.

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* Woodville's Med. Bot. third edit. p. 291, pl. 102. London Dispensatory, art. Styrax. Richard, Hist. Nat. Med. t. ii, p. 160.

In a healthy individual, the fumes of Benzoin excite coughing; but as it is questionable whether they are admitted into the trachea, unless largely diluted with atmospherical air, it is in this state only that it can be employed in any pulmonary disease. I have had no experience of its influence; but it is said to have proved beneficial even in phthisis after the existence of tubercles had been clearly ascertained. It is inhaled in conjunction with aqueous vapour; the Benzoin is broken into morsels, which are put into a jar and boiling water poured over them; a little of the acid and much of the volatile oil are elevated with the aqueous vapour, and thus taken into the lungs. Inhaled through the medium of the air in spasmodic asthma, I have seen it shorten the paroxysm and promote expectoration. We can account for its beneficial influence in asthma more readily than in phthisis; the difficulty of breathing, and the frothy mucus accumulated in asthma, depending on some morbid condition approaching to paralysis of the nerves of the par vagum; and thence, any stimulant likely to rouse these, if there exist a state of deficient energy, will probably relieve the disease. According to Mr. Brodie's experiments, when the par vagum is divided in a dog, the respiration is diminished in frequency, less carbonic acid is evolved, the blood assumes a darker hue than usual, and much frothy mucus is found in the cells after the death of the dog. These are the symptoms of chronic asthma; and it is in this form of asthma that diminished energy of these nerves may exist. I would, nevertheless, be more sceptical regarding its use in phthisis, were I not acquainted with the beneficial effects of some other substances, which can only operate on the same principles.

This acid is occasionally administered internally, for the purposes of rousing the muscular energy and promoting expectoration in weakened habits; but it is inferior to carbonate of ammonia for this purpose.

b. ACETIC ACID. *Acidum Aceticum.* L. E. D.—This volatile acid operates by stimulating the bronchial cells, when it is inhaled into the lungs. This is the oldest of those topical remedies which are supposed to excite the action of the respiratory muscles, in clearing the pulmonary tubes of offending mucus. It is more manageable in its application than benzoic acid, and it can be more directly applied. It is usually extricated from hot diluted vinegar by means of the inhaler. The acid thus evolved communicates the desired stimulus to the bronchial nerves. Distilled vinegar should be employed, instead of the common vinegar which contains sulphuric acid. The vapour of Acetic Acid is employed with seeming advantage in asthma, dyspnœa, and other spasmodic affections of the chest.

c. CHLORINE. This gas is of very late introduction as an

Expectorant and Excitant of the diseased mucous membrane of the lungs. It is rapidly absorbed by water; and in this form it may be preserved for extrication for expectorant purposes; but it must be kept in a blackened bottle, as the water is slowly decomposed, and chloric and muriatic acids are formed. Its goodness is known by mixing the solution with a little tincture of litmus: if it be good, the colour of the litmus will be totally destroyed; if it contain chloric or muriatic acid, the litmus will be reddened.

Chlorine, if attempted to be breathed in its undiluted state, does not enter the lungs, but produces a powerful spasm of the glottis; and if not immediately relieved, the person dies of suffocation. When diluted with a moderate portion of air, it excites violent coughing, irritation in the bronchial cells, great dyspnœa, and a painful, anxious sensation of the chest, which continues for several days. Yet, when largely diluted, this gas is the best topical expectorant and the most salutary excitant to the mucous membrane of the lungs that has yet been inhaled. I have witnessed its beneficial effects in spasmodic cough and in asthma; and I have seen much benefit result from its cautious employment even in phthisis pulmonalis. In its highly diluted state, it was first proposed to be employed as an Expectorant by Dr. Favart, of Marseilles, in 1804. His explanation of its action is, "that by irritating in a peculiar manner the mucous membrane, it draws towards that organ the matter gorging the pulmonary parenchyma; and thus it relieves the lungs in severe catarrh. It is unnecessary to comment on the improbability of this hypothesis. Soon after this period, I had an accidental opportunity of witnessing its beneficial influence in a severe case of epidemic catarrh, in which it was extricated as a fumigation to check infection; but it was not employed, either on the Continent or in this country, by more than one or two physicians, until lately, when a report of Dr. Cottereau, to the Faculty of Medicine of Paris, again brought it before the profession.

Several trading chemists, and particularly M. Gannal, had remarked that phthisical persons, who engage themselves to work in the manufactories of bleaching liquor, in which Chlorine is extricated, gradually but evidently improve in health; and, to confirm his observations, he constructed an instrument for inhaling this gas, and actually administered it as a remedy in phthisis. The success of the experiment surprised M. Gannal; but, not being a medical man, he mentioned his views to Dr. Cottereau, who pursued the same plans as M. Gannal, and with a degree of success sufficient to merit the attention of the profession. As far as my own experience has enabled me to offer an opinion, Chlorine forms a most valuable auxiliary in the treatment of chronic catarrh, humoral asthma, and even phthisis. In the two former diseases I have relieved several

individuals by its means: and, in all the cases of phthisis in which I have employed it, the palliation of symptoms has been considerable; but none of them have been cured.

For the purpose of inhaling, Chlorine should be extricated from the saturated aqueous solution of the gas, by putting ʒi or ʒii of it into a tubulated bottle*, containing about fʒii of hot water, and placed either in a basin of hot water or over a small lamp, in order to extricate the Chlorine from its aqueous solvent. The patient should inhale this quantity at one time, and the dose should be repeated once, at least, every six hours, so as to maintain the effect produced on the mucous membrane. When thus cautiously inhaled, the first effect is a slight sense of constriction in the trachea and some increase of cough: in a few instances, a degree of vertigo has been experienced and tightness across the chest; but these feelings rapidly subside, expectoration is produced almost without any effort, and the patient feels generally more comfortable than before inhaling the gas. In those cases of asthma in which I have seen the Chlorine used, the relief is peculiarly striking; and in phthisis the symptoms of hectic have much abated during its employment; so that in cases in which a fatal termination of the disease has occurred, the Chlorine may be said to have "scattered flowers on the borders of the grave." Its operations can only be explained on its stimulant power, producing a new action in the morbid organ; which, if it could be maintained sufficiently long, might assuredly overcome the diseased action; and by the assistance of other means calculated to support the tone of the habit, without exciting fever, the disease might be cured. In cases where large vomicæ exist, it is in vain to expect a cure from any means; but when we consider the powerful influence of Chlorine in checking putrefaction and in promoting the cure of external ulceration, it is not, in my opinion, a vain speculation to expect advantage in ulcerated lungs from this mode of employing it.

Like every other powerful gaseous excitant, Chlorine, when inhaled without being sufficiently diluted, produces a severe sense of strangulation, which recurs at intervals of two or three minutes, and is momentarily relieved by a tendency to syncope, during which the air in the lungs is changed. These recurring strangulations are accompanied by violent irritating coughing; and individuals have fallen down in a state of complete syncope who have suddenly taken a large draught of it. These effects, however, are in general only temporary: few instances have occurred in which inflammation of the lungs and air tubes have supervened. Indeed the system soon accommodates itself to Chlorine; the workmen in chemical manufactories breathe it

* See p. 541.

daily with impunity*. The best method of overcoming its deleterious effects is to inhale the vapour of ammonia and hot water, or to inhale ether; or, if neither of these substances be at hand, to breathe warm vapour through a large sponge dipped in boiling water.

d. AMMONIA, CARBONATE OF AMMONIA. L. E. D.—These substances operate in the same manner as the three former articles, as violent irritants on the mouth, windpipe, and indeed on the substance of the lungs. Ammonia, largely diluted, is indicated in cases of humoral asthma and pneumonia, in which the lungs are choked up with frothy mucus which cannot be expectorated. I have seen the internal administration of Ammonia highly beneficial in such cases; but my experience does not permit me to offer an opinion on its utility when in a gaseous state. Cases are related by Nysten and Orfila of fatal effects having followed its imprudent inhalation by the nostrils. In one of M. Nysten's cases, the patient, a medical man, died on the third day, after having suffered from symptoms resembling those of severe bronchitis, with difficult breathing, copious expectoration, and a serous discharge from the nostrils; and, in a case detailed in the 14th vol. of the Edinburgh Medical Journal, death occurred in forty-eight hours. These cases render much caution requisite in using Ammonia as a topical expectorant.

2.—*by mechanically compressing the Thoracic Viscera.*

EMETICS.—In the operation of Emetics, by the sudden and violent contraction of the abdominal muscles, in order to force the contents of the stomach upwards, an impulse is communicated to the whole bronchial system, and by this means, the expiratory effect being more forcible, the expulsion of the mucus in the pulmonary tubes is effected. The beneficial influence of Emetics in clearing away mucous accumulations from the lungs is indeed well known; and they are advantageously prescribed for this purpose in some of the pulmonary diseases of children. It might be supposed that the Emetics most likely to promote expectoration would be those which operate directly on the stomach: but in many cases the antimonial preparations are better suited for expectorant purposes than any other, because they aid both the expulsion of mucus from the bronchial tubes, and possess the power of controlling inflammatory action. The employment of emetics as expectorants was formerly in much vogue in phthisis; but the selection of emetics for this purpose was seldom regulated by any principles: at one time we find

* Mr. Tenant, one of the greatest manufacturers of bleaching liquor, has informed me that men affected with chronic cough, who apply to him for work, invariably lose their coughs when cautiously brought into the gas house.

sulphate of zinc and sulphate of copper the favourites; at another, antimonials, ipecacuanha, and other nauseating substances. If the lungs be loaded with mucus, and little or no febrile action present, the direct Emetics—namely, sulphates of zinc and of copper—are to be preferred; for the mechanical impulse only is required: but if, in promoting expectoration, we are desirous of producing and maintaining nausea afterwards, then the emetics to be selected are the antimonial preparations, squill, and similar substances. In general, however, these nauseating Expectorants are employed rather to affect the pulmonary exhalants through the medium of the circulation, than to evacuate the pulmonary tubes by the mechanical action communicated to them in the effort of vomiting.

3.—*by stimulating the Pulmonary Exhalants.*

The substances in this section of Expectorants, instead of exciting the respiratory muscles, operate solely on the pulmonary exhalants; and, as sedatives, relieve the constriction on these vessels, and thereby facilitate expectoration. In those unaccustomed to their use, they undoubtedly excite coughing; but in this case the spasmodic action is produced by their first impression on the glottis; for when they arrive at the bronchial cells, no coughing is produced.

a. TOBACCO. *Nicotianæ Tabaci folia.* L. E. D.—Smoking Tobacco has long been known to the unprofessional as the means of allaying violent paroxysms of asthma; but many years have not elapsed since it was prescribed for this purpose by the physician. Whether it is the *Nicotina* or the *volatile oil* which is the active agent in this case, is still doubtful. Let us examine the manner in which Tobacco operates in stimulating the pulmonary exhalants, when received into the lungs in the form of smoke. It must be recollected that both *Nicotina* and *volatile oil* of Tobacco act powerfully on the animal œconomy; but, as Nicotina is more volatile than the oil, and smoking is a species of distillation, it comes over with the smoke, and is the principle that operates in this mode of using Tobacco. It first operates as a topical excitant on the mucous membrane of the pulmonary tubes, and afterwards acts on the circulating system through the medium of the nerves. This is rendered more evident by the effect of the infusion, or the syrup, which contain the Nicotina, when these are administered in that state of the chest in which there exists something like œdema of the organ, and in which the expectoration is difficult or wholly impeded. In such a state, the infusion or the syrup aids powerfully the expectoration. Nicotina in large doses paralyzes the heart, rendering it insensible to the stimulus of the blood, and the circulation ceases: on this account, we find that fatal effects have arisen from excessive

smoking*; and to the same cause we attribute the vertigo, sickness, and fainting, that invariably the first essay in smoking produces.

Much of the influence of smoking, either as an expectorant or as a sedative, depends on the kind of Tobacco employed. The coarse, acrid Tobacco used by the lower classes of the people, and which is the produce of Virginia, contains the largest proportion of Nicotina, and produces the most powerful expectorant effects; but, at the same time, to those unaccustomed to smoking, the most unpleasant results occur. The Turkish Tobacco is milder and weaker than the Virginian, and has a sweet or honey-like flavour; that of Cumana is the most aromatic†: but the Tobacco most prized for smoking is that which is reared in Cuba and on the Rio Nigro.

Upon the whole, the salutary influence of smoking Tobacco in promoting expectoration cannot be denied, whilst at the same time its narcotic power, when it is employed in excess, weakens the digestive function, obtunds the nervous sensibility, and depresses the whole vital energy.

2. STRAMONIUM. *Daturæ Stramonii Herba.* L. E. D.—The nature of this plant and its active principle, *Daturia*, have been already described. The custom of smoking the dried herb was introduced from Ceylon. It seems to operate in two ways: in the first place, it is applied to the mucous membrane in a state of great irritability, and, as a sedative, allays this condition; thus favouring a slower and more perfect secretion of the mucous follicles; so that the mucus, being in a more natural state, is easily separated and excreted: in the second place, by influencing generally the nervous system, the spasmodic symptoms attendant on the paroxysm of asthma are allayed, and respiration proceeds in a calm and undisturbed manner. I am fully aware that the power of Stramonium has been much overrated; but experience has sufficiently demonstrated its influence as a palliative when smoked in asthma, although it may effect little in establishing the permanent relief of the disease. The use of Stramonium has

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* Philosophical Transactions, 1811.

† It is pleasing to trace the origin of popular customs: that of smoking is unknown; but all the Scythian nations employed certain herbs, which they threw into the fire, and the ascending smoke of which the company seated round the fire collected, causing them to dance and sing*. They had also a religious order who smoked herbs through wooden and earthen tubes†; and this mode of using Tobacco prevailed in America when Columbus discovered that continent. "The calumet, or pipe of peace," says Harris, "is a large Tobacco pipe, with a bulb of polished marble and a stem two feet and a half long, made of a strong reed, adorned with feathers and locks of women's hair. When it is used in treaties and embassies, the Indians fill the calumet with the best Tobacco, and, presenting it to them with whom they have concluded any great affair, smoke out of it after them"—Harris's Voy. fol. 1705, v. ii, p. 908.

* Herodotus, lib. i, § 36. † Strab. lib. vii, p. 196.

been objected to by Dr. Bree, a high authority on this subject, from an idea that it gives a tendency to apoplexy; but my experience has afforded me no reason for according with such an opinion.

3. VAPOUR OF BOILING TAR.—Sir Alexander Crichton introduced the inhalation of the fumes of boiling Tar as a remedy in phthisis. If we examine the components of Tar which are most likely to be raised in the process of boiling, there can be no doubt that the empyreumatic oil and the acetic acid, dissolved in the aqueous vapour, are the principles which stimulate the bronchial tubes when fumes of Tar are breathed. It causes some increase of cough on the first application of it; but by degrees this abates, and the nature of the expectorated matter is so much improved as to promise the most salutary results. Like many other new remedies, it was overpraised; and thence it has fallen into neglect—the natural consequence of exaggerated encomiums. Dr. Chapman, an American professor of Materia Medica, brings forward, as evidence in favour of this method of employing Tar in consumption, the circumstance that "a residence in the cedar and pine swamps of North America, during the summer months, is well known sometimes to have been productive of advantage in pulmonary cases." But Dr. Chapman seems to have forgotten the established fact, that swampy situations and damp places, favourable for the production of agues, are favourable also, in a striking degree, to the improvement of pulmonary cases. In our expedition to Walcheren, so destructive to our soldiers, by the intermittents and remittents under which they suffered, many of them who were afflicted with incipient Phthisis pulmonalis lost their coughs, and were cured of their pulmonary complaints.

Another fumigation, which operates in some degree in the same manner as the vapour of Tar, was tried by myself in some cases of phthisis, two years ago. It is the fumes arising from *burning wool* which has not been dressed. I tried it in cases of open ulcers. In one of them a vomica had burst fortunately into the trachea, and the contents were coughed up. The daily excretion of pus amounted nearly to a fluid pint; and greatly debilitated the patient. The smoke of the burning wool excited great coughing when it was first inhaled; but this rapidly subsided; and, although I cannot aver that any benefit arose from inhalation of this smoke, yet, until a week before the death of this young gentleman, I never witnessed, in this disease, so little disturbance in the system as he suffered. The employment of this vapour was first recommended by Dr. Physick, a popular American physician, who found it useful in stimulating and healing external sores, and thence naturally inferred that it might be equally beneficial if received into the lungs. He conceived that he had established its utility in consumption; but it has not yet accomplished one cure.

B. GENERAL EXPECTORANTS WHICH OPERATE THROUGH THE CIRCULATION, OR BY SYMPATHY WITH THE STOMACH.

1.—*stimulating the Pulmonary Exhalants*

a. EMETINA or *Emetia.*—In its pure state, this substance is white, pulverulent, unalterable in the air, sparingly soluble in cold water, more soluble in boiling water, very soluble in alcohol, but insoluble in ether and in oils. Pure Emetina is inodorous and bitter to the taste: although free from the nauseating flavour of ipecacuanha, as commonly obtained, it is in dark brownish-red scales, deliquescent in the air. It fuses at 122° Faht. It has a distinct alkaline reaction. The ultimate components of Emetina, according to the analysis of Pelletier and Dumas, are—Carbon 64.57 + oxygen 22.95 + hydrogen 7.77 + nitrogen 4.0.

Emetina is procured from the cortical part of the root of CEPHAELIS *Ipecacuanha*, a small plant found in the woods and shady places in Brazil, in the provinces of Fernambucca, Bahia, Rio Janeiro, and Mariana, belonging to the natural order Cinchonaceæ*. The roots of this plant are in diameter the size of a small quill, contorted, wrinkled, covered with a brownish-grey, thick bark, deeply fissured transversely, so as to resemble rings, or cylindrical beads strung upon a thread. In the entire state they are inodorous; but, when reduced to powder, they exhale a faint nauseabond odour; their taste is nauseous, bitter, and slightly acrid. Water at 212° takes up eight parts in twenty, alcohol four, and proof spirit six and a half; the alcoholic is the most active of these solutions. The central part of the root is woody and inert. According to the analysis of Pelletier, 100 parts of brown ipecacuanha yield 16 of Emetina + 2 of a fatty matter, acrid but not emetic + 6 of wax + 10 of gum + 42 of starch + 42 of lignine, with traces of gallic acid†. Emetina is procured by digesting the powder of the root in twice its weight of ether, which separates the fatty matter; the residue is then digested, with the aid of heat, in four times its weight of highly rectified alcohol, until it cease to colour the spirit. This alcoholic solution, evaporated to dryness, is redissolved in water, the solution precipitated by acetate of lead, and the precipitate acted upon by sulphuretted hydrogen gas; which throws down the lead, while the Emetina is left in solulution. On evaporating the solution, the Emetina forms in brownish-red, diaphanous, inodorous scales, which must undergo several solutions in ether and alcohol, and be treated with magnesia more than once before it can be obtained pure. It

* Woodville's Med. Bot. third edit. vol. v, p. 14. London Dispensatory, art. Cephaëlis. Richard, Hist. Nat. Med. t. ii, p. 285.

† Ann. de Chimie, t. iv, p. 181.

possesses the same properties in its impure state, differing only in strength.

Emetina is precipitated by gallic acid and tincture of iodine, both of which form compounds with it, devoid of emetic properties. All astringent vegetable infusions precipitate the Infusion, Wine, and Tincture of Ipecacuanha, forming tannates of starch and Emetina. The infusions are also precipitated by solutions of muriate of mercury and subacetate of lead: all of which, therefore, are incompatible with preparations of Ipecacuanha.

I have had no experience of the expectorant influence of Emetina in its uncombined state; but, knowing the effect of small doses of Ipecacuanha, when no nausea is produced, I can credit the French physiologist, that it exerts a peculiar influence on the pulmonary exhalants. Pure emetina is rarely administered: in doses of one grain it causes vomiting; in its impure state, doses of four grains are requisite to produce the same effect. Its influence on the pulmonary tissue is demonstrated by the post-mortem examination of dogs poisoned by large doses of it, whether administered by the mouth or the anus, or injected into the jugular vein: in every instance the mucous membrane of the lungs is found inflamed. In old chronic catarrhs, the French physicians have successfully administered it, in doses of the eighth of a grain three or four times a day; and, in more recent catarrh, they have found it equally beneficial in doses of a quarter to half a grain. In these cases it appears to operate, without exciting nausea, by simply promoting expectoration. Now, if we admit that it is determined to the lungs as its emunctory, after entering the circulation, we can understand in what manner it produces its effects, as readily as we can comprehend the reason why old and chronic catarrhs are benefited by the inhalation of chlorine, tar vapour, and other substances that are directly applied to the mucous membrane of the bronchial cells. If we do not admit its direct influence on the pulmonary exhalants, I cannot conceive in what manner it operates, as its beneficial effects are undoubted. When Ipecacuanha is given in small doses, it is beneficially combined with opium, in the form of Dover's powder. In doses of three or four grains, which contain about one third of a grain of Ipecacuanha and the same quantity of opium, this powder given in f℥iss of almond emulsion, produces the most decided beneficial effects when neither sweating nor nausea result. The French physicians conceive that Ipecacuanha in substance is less energetic in pulmonary affections, owing to its peculiar fatty principle interfering with the narcotic influence of the Emetina. Setting aside this hypothesis, for it is an hypothesis, the evidence of the influence of Emetina, as an Expectorant, is amply sufficient to recommend it to the notice of British practitioners. At

all events, I have no hesitation in ascribing the influence of Ipecacuanha, in small doses, to its introduction into the circulation and its stimulant effect on the pulmonary exhalants.

Ipecacuanha may be administered, for expectorant purposes, in the form of powder, the medium dose of which is gr. ss to gr. ii; or in that of wine in doses of m. xx to m. xl, in any bland vehicle containing neither tannin nor astringent matter.

b. SCILLITINA.

This substance is asserted to be the active principle of Squill, a well-known expectorant. It is pulverulent, inodorous, extremely bitter to the taste, and leaves a slight impression of sweetness upon the palate; it has a resinous fracture; is very soluble in water, and deliquescent when exposed to the air. Scillitina was regarded by Vogel, its discoverer, as a simple substance*; but M. Tilloy, of Dijon, asserts that it is a compound of an uncrystallizable sugar, gum, and a bitter acrid principle†. It has not yet been employed as a curative agent in its separate state.

SQUILL, *Scillæ maritimæ bulbus*, L. E. D. is the bulb of a plant found on the shores of the Mediterranean, and also on those of Normandy, Britany, Spain, Portugal, Sicily, Syria, and elsewhere, and belonging to the natural order Asphodeleæ‡. The bulb is sliced transversely, and dried at a low temperature. As it attracts moisture from the air, it should be preserved in well-stopped bottles. It contains about 0.70 parts soluble in water, and 0.30 of woody fibre. According to Vogel, the soluble portion consists of 35 parts of Scillitina + 34 of tannin + 6 of gum, with traces of citrate of lime and saccharine matter.

The tannin may be separated by treating the solution with subacetate of lead; the sugar by adding alcohol to the separated fluid, and throwing down the sugar by ether. On evaporation we obtain the Scillitina. If Scillitina be the active principle, it is probable that the powder of Squill undergoes decomposition in transitu, and that the Scillitina operates as a stimulant to the mucous membrane of the bronchial tubes: but much obscurity still involves the operation of Squill. According to Vogel's analysis of Squill, it contains 24 per cent. of tannin, which, in conjunction with the bitter of the Scillitina itself, will aid the digestion of the mucilaginous constituent of the Squill; and in this manner the Scillitina may be carried into the circulation. The ready solution of Scillitina in alcohol, wine, and vinegar, accounts for the fact, that these vehicles are the best for the administration of Squill as an Expectorant.

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* Bulletin de Pharm. t. iv. † Journ. de Pharm. t. xii, p. 635.

‡ Woodville's Med. Bot. third edition, p. 715, pl. 255. London Dispensatory, art. Scilla. Richard, Hist. Nat. Med. t. i, p. 386.

As Squill is an excitant, it is scarcely necessary to say that its use is contraindicated in all inflammatory cases. It is usually combined with honey and vinegar, in the form of what is termed an oxymel; or with soap and ammoniacum, as in the Squill pill of the Pharmacopœias. It is chiefly useful in asthma and chronic catarrh. In large doses, it is apt to prove emetic and purgative, or diuretic; so that, as an Expectorant, the dose must be small, not exceeding one grain of the dried bulb. Thirty drops of the tincture is equivalent to this quantity of the dried bulb. When overdosed, it excites the most violent vomiting, purging, and convulsions; symptoms which induced Orfila to refer its operation to the nervous system: the lungs, on dissection, present no appearances of inflammatory action. The best antidotes are ammonia and other alkalies; on which account, these substances ought not to be prescribed in combination with Squill.

c. GUM-RESINS.

The chemical nature of Gum-Resins has been already described; it only remains to speak in detail of those which possess expectorant properties.

1. ASSAFŒTIDA.—The origin of this Gum-Resin has been already traced. Dr. Cullen first remarked that, when it is taken into the stomach, it stimulates that organ, and rouses into action the respiratory muscles, so as to aid the expulsion of whatever is accumulated in the pulmonary tubes. From the stimulant nature of Assafœtida, it is evident that it can only be employed when no inflammatory symptoms are present: experience has amply confirmed its efficacy in chronic catarrhs and old asthmatic affections; but, in asthma, much of the benefit derived from it must be ascribed to its power of resolving spasm. Perhaps the best form of administering it, as an Expectorant, is that of a pill in combination with ipecacuanha and extract of conium. The dose is from four to twelve grains of the Gum-Resin; but this should be repeated at short intervals.

2. DOREMÆ AMMONIACI, SUCCUS CONCRETUS. *Ammoniacum.* L. E. D.—Although Dioscorides has stated that the plant from which Ammoniacum is obtained is a native of Lybia, and named *Agasyllis*, and Pliny has also noticed it, under the appellation of *Metopium*, yet both the plant itself and its native soil were equally unknown, until Lieutenant-Colonel Wright, of the Royal Engineers, discovered it in the vicinity of Jezd Kahst, a town of Irak El Ajam, the ancient Parthia, about forty-two miles south of Ispahan. The plant belongs to the natural order Umbelliferæ: a dried specimen, presented to the Linnæan Society by Colonel Wright, has enabled Mr. Don to describe it; and as it is a new genus, he has also named it*. Mr. Don informs us

* Dorema, from the Greek δορημα, a gift or benefit.

that the plant is not unlike Opopanax, "facie fere opopanacis;" and that the Ammoniacum exudes spontaneously from it surface. The genus Dorema is distinguished from Ferula and Opopanax, to both of which it is closely allied, by a large cup-shaped epigynous disk, completely sessile flowers, and solitary resiniferous canals*. The plant is called *Oshac* by the Persians: it is perennial, and grows without cultivation on the plains between Yerdekaust and Kumisha, in the province of Irak, exposed to an ardent sun. The proper juice "is so abundant, that upon the slightest puncture being made it instantly oozes forth, even at the ends of the leaves. When the plant has attained perfection, innumerable beetles, armed with an anterior and posterior probe of half an inch in length, pierce it in all directions: it soon becomes dry, and Ammoniacum is then picked off, and sent *via* Bushire to India, whence it is exported to Europe†."

Until these facts, collected by Mr. Don, and some remarks which appeared in the first volume of the Dictionnaire Universel de Matière Médicale, in 1829, were laid before the public, there was much diversity of opinion respecting the Ammoniacum plant. Wildenow regarded it as a species of Heracleum, and named it H. *gummiferum:* Sprengel asserted that it was the Ferula *ferugala* of Defontaines; Olivier, that it was the Ferula *Persica;* whilst others contended that the plant was the Bubon *gummiferum* of Linnæus: in one point only all agreed, namely, that Ammoniacum is the product of an umbelliferous plant.

Ammoniacum is in irregular masses, yellow exteriorly, white within, and breaking with a vitreous fracture. The masses are formed of agglutinated tears, which are also yellow on the surface and white within. The odour is faint, the taste bitter, nauseous, and pungent. It is sufficiently brittle to be powdered in a low temperature; but the powder again runs into a mass in warm weather. In a moderate heat it softens and loses five per cent. of its weight, probably water. It is partly soluble in water, forming a milky-looking emulsion; but by rest it deposits four parts of resin, and one of gummy matter remains in solution. The gummy solution reddens the tincture of litmus: and is precipitated by subacetate of lead and oxalate of ammonia. The resinous part of Ammoniacum resembles wax in many particulars. It unites with alkalies, forming soapy compounds, having considerable bitterness: is dissolved by sulphuric acid, and forms a solution which is decomposed by water. Nitric acid, aided by heat, decomposes it, and produces a yellow resiniform substance; and, on evaporating the fluid, a yellow resino-bitter residue is procured, which is partially soluble in hot water, and

* Transactions of the Linnæan Society, 1832.

† Linnæan Trans. l. c. quoted from the Trans. of the Med. Soc. of Calcutta, vol. i, p. 369.

communicates to wool or to silk a beautiful permanent yellow colour, which resists the action both of chlorine and weak alkaline solutions. According to the analysis of Braconnot, one hundred parts of Ammoniacum contain 18.4 of gum, 70 of resin, 4.4 of a glutinous matter insoluble in water and alcohol, 6 of water, and 1.2 loss.

When Ammoniacum is taken into the stomach, its impression upon the nerves of that organ is transmitted to the respiratory nerves; at the same time, it is absorbed, and operates directly upon the bronchial tissue. As an expectorant, it has been found useful in asthmatic affections, in peripneumonia notha, and in the chronic catarrh of old people. It has been employed in tubercular consumption; but it is too stimulant for the early stages, and the little probability of any thing proving useful in the advanced stage of that disease, renders its employment then of little consequence. It is generally given in conjunction with squill, antimonials, and sedatives. A curious form of prescribing it in conjunction with nitric acid is adopted in America. Two drachms of the gum-resin are triturated with f℥ii of nitric acid, diluted with f℥viii of water, until an emulsion be formed. A table-spoonful of this solution is given in any bland vehicle, every two or three hours, in cases of old catarrhs, in which large accumulations of viscid mucus exist in the pulmonary tubes, with feeble and difficult expectoration. I have had no experience of this form of prescribing Ammoniacum; but it may prove useful in chronic cough attended with much weakness, to rouse the feeble powers of the respiratory muscles and enable the lungs to throw off the offending matter. It may be given in conjunction with Ammonia; and, in those irritable coughs that accompany hysterical affections and are attendant on dyspeptic and hypochondriacal states of the habit, no other expectorant produces so much benefit. The dose in these cases is from gr. viii to gr. x, three or four times a day.

3. Galbanum. L. E. D.—Mr. Don asserts that the plant which affords Galbanum is not the Bubon *Galbanum* of Linnæus, but one which appears to constitute a new genus, allied to *Siler*, but differing from it in the absence of dorsal resiniferous canals, and the commissure being furnished with only two. He proposes to call the plant Galbanum *officinale*. He has only seen the fruit which he has described*. The plant is probably a native of Persia, as the gum-resin is partly imported from Smyrna, partly from India. It is scarcely necessary to say that it belongs to the natural order Umbelliferæ.

As an Expectorant, Galbanum is supposed to possess properties closely resembling those of assafœtida: it is given with the same view, that of aiding the expulsion of viscid or irritating

* Trans. of the Linnæan Society, 1832.

matters from the bronchial tubes and cells, in chronic catarrh and humoral asthma. It may be given in doses of from gr. x to ʒss, in combination with ipecacuanha and any narcotic, two or three times a day.

4. SAGAPENUM. L. E. D.—This substance, the source of which is still uncertain, although it has been attributed to the Ferula *Persica*, is in masses of a reddish-brown colour, soft and semi-diaphanous. Its odour is disagreeable, somewhat resembling that of weak assafœtida: its taste is acrid and slightly bitter. According to the analysis of Pelletier, it consists of 27.13 parts of resin + 15.97 of gum. + 0.80 of insoluble gum and other matter + 0.20 of malate of lime, + 5.90 of volatile oil. It operates as a stimulating Expectorant; but it possesses no advantages over assafœtida, and is inferior to ammoniacum. The dose is from gr. vi to gr. xii.

5. MYRRH, L. E. D.—Under the head of Tonics some account is given of the origin of this gum-resin. Besides the resin and gum, which make up the greater part of it, a free acid, which is supposed to be carbonic acid, holding lime in solution, is found: this carbonate effervesces with sulphuric acid, and is precipitated by oxalate of ammonia.

The expectorant property of Myrrh, although it is very commonly employed in pulmonary diseases, is doubted by some physicians; and I have never observed it produce any beneficial effects when it is given alone. The use of Myrrh is chiefly indicated in chronic coughs and catarrhal affections of debilitated habits, when other and more decided Expectorants are conjoined with it; such, for example, as ipecacuanha or squill; but in these cases more is due to its tonic than to its expectorant properties. It is undoubtedly stimulant, and therefore ought never to be employed when decided inflammatory symptoms are present. In the advanced stages of pulmonary consumption, Myrrh is daily prescribed; and as it is in such cases that chlorine gas is most useful, I am disposed to recommend Myrrh as the best medicine for propping the habit during the topical use of chlorine. It can only be regarded as an auxiliary in phthisis. In prescribing it, we must bear in recollection that its aqueous solution precipitates all the salts of lead and of mercury; and consequently that they are incompatible in prescriptions with it. In phthisis, it may be advantageously combined with sulphate of zinc; and when there is much acidity of stomach, the gum-resin may be dissolved in liquor potassæ or liquor ammoniæ, and administered in any bland aqueous solution. Its efficacy is well established in chronic catarrh and humoral asthma, in which its tonic property, in counteracting the exhaustion produced by profuse expectoration, is highly beneficial. The dose of Myrrh, as an auxiliary to Expectorants in such cases, is from four to eight grains, repeated every three or four hours.

d. BALSAMS.

The characters which distinguish a Balsam are its containing *resin*, *benzoic* acid, and *volatile oil*. The general properties and appearances of a Balsam are those of the resins; but when it is heated or digested in an acid, benzoic acid is procured, although it has been doubted whether this be the production of the process by which it is obtained, or whether it exists ready formed in the Balsam: but, as water dissolves the acid part of Balsams, it is probable that the acid exists ready formed in them. Alcohol and ether readily dissolve them. The strong acids dissolve them, and during the solution a portion of benzoic acid is separated. The resin of the Balsams differs from common resin*. The purest common resin dissolves in sulphuric acid, affording a yellowish or reddish-brown solution, which precipitates whitish flocculi when dropped into water: the resin of the Balsams produces a beautiful red or deep crimson solution with sulphuric acid; and, when dropped into water, precipitates beautiful rose-red or crimson flocculi, which, when washed, do not contain any sulphuric acid; a fact demonstrated by nitrate of baryta, which, even when boiled over them, affords no sulphate of baryta. By heating any Balsam to expel the benzoic acid, and then dissolving the residue in concentrated sulphuric acid, and precipitating it with water, the purity of the Balsam is readily ascertained by the colour of the precipitate.

The Balsams are of different consistence; some being solid, as Benzoin and Storax, others of a semifluid consistence, as that of Peru.

* *Solid Balsams.*

1. BALSAM OF TOLU. *Balsamum Tolutanum.* L. E. D. BALSAM OF PERU. *Balsamum Peruvianum.* L. E. D.—The former of these Balsams is stated to be the secretion of the Toluifera *Balsamum* of Linnæus; but in truth the genus Toluifera has been proved by Humboldt to have been founded on false documents, and, consequently, does not exist. The pale-coloured Balsam, which derives its name from the town of Tolu, in South America, is the produce of a species of Myroxylon, so nearly allied to that which yields the red Peruvian Balsam, Myroxylon *Peruiferum*†, that it is, with much probability, asserted to be the same tree. This species of Myroxylon is a native of the warmer regions of South America, growing in the forests of Paxaten, Muna, Cuchero, and Puzuza. It belongs to the natural order Leguminosæ.

The character of the Balsam yielded by this tree is greatly modified by circumstances. When it is procured by incisions at

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* This remark was first made by M. Dulong d'Astafort.—Journ. Pharm. 1826, p. 37.

† Woodville's Med. Bot. 3d edit. vol. v, p. 48. Richard, Hist. Nat. Med. t. ii, p. 509.

the commencement of spring, "when the showers are frequent, short, and gentle," the Balsam is white, and, being collected in bottles, remains liquid for many years: when it is deposited in calabashes, it condenses and hardens, and forms the dry white Balsam, which is named *Balsam of Tolu*. When the bark is boiled in water, the product is the dark liquid *Balsam of Peru*.

1. *Balsam of Tolu* is generally brought to this country in gourd shells, or calabashes; its odour is extremely fragrant, somewhat resembling that of lemons; its taste aromatic, and somewhat sweetish. In distillation it yields a small portion of volatile oil, and benzoic acid sublimes. According to Tromsdorff, it contains 88 parts of resin, 12 of benzoic acid, and 0.2 of volatile oil, in 100 parts. When digested in sulphuric or nitric acid, much benzoic acid sublimes; and when the nitric is employed, traces also of hydrocyanic acid are evolved. It is wholly soluble in alcohol, ether, and the alkalies: when dissolved in a small quantity of the solution of potassa, it loses its natural odour and acquires that of the clove pink. It forms the chief ingredient in two pharmaceutical preparations: a tincture, which is a simple solution of the Balsam in rectified spirit of wine, which requires to be rubbed with mucilage before it can be rendered miscible with water; and a syrup, which is most readily prepared by adding to two pounds of simple syrup, just prepared, and whilst hot, one fluid ounce of the tincture, and agitating until the whole is well mixed. It is also a component of the compound tincture of benzoin. In all of these preparations the Balsam of Tolu operates as a stimulant Expectorant; and, therefore, can only be administered in chronic catarrh and asthma, when it is necessary to rouse the energy of the lungs and respiratory organs, to promote the expectorant effort. In an opposite state of the chest, Balsam of Tolu is undoubtedly contraindicated, although the syrup, in the small quantity in which it is used to communicate taste and flavour, may be even then administered.

2. *Balsam of Peru* is a viscid, deep brown coloured fluid, somewhat of the consistence of fluid honey, having a fragrant odour, and a warm, pungent, aromatic, bitterish taste. When boiled in water for some time, the water becomes acidulated, and deposites, on cooling, crystals of benzoic acid. When distilled with water, it yields a reddish, limpid oil, in the proportion of $\frac{1}{16}$ of the Balsam employed; and benzoic acid sublimes in the neck of the retort. When distilled pure, very little oil is obtained; but if the heat be raised to 617, a yellowish oil comes over abundantly, and benzoic acid sublimes; at a lower heat the products are an acid, water, and a dirty-looking benzoic acid. If the heat exceed 617, the Balsam is completely decomposed, and a black, pitchy, empyreumatic oil, with plenty of carbonic acid and carburetted hydrogen gas come over.

Sulphuric acid acts upon Balsam of Peru in the same man-

ner as upon other Balsams. Nitric acid acts upon it with violence; but when the acid is diluted and distilled from Balsam of Peru, the liquid in the receiver smells of bitter almonds, and, when treated with potassa, solution of protosulphate of iron, and muriatic acid, it shows evident traces of hydrocyanic acid. In this case, both the nitric and the benzoic acids are decomposed; the equivalent of nitrogen necessary to form the hydrocyanic acid is supplied by the nitric acid, whilst the carbon and hydrogen proceed from the benzoic.

According to the analysis of Stolze, this balsam consists of 24 parts of brown, nearly insoluble resin; 207 of soluble resin; 690 of a volatile oil; 64 of benzoic acid; and 6 of extractive, in 1000 parts. It may be given to the extent of f℥i, triturated with yolk of egg to suspend it in water. It is a more stimulant Expectorant than that of Tolu; it is occasionally, but not often, employed in asthma, in old and debilitated persons: but it is chiefly used externally, to cleanse ulcers and promote their healthy granulation.

4. STORAX. L. E. D.—This balsam, when pure, is a spontaneous exudation from the bark of the Styrax *officinale**, a native of the South of Europe and the Levant. The tree belongs to the natural order Erinaceæ of Von Martius;—Styraceæ of De Candolle. Pure Storax is in concrete tears of a yellowish or reddish-yellow hue, having the consistence of wax, and an agreeable odour; it is now rare in the market.

The Red Storax, or, as it is called, Storax in mass, is of a clear reddish-brown colour, and consists of agglutinated masses, which are clammy when handled. It has an odour not unlike that of Balsam of Peru, and a warm aromatic taste. Both varieties are inflammable, and possess the general properties of the other balsams. Storax is a stimulant Expectorant; but it is a useless incumbrance of the Materia Medica; all the advantages which it possesses being more amply obtained from the Balsams of Peru and Tolu.

5. BENZOIN. L. E. D.—Benzoic Acid has been already noticed in its separate state. Benzoin is the production of the Styrax *Benzoin*†, the balsam which yields Benzoic Acid in greatest quantity, and from which it is named. This tree grows in the northern parts of Sumatra, named the *Batta* country. On some parts of the coast it is cultivated, being a quick-growing tree. The seeds are sown in the paddee fields; and, when the trees acquire trunks of six or eight inches in diameter, incisions are made in the bark, from which the Benzoin exudes and is pared off with a knife. The first portion is the purest;

* Woodville's Med. Bot. third edit, p. 201, pl. 101. Richard, Hist. Nat. Med. t. ii, p. 158.

† Woodville's Med. Bot. p. 294, pl. 102. London Dispensatory, art. Styrax. Richard, Hist. Nat. Med. t. ii, p. 160.

it is white, soft, and fragrant, and is called *Head Benzoin;* the next is mixed with parings of the wood, and called *Belly Benzoin;* and least pure, or *Foot Benzoin*, is very foul. The trees will bear these incisions ten or twelve years. The best Benzoin is sent to Europe; the rest is used in India and the Malay islands for burning to perfume the houses and to expel troublesome insects.

Benzoin is in dry, pulverulent masses, of a pale reddish-brown colour, spotted with clear red, and intermixed with numerous small amygdaloid masses, or whitish tears, about the size and shape of an almond, presenting an even, translucent fracture. It has a sweetish, balsamic taste, and an aromatic, agreeable odour. Its sp. gr. is 1.068. According to the analysis of M. Bucholz, it contains resin, benzoic acid, a substance analogous to balsam of Peru, and a peculiar aromatic principle soluble in water and alcohol, ligneous matter, and impurities. Stolze analysed the tears and their connecting mass separately, and found the following matters in 1000 parts of each.

	Tears.	Mass.
Yellow resin, soluble in pure ether.	798.25	88.00
Brown resin, insoluble in pure ether	2.50	697.25
Benzoic acid	198.00	197.00
Extractive	0.00	1.50
Impurities	0.00	14.50
Moisture and loss	1.25	1.75

Benzoin is wholly soluble in alcohol and in the solution of potassa; and crystals of benzoate of potassa are mixed with the solution. It is soluble in boiling nitrous acid; but, on cooling, a copious deposite of benzoic acid takes place. By digestion in strong nitric or sulphuric acid, it is converted into artificial tannin. When it is exposed to heat, the benzoic acid is exhaled in combination with a small quantity of aromatic oil, which gives it odour. On this account, it is preferable to extract the acid by forming a benzoate with lime or potassa boiled with the Benzoin in a large quantity of water, and then to decompose the filtered solution by means of muriatic acid, which, uniting with the alkaline base, throws down the acid. This, after being dried, yields pure crystals of the acid by sublimation. The acid thus procured is inodorous; it has a sweetish aromatic taste; melts in a moderate heat, and is volatilized; but at a higher temperature it burns with a clear yellow flame. It is soluble in 24 parts of boiling water: scarcely at all in cold water: alcohol dissolves it readily. According to Berzelius it is composed of 15 prop. of carbon $(6 \times 15) = 90 + 3$ of oxygen $(6 \times 8) = 24 + 6$ hydrogen $= 6$, making the equivalent 120. Butaccording to Liebeg and Wöhler, it is an oxide of a compound, inflammable, which they have named *Benzule;* thence its constituents are 14 eq. of carbon $= 84 + 5$ Hydrogen $= 5 + 3$ oxygen $= 24$, making

the eq. of the anhydrous acid 113. The crystals contain 1 eq. of water of crystallization. It may be administered in doses of from gr. iv to gr. xii, combined with sugar or mucilage.

As a stimulant Expectorant, Benzoin is advantageously employed in humoral asthma; but its effects do not differ from those of the other balsams. The acid is useful in an atonic or debilitated state of the system, when the expectoration is difficult in peripneumonia and chronic catarrh.

All the balsams were formerly much employed as Expectorants in pulmonic diseases, whether recent or chronic; whether pleuritic or asthmatic; pneumonic or phthisical. But there are, doubtless, unanswerable objections to the employment of balsamic medicines in the inflammatory stage of any pulmonary disease. Dr. Fothergil loudly denounced the use of them in such cases; but perhaps he carried his objections too far. Experience has demonstrated that, when the excitement is subdued, they may be employed with advantage. The best form of giving them is to suspend them in water by triturating them with sugar and yolk of egg. The mildest is the balsam of Tolu. An elegant mixture is formed by rubbing from forty to fifty drops of the tincture with mucilage of gum, which renders it miscible in water. This emulsion is an excellent vehicle for the compound powder of ipecacuanha in obstinate coughs, when all inflammatory symptoms have subsided.

e. OLEO-RESINS.

These are the proper juices of those plants which constitute the natural order Coniferæ, Amyrideæ, and some of the Leguminosæ: they are natural compounds of volatile oil and resin.

1. AMYRIS GILEADENSIS RESINA. *Balsam of Gilead or Mecca.* E*.—This substance, however, is not the production of an Amyris, but of the Balsamidendron *Gileadense*, a native of Abyssinia. Burckhardt asserts that, at Szafra and Beder only, the Balesan or Mecca Balsam can be procured in a pure state. In the middle of summer, small incisions are made in the bark of the tree, whence the Balsam flows, and is taken off with the thumb nail. The purest is of a clear white colour; the next kind is of a yellowish-white colour: the people of Szafra adulterate it with sesamum oil and tar. It has a strong terebinthinate odour, and a pungent taste: and, when set on fire, burns without leaving any ashes. The Arabs try its purity by dipping the finger into it, and then set it on fire: if it do not burn the finger, they judge it to be pure; but if it burn the finger as soon as it is set on fire, they consider it adulterated. The pure Bal-

* Woodville's Med. Bot. third edit. p. 603, pl. 214. London Dispensatory, art. Amyris.

sam is bought up principally by Persians who carry it to Djidda and Mecca; whence it arrives at Cairo, and undergoes adulteration. It is chiefly used in Upper Egypt, by the richer classes of the Hadjis, who put a drop into their first cup of coffee in the morning. It is rarely brought pure to Europe; and it is difficult to say what could induce the Edinburgh College of Physicians to retain it in the list of the Materia Medica.

2. Copaiba. L. Resina Copaiferæ officinalis. E. D. *Copaiva. Balsam of Copaiva.* — The tree which yields this specis of oleo-resin, the Copaifera *officinalis**, is a native of Brazil and Guiana, and belongs to the natural order Leguminosæ. The Balsam, as it is erroneously termed, is procured from incisions in the bark of the trunk: it flows so abundantly that twelve pounds are often procured in three hours. This oleo-resin is of a bright-yellowish colour, of the consistence of thick oil, transparent and lighter than water; it has a strong disagreeable odour; an acrid, bitter taste; and a sp. gr. of 950. By distillation it yields a greenish-white, transparent, volatile oil, which has the odour of Copaiba, and to which it owes its medicinal powers; whilst a reddish-brown, solid, transparent, inodorous resin is left in the retort. According to the analysis of Stolze, 100 parts contain 45.79 of volatile oil, + 1.66 of a clammy resin, + 52 of brittle resin, and 0.75 of extractive. It is soluble in strong alcohol, ether, and the volatile and fixed oils: but insoluble in water, in which, however, it can be suspended by yolk of egg. It is often adulterated with castor oil, which may be detected by mixing three parts of the suspected Copaiba with one of sulphuric acid; if the Copaiba be pure, it forms a plastic, reddish mass.

Copaiba has been prescribed successfully as an expectorant in chronic catarrh, with the view of inspissating rather than attenuating the mucus of the bronchial tubes. If, as is probable, it stimulate directly the mucous membrane, the effect produced may arise from a new action being induced upon the inflamed surface, in somewhat the same manner as occurs, from its employment in gleet, on the mucous membrane of the urethra: and it is only upon such a mode of action that we can account for the benefit which results from its administration in the advanced stages of Phthisis. The average dose is from m. xxx to f℥i, combined with sugar and any bland fluid as an oleo-saccharum. It may also be given in the form of pills, by rubbing it up in the proportion of two parts of Copaiba with one part of the carbonate of magnesia, and leaving the mixture for some time at rest, until it become solid; if the Copaiba be pure, the mass remains diaphanous.

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* Woodville's Med. Bot. third ed. p. 609, pl. 216. London Dispensatory, art. Copaifera. Richard, Hist. Nat. Med. t. ii, p. 506.

f. BITTER EXTRACTIVE.

The substances to be described under this head are little used; but, nevertheless, they possess considerable expectorant powers.

1. MARRUBIUM VULGARÆ, *Common Horehound**, is an indigenous plant, found as a weed under every hedge. It belongs to the natural order Labiatæ. Besides extractive, Marrubium contains volatile oil, on which its strong and unpleasant odour depends: it is in the recent plant of Marrubium that this strong musk-like odour exists: it is soon lost when the plant is dried and kept. Marrubium has a bitter, slightly acrid taste: its medicinal properties evidently depend on bitter extractive and volatile oil. Water takes up a considerable portion of these components, and also tannin; thence persulphate of iron throws down a greenish-black precipitate when added to the watery infusion; which contains a free acid, and precipitates nitrate of silver, bichloride of mercury, and the salts of lead. It is also precipitated by oxalate of ammonia; and it is probable that the lime is in the form of a carbonate, as barytic salts throw down a precipitate, which is soluble in nitric acid.

The employment of this plant as an Expectorant is of very ancient date. It was commonly employed in humoral asthma, when accompanied with much oppression, and with a tough, ropy, expectorated matter, difficult to be thrown off, or causing pain in its expectoration. Alexander Tralles recommends it greatly in phthisis pulmonalis; but, although I cannot accord with his eulogy of it in this cruel disease, yet it produces considerable benefit in that state of chest which has been named catarrhal phthisis, in which there is much cough with copious excretion of mucus, a diurnal fever, recurring twice a day, nocturnal sweats, and great prostration of strength. In this state, in which a tonic is clearly indicated, the Horehound may be prescribed with advantage. It may be administered in the form of powder, mixed with syrup of white poppies, or in the form of an aqueous or a vinous infusion. On the Continent an extract is prepared; but it is much less useful than the other preparations, owing to the dissipation of the volatile oil. The infusion, made with ℥i of the dried plant to half a pint of boiling water, may be given in doses of f℥ii three times a day.

2. TUSSILAGO FARFARA. *Coltsfoot.* L. E. D.—This indigenous plant has been much neglected by the moderns, although it held a high rank as a pectoral among the ancients. The Tussilago *Farfara*† belongs to the natural order Compositæ. The

* This species of Marrubium should not be confounded with Marrubium *nigrum*. Vide Woodville's Med. Bot. third edit. p. 332, pl. 118. Richard, Hist. Nat. Med. t. ii, p. 51.

† Woodville's Med. Bot. third edition, p. 45, pl. 68. London Dispensatory, art. Tussilago. Richard, Hist. Nat. Med. t. ii, p. 256.

plant is found in great abundance on waste grounds of a chalky and argilaceous character, propagating itself by rhizomes, or underground creeping stems*. The dried plant yields its medicinal properties to water: the decoction or infusion of the leaves strikes a black colour with sulphate of iron. It is copiously precipitated by subacetate of lead and oxalate of ammonia; but is little affected by any other reagent. Its active principle is unknown; but it is combined with a pure bitter, to which must be attributed its influence as a tonic, in combination with its expectorant power. The decoction of Tussilago was a remedy for phthisis so early as the time of Dioscorides; but it is now seldom prescribed; it nevertheless has properties which require the attention of the physician. As a tonic, it may be employed in the latter stages of phthisis and chronic catarrh. I can bear ample testimony to its expectorant powers. In making the decoction, care must be taken to strain it carefully, as the hairs of the pappus of the flowers may be taken into the gullet, and produce much injurious irritation there. The decoction is made with two ounces of the dried plant to a pint of water, and may be administered in doses of from f℥iss to f℥ii three times a day.

3. CETRARIA ISLANDICA. *Lichen Islandicus. Iceland Liverwort.*—This plant belongs to the natural order Lichenes†. This lichen grows in great abundance in the North of Europe and Iceland: on almost every mountain in the north: and even in England, on the high grounds near Cambridge; and at Stiesserstone in Shropshire. It is inodorous; and, when chewed, tastes bitter and mucilaginous. It has been analyzed by several chemists. According to Berzelius, 100 parts contain 3.6 of a bitter principle + 3 of acidulous tartrate of potassa and lime + 1.9 extractive + 7 green wax + 44.6 of fecula + traces of gallic acid, and 36.6 of lignine. It is to the bitter principle that it owes its medicinal properties; and which, if it possess any influence as an Expectorant, must enter the circulation and stimulate the pulmonary exhalants. I have doubts if it possess any Expectorant influence; although this lichen has been vaunted as a *Pectoral* for more than 200 years. Scopoli, Dr. Herz, Schneider a Danish physician, Stoll, Tromsdorff, and a long list of physicians of Germany, have published their testimony to its efficacy in phthisis: but still it must be regarded

* It is this plant which first shows itself when earth is thrown up from a great depth, as in digging wells, &c.

† The lichens are found in all humid places, and sometimes on the faces of the hardest granite rocks, from which, if they had roots, no nutriment could be drawn. What appear as roots, therefore, in this class of plants, are mere claws, as it were, to fix them to the trees, decayed wood, stones, rocks, and surfaces of whatever kind they are attached to: consequently they are not parasitic plants, but derive their nutriment by superficial absorption.

rather as a tonic of a light kind, in combination with a feculacious nutriment, than as an Expectorant. In scrofulous affections, connected with irritation of the lungs, it has displayed much efficacy; but in correcting this diathesis, we must refer the benefit to its tonic powers. A better idea of its value in phthisis cannot be given than in the words of Sir Alexander Chrichton. "In phthisis," says he, "its good effects consist in improving the matter to be expectorated; in diminishing the frequency of the cough, and rendering it more easy: in calming the irritability of the patient, and in preventing, or much moderating, hectic fever." In prescribing it, the bitter should not be ordered to be wholly removed, but only as much of it as can be taken up by cold water, in which the Cetraria should be steeped for twelve hours; after which the water should be decanted off, and the lichen squeezed between the folds of a coarse cloth: it should then be boiled with fresh distilled water, until the whole assume a smooth gelatinous consistence. When this decoction is strained, it consists of starch, holding in solution a considerable portion of bitter extractive, and some traces of tannin. The best form of administering this decoction is to combine it with some of the mineral acids, and to sweeten it with syrup of white poppies. In this form it may be freely administered in cases in which the powers of life are sinking.

** *Inorganic Substances.*

AMMONIA. CARBONATE OF AMMONIA.—In mentioning the topical effects of Ammonia when taken into the lungs, in the form of vapour, I stated its utility as arising from the stimulus which it affords to the mucous membrane when in a highly relaxed state; and that, by calling into action the respiratory muscles, it enables the patient to expel from the lungs the superabundant mucus which, in such states of the chest, obstruct respiration and destroy life by suffocation. There is much risk, however, in the topical application of Ammonia in this manner; and therefore its internal administration is always to be preferred. It exerts an immediate and powerful influence on the animal œconomy, when it is taken into the stomach; its power being exerted on the nervous system, without quickening or much increasing the force of the heart and arterial system. In the latter stage of inflammation of the lungs, when the expectoration suddenly stops, and suffocation is threatened, Carbonate of Ammonia is the best medicine to restore the power of expectorating, and maintaining the nervous energy necessary for that effort. The dose may be regulated according to circumstances:—it may be extended to ten, or even, occasionally, to sixteen grains, repeated every second hour until the effect is produced; when the dose must be again diminished,

and the intervals extended. The chief inconvenience in the administration of such large doses of the medicine arises from the heat it excites in the fauces in the act of swallowing it; and, therefore, it is requisite to involve it in some mucilaginous substance; the best, perhaps, is simple mucilage of gum, diluted with the emulsion of almonds.

2. *Substances which operate as Expectorants by producing Nausea.*

* *Organic Products.*

a. EMETINA.—The nature of this substance has been already detailed. In attempting to explain the mode by which nauseating medicines produce expectoration, we must consider the sympathy which exists between the skin and mucous membrane of the pulmonary tubes, and the similarity of the functions of both as exhalant organs. In febrile and inflammatory states of the system, both the skin and the bronchial membrane suffer constriction capable of impeding their exhalant function, and giving origin to a train of symptoms depending on a deficiency of the natural secretion. In this condition of the mucous membrane, nauseating substances operate by relaxing this constriction, and enable the secretion to proceed. Under such a state, it is probable that the mucus present in the air tubes is of an acrid character; but as it remains adherent, it excites no effort for its expulsion. When, however, the constriction is relaxed, and the mucus becomes diluted and moveable, it still remains sufficiently acrid to stimulate the glottis and larynx, and thus to call into sympathetic action the whole of the respiratory muscles requisite for the effort of coughing, to expel the now loosened mucus. To effect this purpose the Emetina is well adapted, either in its pure state or in combination, as it is found in ipecacuanha. In its uncombined state, brown or coloured Emetina may be administered in doses of a quarter of a grain in combination with syrup of Tolu; but, for expectorant purposes, the ipecacuanha is preferable to Emetina, both on account of the manner in which the active principle is sheathed in the powder of the root, and also because the Emetina has been found more likely to excite, in some individuals, inflammatory action in the stomach than ipecacuanha. This active principle appears to be separated, by the digestive process, from the other components of ipecacuanha, and taken into the habit: it passes to the lungs and produces a direct impression upon the pulmonary tissue. The dose of the ipecacuanha, to produce expectorant effects, is from a grain to two grains; but much depends on the nature of the vehicle in which it is administered. It cannot be administered in combination with any astringent infusion, as tannin forms with it an insoluble

compound, which exerts no influence whatsoever on the living system.

* * *Inorganic Substances.*

b. ANTIMONIALS. — The best of these, for expectorant purposes, are the *Tartrate of Antimony and Potassa*, and the precipitated *Sulphuret of Antimony*. The nausea which both of these medicines excite relaxing the spasm of the capillaries of the mucous membrane, and permitting the exhalation to proceed, easily explains the dilution of the viscid mucus, and the production of that state in which it is most readily expectorated. Now, although this explanation of the action of the nauseating antimonials is satisfactory to a certain extent, as far as regards the pulmonary exhalants, yet, it is evident that the result would be much facilitated by administering, at the same time, the carbonate of ammonia, when the habit admits of it; by which means both the indications can be at once fulfilled—the viscid mucus is diluted, and the means of expelling it by coughing greatly aided.

The *Precipitated Sulphuret* was formerly much employed in asthma and chronic catarrh; but the uncertainty of its operation narrows the chances of its beneficial influence: the *Tartrate of Antimony and Potassa* is undoubtedly a more manageable and active preparation, and answers every purpose which can be expected from Antimonials. For producing its expectorating effect, it is given in minute doses—for instance, from $\frac{1}{10}$ to $\frac{1}{4}$ of a grain, repeated every second hour. It is best given in solution. To secure its operation, the body should be kept moderately warm; for cold on the surface checks expectoration. Squill and other vegetable Expectorants do not materially improve the powers of the tartarized antimony when combined with it. The Tartrate should be free from adulteration. Its purity can be easily ascertained by dropping one or two of its crystals into a solution of sulphuretted hydrogen gas in water; when, if it be pure, an orange-coloured deposite will be formed on them: or the solution may be precipitated with acetate of lead or with lime water: in either case, if the tartrate be pure, the precipitate is soluble in nitric acid.

In employing the different Expectorants, frequent occasions occur for conjoining opium with them. In these combinations opium operates solely by its sedative influence: it certainly does not diminish the bronchial exhalation, as has frequently, but erroneously, been stated: on the contrary, it facilitates expectoration. This is to be attributed both to its increasing the natural exhalation of the lungs, and to its rendering the cough less frequent; and thereby diminishing the irritation which exists on the mucous membrane.

EMPLOYMENT OF EXPECTORANTS AS REMEDIAL AGENTS.

If we compare the class of Expectorants with many of the other classes of medicines, the range of their utility is extremely limited. It is, nevertheless, necessary that the employment of them should be properly regulated. Before prescribing an Expectorant, we must carefully consider upon what grounds we are to select the substance we intend to employ. We are aware that there are two distinct descriptions of Expectorants; one kind which operates by its stimulant properties, whether these act *directly* by an immediate impression upon the bronchial membrane, or *indirectly* through the medium of the system; and another kind, which takes off the constriction and diminishes excitement in the pulmonary exhalants, by exciting nausea. Now, the circumstances that would induce us to select our Expectorant from either of these classes must be connected with the nature of the disease affecting the pulmonary organs; its exciting cause; and the consideration whether it be a cough of inflammation and increased action, or whether it be connected with debility, and, in that case, be kept up by nervous irritation. In every pulmonary disease there is reason for thinking that the early symptoms are those of inflammation: Expectorants are then of little importance, except as auxiliaries in bringing on a crisis: but when this is overcome, or partly subdued, then the most salutary effects are obtained from expectoration. In this stage of pulmonary inflammation, the nauseating Expectorants are to be preferred. After expectoration, however, has been induced, and the inflammatory symptoms have been subdued, it is still requisite to continue the use of the nauseating Expectorants; for, as absorption is greatly promoted by nausea, it is necessary to relieve the chest of the superabundant mucus which, at this period, is poured out into the bronchial cells; and, therefore, those stimulants that experience has taught us are chiefly determined to the lungs, must be resorted to for the purpose of throwing off the burthen of mucus with which these organs are oppressed. It is easy to conceive that thickened, or, as they are termed, well-concocted sputa, which are generally sufficiently glutinous to adhere together in masses, will be more easily detached and ejected by a violent expiratory effort, than thin mucus, whether accumulated in the tubes or spread out upon their sides. The necessity, therefore, of ascertaining whether the disease be one of excitement or of debility, is essential: it is necessary also to take into consideration the period of the attack, whether it be the commencement, the middle, or the termination, for which we are called upon to prescribe: for although each of these periods may be benefited by expectoration, yet the substances employed to effect this require to be

very different in their characters, according to the period in which they are given. To illustrate these remarks, let us take, as an example, a case of pneumonia. In the commencement of the attack, the secretion of the mucous membrane of the bronchial tubes is greatly deranged, and the tubes themselves are comparatively dry; and the inhaled air becomes, on this account, an injurious, instead of a healthful stimulus. As the disease advances, this state is overcome, either by bleeding or by a tendency to a spontaneous crisis; the quantity of the mucus is then greatly increased, and it is often tinged with blood. The most favourable symptom, in this state, is a free expectoration; the most unfavourable, the sudden cessation of it. Our object, therefore, is to aid this effort of Nature, or to produce an artificial state resembling it; not from any erroneous idea that the disease depends on some morbific matter which is to be thrown off, but on principles of a sounder pathology. It was from this erroneous notion of a morbific matter which required to be thrown off, that stimulants were formerly so freely and indiscriminately administered. We know now that there is no such matter; but that there is a diseased action in the vessels secreting the pulmonary mucus. At first there is a constriction of these vessels; but, as the disease advances, this is changed to a state of relaxation. The first attention of the physician is, therefore, to be directed to the inflammatory condition of the lungs; and if there be any reason for endeavouring to promote expectoration at this time, it must be effected by the gentlest means—such, for instance, as the inhalation of watery vapour, or by nauseating doses of ipecacuanha, or of tartar-emetic and opium. Full vomiting in this state of the chest is also occasionally highly beneficial; and although, on a prima facie consideration of its mode of action, it may appear at variance with the means just recommended, yet, by favouring a transfer of action, it often induces an increased secretion of mucus from the pulmonary exhalants, producing the most marked relief. To effect this benefit, however, the vomiting must be full, and maintained for a specific time, certainly not less than an hour. If, notwithstanding the employment of these means, the expectoration generally becomes too abundant, and there is danger from the obstacles it opposes to the free entrance of air into the lungs, then the stimulating expectorants are indicated—squill, ammoniacum, the balsams, the turpentines, ammonia, and the topical application of the expectorant gases.

The nauseating Expectorants are equally indicated on the same principle, in the commencement of catarrhs, especially in that epidemic variety of the disease termed influenza. After bleeding moderately, and the administration of an emetic, the best results have followed the administration of small doses of ipecacuanha in combination with squills and opium: but when

the febrile symptoms have disappeared, and cough, attended with a thin, frothy excretion, remains, then the gum-resins, or the balsams and opium, administered in the evening and at bed time, are generally productive of the most beneficial results. The same precautions are requisite in the administration of Expectorants in the commencement and in the advanced stages of phthisis. But in all of these diseases expectoration may be too profuse; in which case we must resort to tonics and other means likely to support and bring up the vigour of the system. In the greater number of cases of asthma of a recent date, the disease begins with fever; a quick, hard pulse; a dry cough; oppression of the chest; and suppressed expectoration; and the paroxysm terminates with increased expectoration. This progress of the paroxysm led to the notion that it depends on the retention of the expectoration, and that the solution of the paroxysm must follow its appearance; and, consequently, squill, ammoniacum, and other stimulants, were inconsiderately prescribed, instead of the nauseating Expectorants, and were productive of injurious consequences. As long as the least suspicion of inflammation exists, the stimulant Expectorants must not be prescribed: and it is only after this has subsided that squills, ammoniacum, and assafœtida, can be either advantageously or safely administered. On the contrary, in that variety of asthma which appears to depend on a state approaching to that of paralysis of the system of the par vagum, in which the bronchial cells, being deprived of their nervous energy, do not act sufficiently to aid the expulsion of the air in expiration, and, consequently, instead of aiding, prevent the necessary change required to be produced in the pulmonary circulation, the nauseating Expectorants would be hurtful; inasmuch as they tend to relax and keep up that state of diminished excitability which is the result of the morbid condition of the bronchial nerves. It is in such cases, and in the low stage of pneumonic inflammation, when the fever has assumed a typhoid character, and the lungs are loaded with mucus, that the inhalation of the irritant gases, the internal administration of the balsams, and more especially of Ammonia, are undoubtedly beneficial.

Uuder all circumstances, there are three general rules to be kept in view in administering Expectorants.

1. The surface of the body should be kept moderately warm, and even in a gentle or breathing perspiration.

2. Whatever determines to the kidneys must be avoided.

3. Purging is not only not to be promoted, but to be carefully guarded against; for, as the action of the secreting vessels of the lungs and intestines seem to alternate and to be opposed to one another, Expectoration is checked when purging occurs.

SECTION XIII.

EMETICS.—MEDICAMENTA EMETICA.

Syn.—Vomitoria.

EMETICS* may be defined—"substances which cause the ejection of the contents of the stomach by the mouth, independently of the stimulus of quantity, or of the influence of any nauseous taste or flavour." This definition is a modification of that of Dr. Murray, who adds, "or of any narcotic or acrid power:" but as the real principle which enables emetic substances to produce their effects is unknown, it is going, perhaps, too far to affirm, in a definition, that this is neither *narcotic* nor *acrid*.

When emetic substances, with a few exceptions, are taken into the stomach, they do not immediately operate; and the stomach remains for some time undisturbed. This operation is preceded by an uneasy sensation, or nausea; which increases and terminates in vomiting. But the influence of the emetic substance, even before vomiting commences, is not confined to the stomach. As soon as the nausea is felt, the countenance becomes pale; the pulse is diminished in strength, and it beats quicker and more irregularly than before. There is, occasionally, great anxiety, listlessness, depression of spirits, and a tendency to fainting: at length sweat breaks out; and, before vomiting takes place, there is a peculiar uneasy sensation experienced at the clavicles. After the vomiting has begun, the face flushes; the pulse, although feeble, yet is quickened; and it remains so between each effort of vomiting, which occurs several times in succession, at short intervals, before it ceases. The nausea now subsides, either at once or by degrees, leaving a transitory feeling of depression, which makes the patient indifferent to every thing around him.

To understand the theory of vomiting, the general functions of the stomach should be known.

The stomach is amply supplied with nerves, derived from the par vagum and the great solar plexus; but, except at the cardiac orifice, it is not an organ of much sensibility. Its natural action is a gradual and regular succession of moderate contractions from the fundus to the pylorus; or, as it is termed, a peristaltic movement, by which the chyme or food changed by the digestive process is carried forward and pressed through the relaxed pyloric orifice into the duodenum.

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* The term Emetic is derived from ἐμέω—I vomit.

In swallowing the food to convey it to the stomach, the pharynx is elevated by a peculiar set of muscles; and I am anxious to direct attention to this fact, because the same state of parts occur in vomiting, the pharynx is elevated and the glottis shut; and both these parts remain in this state during the act of straining, until the ejectment of the contents of the stomach is effected, when the pharynx again falls, the glottis is opened, and a full inspiration takes place.

The food is received into the stomach on the left extremity of the organ. Here it remains until it is changed into chyme, and becomes the natural stimulus to the muscular fibres, or rather of the nerves, calling these fibres into action; and by their contraction it is pushed from the fundus to the pylorus. If the stomach be in a healthy condition, the pyloric orifice opens and the chyme passes into the duodenum: but, on the contrary, if the food be imperfectly digested, the pyloric fibres do not relax; they contract and forcibly push backwards, by an inverted action, the chyme again into the fundus of the stomach, and sometimes even into the gullet, exciting eructations. This repulsion of undigested food, by the pylorus, appears almost an instinctive operation. Sir C. Bell considers it approaching to something like intelligence; but it evidently depends on the distinction between the influence of a natural and an unnatural or unaccustomed stimulus applied to the same part. When the chyme is perfected, it affords the *natural* stimulus; and the contraction, excited in the pyloric region of the stomach, is preceded by the relaxation of the fibres of its valvular orifice; but when the chyme is imperfect, or any foreign matter stimulates this region of the organ, the stimulus is *unusual;* no relaxation of the pyloric fibres follow, and an antiperistaltic movement of the viscus is the result. Although the stomach, also, is a highly irritable organ, yet it is not, as I have already stated, very sensitive; and its healthy excitement and action do not become obvious to us, although any unusual excitement is rendered sensible by an uneasy feeling, if not by pain. From this cause, food of difficult digestion oppresses the stomach; for, although that portion of the food which has undergone the change of digestion, or chymification, may pass into the duodenum, yet that which is undigested does not pass.

The stimuli, which excite the muscular fibres of the stomach, are not immediately applied to these fibres, but to the contiguous coats. Between the villous coat, however, and the muscular coat there is the closest sympathy. Indeed, this is the case between all the coats; for if, in an animal killed by a blow and immediately opened, the peritoneal coat be stimulated, the muscular coat will contract in the same manner as if the stimulus were applied to the villous coat. When an Emetic is received into the stomach, it is supposed to operate by its local stimulating

influence on the coats of the stomach; but I greatly doubt the correctness of this opinion. If this were the case, the time which elapses between taking an emetic substance into the stomach and its operation would be much shorter than it is; and there are circumstances which induce me to believe that, in every instance, unless the emetic substance be an irritant, it must be taken into the circulation before vomiting be induced. We know that when tartar-emetic is introduced directly into the circulation—into a vein, for example—it produces vomiting sooner than if it had been swallowed; and an experiment of M. Majendie has demonstrated, that when vomiting has been produced by an Emetic substance, it may be stopped by pressure made upon the medulla oblongata, in the same manner as the convulsions caused by strychnia may be arrested by pressure on the motor tracts of the spinal marrow. Now, the inference that may be drawn from this fact is, "that the action of Emetics is not owing to any local stimulus on the nerves of the stomach, but to the action of the emetic substance, after being absorbed into the circulation as a direct stimulus, *ultra naturam*, to the origin of the nerves, whereby contractions of the stomach and the action of the other muscles concerned in the act of vomiting are induced. These nerves comprehend a branch of the eighth pair, the intercostal, and the phrenic nerves.

It may be enquired, what is the nature of the irritation which excites vomiting? Is it mechanical? Does it depend on the physical character of the particles of the substance employed? or is it the result of some chemical or electo-chemical change? These are queries which cannot be satisfactorily answered: it is probable that there is something in the substance employed which has the power of irritating a particular set of nerves only; for were this not the case, why should emetic-tartar, when injected into the jugular veins, excite vomiting?

Vomiting may be produced by a variety of causes. 1. It may occur from the food undergoing changes inconsistent with healthy digestion; from mechanical irritants lodging in the stomach; from tumors pressing on the pylorus; from inverted actions of the intestinal canal, forcing the contents of the duodenum, particularly the bile poured into it from the biliary ducts, into the stomach; from chemical acrids, or poisons, or emetics taken into it; or from any substance, even the mildest, when inflammation or ulceration of its coats augments its nervous irritability. 2. Vomiting may be indirectly induced by strangulations of the intestinal canal: by irritations arising from biliary or renal calculi impacted in the excretory ducts of the liver or the kidneys; by titillation of the fauces; by inflammation of certain portions of the contents of the cranium—for example, by the arachnoid membrane covering the base of the brain; by repelled cutaneous eruptions; by emetic substances

injected into the veins; by sailing, swinging, riding in a carriage, and other movements of the body; by pregnancy; by the influence of certain odours; and even by mental impressions.

Whichever of these causes produces vomiting, a specific action of the stomach and the consent of certain muscles of the thorax and the abdomen are necessary to produce the effect: thence the question, in what manner is vomiting produced? In replying to this query, let us *first* enquire what opinions have been advanced by others. M. Chirac* first suggested the idea that the stomach is passive during vomiting, which, he contends, is affected solely by the action of the diaphragm and the abdominal muscles; an opinion which was afterwards maintained by Duverney, Bayle, and John Hunter. M. Litre denied the influence of the abdominal muscles, and maintained that the diaphragm is the chief agent in producing vomiting; an opinion held also by Lieutaud and Haller: the former founding his opinion on having observed in a patient, who could not be made to vomit by the most powerful Emetics, that the stomach was greatly distended and insensible. Sir Charles Bell† appears to hold, with some modifications, nearly similar opinions to those of Lieutaud upon the subject. "That vomiting," says he, "may be produced by the inverted motion of the stomach and œsophagus alone, is apparent from experiments upon living animals, where the abdominal muscles are laid open, and from cases in which the stomach has rested in the thorax, and yet been excited to active vomiting." He also states that the walls of a stomach in his possession "had become so thick that they could no longer suffer contraction by the muscular fibres; the consequence of which was, that, although the inner coat of the stomach was in a raw and ulcerated state, there was no active vomiting." Sir Charles, however, modifies this opinion, by remarking, "that, when the stomach is excited to vomiting, there is consent of the abdominal muscles, by which they are brought into violent spasmodic action, as in the motion of respiration, but acting synchronously, so as greatly to assist in compressing the stomach: but," adds he, "at the same time, the action of these muscles, however forcible their contraction, cannot alone cause vomiting; nor has this action any tendency to produce such an effect on other occasions, in which the utmost contraction of the diaphragm and abdominal muscles is required to the compression of the viscera." M. Majendie, in an able memoir, published in 1813‡, endeavours to refer this operation solely to the influence of the

* Histoire de l'Academie des Sciences, 1686.

† Anatomy of the Human Body, vol. iv, p. 54.

‡ See also Précis Elémentaire de Physiologie, vol. ii, p. 140.

diaphragm and the abdominal muscles; and thus supports the opinion of Chirac. In one of his experiments, he drew the stomach through an opening of the abdomen; thus freeing it from the influence of the diaphragm and abdominal muscles; and he found that vomiting could not be excited. He also ascertained that if all the abdominal muscles be removed, leaving the linea alba, vomiting still occurs, from the stomach being pressed, as he supposes, between that part and the diaphragm. In another experiment he states that he substituted a pig's bladder for the stomach, and nevertheless found that vomiting took place! He found that the division of the phrenic nerve weakens the action of vomiting, but does not altogether prevent it. These experiments prove—1, that the influence of the nervous system is essential for the production of vomiting; 2, that the abdominal muscles influence the ejectment of the contents of the stomach: but they do not satisfactorily explain the action of the diaphragm, nor the part which the œsophagus bears in the operation of vomiting.

Dr. Richard Harrison, in his Gulstonian Lecture, adopts the opinions of Chirac and Majendie, as far as regards the influence of the diaphragm and the abdominal muscles; but he adds, to this call upon the expiratory muscles, through the agency of the brain, and their consequent action, the contraction of the stomach itself. Now there can be no doubt of the agency of the nervous system in this operation; the only question is, whether the excitement be first exerted upon the extremities of the nerves of the stomach itself, from which the impression is communicated to the brain by sympathy, and the auxiliary muscles be thus called into action; or whether, as I imagine to be the case, the impression is made upon the spinal marrow, from the absorption of the emetic substances, and through the influence of the nerves of motion to the respiratory muscles, so that all the machinery concerned in the operation is excited into simultaneous action.

Dr. Marshall Hall has endeavoured to prove that Majendie's assertions respecting the influence of the diaphragm are incorrect; and that the act of vomiting is a forcible expiratory effort. He contends that if the diaphragm contracts, as Majendie affirms, the act of vomiting would be attended by inspiration; that the glottis in this case would be necessarily open, and the fluids ejected from the stomach would be drawn into the larynx, and induce great irritation there—an event which does not occur in vomiting. On the contrary, as M. Majendie admits, although he contends for the agency of the diaphragm, the larynx is accurately closed at the instant that the vomited matter is passing through the pharynx. Dr. Hall's explanation of the mechanism of vomiting is this:—"The contents of the thorax and abdomen are subjected to the sudden and almost spasmodic contrac-

tion of all the muscles of expiration, the larynx being closed so that no air can escape from the chest, and the two cavities being made one by the floating or inert condition of the diaphragm." The mere mechanism of vomiting, therefore, according to Dr. Hall, "differs little from that of coughing, by which indeed the contents of the stomach are frequently expelled: the larynx in the former is, however, permanently—in the latter only momentarily—closed; and there is doubtless a different condition of the cardiac orifice and of the œsophagus." In order to confirm his opinion, Dr. Hall made an opening into the trachea of a dog, who was excited to vomit by means of the subsulphate of mercury: during the act of vomiting, the air from the lungs was forcibly driven through the artificial opening. Dr. Hall, in his explanation, admits the influence of the œsophagus, and adds, "it is plain that the cardiac orifice must be freely opened; for mere pressure upon the viscera of the abdomen will not, in ordinary circumstances, evacuate the contents of the stomach. To effect this open state of the cardiac orifice, it is probably necessary that the diaphragm should indeed be in a relaxed rather than in a contracted state." There is much ingenuity and considerable truth in this theory of Dr. Marshall Hall; but still it does not correctly explain the mechanical operation of vomiting. The following opinion which I have formed may be regarded as a modification of that of Dr. Hall.

We must admit that the glottis is closed, and that a powerful effort, resembling but not altogether that of expiration, takes place; for, whilst there is a powerful and sudden contraction of the abdominal muscles, forcing up the whole of the contents of the abdomen towards the thorax, the diaphragm is fixed, owing to the closing of the larynx and the retention of the quantity of the air which the lungs contained at the commencement of the effort. The diaphragm is thus prevented from ascending into the chest; and the pharynx being drawn up, as in the act of deglutition, opens the cardiac orifice of the stomach and forms with this viscus one continuous cavity. This open state of the cardiac orifice of the stomach, forming the œsophagus and the stomach into one continuous cavity, explains an observation of Majendie, that, "during the state of nausea which preceded vomiting in some of his experiments, air was drawn into the stomach." Now, if it be true that the cardiac orifice of the stomach is open, and the mouth, the œsophagus, and the stomach form one continuous cavity, it is evident that the external air, which is heavier than the air and the vapour contained in the stomach, will be necessarily forced into this organ by its mere gravity, as it would be into a receiver containing the vapour of water and little or no air. In this state, on the sudden compression of the stomach, by the abdominal muscles drawn forcibly inwards, the diaphragm being fixed, the contents of the

stomach are directed upwards with a degree of force commensurate to the suddenness of the pressure upon its walls, and are thus ejected by the mouth. If this description be correct, it is evident that the act of vomiting is the result of the simultaneous action of all the muscles of respiration, at a moment when the glottis is shut and offers resistance to the ascent of the diaphragm. Dr. Marshall Hall is correct in describing vomiting as an expiratory effort; but this effort alone would not effect it, were there not the resistance which I have described opposed to it. The stomach, therefore, is in every respect passive; and it is not obvious that contraction of this organ forms any part of the process of vomiting: it is rather in a state of relaxation than of contraction. Thus, if a bag half filled with fluid, with an open tube attached to it, and laid on a table, were suddenly compressed by any external force applied to it, the fluid would be ejected through the tube; but if, at the time of this compression, the bag was also contracting its general capacity, the impulse of the exterior compressing force would necessarily be diminished, and the impetus of ejectment considerably weakened.

Such is my view of this operation: but in whatever manner it is accomplished, there can be only one opinion respecting the share which the nervous system has in the operation. "This act (vomiting) will not take place," justly remarks Dr. Paris*, "however forcibly the stomach may be goaded by Emetics, where the energy of the nervous system is suspended, as in cases of profound intoxication, or in violent wounds and contusions of the head, while if the brain be only partially influenced, as by incipient intoxication, or by a less violent blow upon the head, its irritability is increased instead of being paralysed, and vomiting under such circumstances is excited by the slightest causes."

The action of Emetics varies: some exert an immediate or *primary* influence on the stomach, whilst that of others is *secondary*. An emetic substance swallowed, or, under certain circumstances, applied to the surface of the body, produces nausea, which is debilitating; thence, the excitement of the habit is immediately diminished: the second effect is, vomiting, or the forcible ejectment of the contents of the stomach; and, in producing this, the influence of the Emetic is carried beyond the stomach: for the contents of the hepatic tubes of the liver, being forced into the duodenum, and passing from that into the stomach, in the act of straining, are also ejected. Besides, by the same act, all the abdominal viscera are compressed; and, by a repetition of this cause, the blood is propelled more forcibly through these viscera, and the secretion of the fluids thereby increased and altered. The blood in particular is propelled through the vena portarum, and the secretion of bile, conse-

* Pharmacologia.

quently, is both augmented in quantity and altered in its quality; the gall bladder and the biliary ducts are emptied; the pancreas and the spleen are similarly affected; even the kidneys are within the influence of its action, and the urine is increased.

The pulmonary system, as may be readily supposed, shares the influence of the act of vomiting on the general system; and the circulation of the blood through the lungs is thereby accelerated. But the lungs are also affected by their sympathy with the stomach, not wholly by the mechanical action of vomiting. Vomiting, we know, is sometimes caused by difficulty of breathing or dyspnœa, and this again by an affection of the stomach. The secreting and exhaling vessels of the lungs are excited by vomiting; and therefore emetic substances hold a place among the tribe of expectorants. Upon the stomach itself, Emetics produce a change, and alter the state of the secreted fluids: thus they not only evacuate any superabundant acid contained in the stomach, but so change the action of the secretory follicles, that all acid totally disappears for the time. When an Emetic acts, after the contents of the stomach have been ejected, the next matters thrown up are the humours, which are the result of the irritant action of the Emetic upon the coats of the stomach, and which are secreted almost at the instant of their ejectment. This is particularly the case when the ejected matter is thick, viscid, or floculent. When there is much straining, these matters are tinged with cystic bile.

Emetics act upon the general system. They stimulate generally the heart and arteries. During the action of vomiting the blood is propelled not only more quickly through the arteries, but it is also returned with greater rapidity through the veins. Thence the blood is more generally and equally diffused through the body, and of course local determinations and congestions are removed. How far these effects depend, in part, upon the absorption of the emetic substance, is yet to be ascertained. Emetics act as evacuants in other respects than in the simple ejectment of the contents of the stomach; the excretion of fluids from the exhalants is greatly promoted, and thence depletion is favoured. It is generally stated that they augment effectively the action of the absorbents; but this is doubtful; and it is more likely that the impulse which they communicate to the capillaries prevents the deposition of fluids, so that those which are already deposited are removed without any increased energy of the absorbents; thence, nausea and vomiting, although apparently they augment absorption, yet merely prevent depositions; and thence, also, collections of fluids, tumours, and thickenings of membranes, often disappear after the operation of Emetics. In consequence of that law of the system, that all excitation is quickly followed by relaxation, Emetics also produce a sudorific effect. By abating the force of the circulation, they are useful in active hæmorrhages.

Although all the substances classed as Emetics so far accord in their effects that they produce nausea and vomiting, yet they differ in some subordinate circumstances. Thus they differ in the time required for their operation. The sulphates of zinc and of copper operate the quickest of the usually employed emetic substances; exciting vomiting when taken in a proper dose, almost as soon as they are swallowed. Tartar Emetic and the other antimonial preparations, and subsulphate of mercury, an Emetic now obsolete, operate quickly also, but less so than the salts of zinc and of copper. The vegetable Emetics require a much longer time for their operation than the saline. This difference in point of time is not satisfactorily explained. It has been supposed to depend on the solubility of the emetic substance in the gastric juice, and its application to the extremities of the nerves being thus facilitated; but there is no evidence of the action of the gastric juice in this manner. Substances which are already in a state of solution, and therefore require no action of the juices of the stomach to render them fluid, are influenced by the circumstances, whatever they may be, that produce this difference; and two substances held in solution in the same solvent, and conveyed into the stomach under the same circumstances, differ considerably in the time at which they operate. This is the case with the solution of Emetic Tartar and that of Ipecacuanha: the former acts more quickly than the latter; and supposing they were both administered in the solid state and the action of either promoted by solution in the gastric juice, it is probable that the vegetable substance would be the most readily dissolved, and consequently act most quickly; but the reverse is the case. The only way in which it can be explained is by supposing that both pass the pylorus, and that the antimonial preparation is more rapidly absorbed than the emetina of the ipecacuanha. The time required for the operation of different Emetics should be known to the physician, as much of the advantage expected from this order of remedies may depend upon this circumstance.

Emetics also differ in the degree and severity of their effects. The saline operate more violently than the vegetable Emetics; but the latter produces a longer-continued and more severe nausea. It is not easy to account for these effects, unless we admit that, whilst the first impression of the saline emetic on the nervous system is the most energetic, it is more readily decomposed or thrown out of the system than the vegetable substance.

Owing to the violence of the muscular exertion which attends vomiting, some precautions are necessary in the administration of Emetics. Persons of torpid habits are more difficult to vomit by Emetics than those of irritable systems: they require larger doses; and, frequently, vomiting cannot be excited by the largest doses: when this is the case, Emetics cause great anxiety

and uneasiness. Persons of a sanguine temperament are more easily excited to vomit than those of a melancholic: women, in general, are more readily vomited than men; children than adults; consequently, we find that, in febrile affections, vomiting in persons of such habits is a very common symptom. The cause of this diversity is not very obvious: but it is of importance to have some rule for anticipating the degree of difficulty or facility with which different persons are excited to vomit; seeing, as I have already stated, that those who are excited with difficulty suffer from pain and anxiety; and those who are easily affected are apt to be hurt by the ordinary dose of an Emetic.

As, during the action of vomiting, pressure is necessarily applied to the descending aorta, and, from the impeded respiration, there is a temporary interruption of the pulmonary circulation, the blood is returned with difficulty from the head: vomiting should not be excited in conditions of the habit predisposing to apoplexy and other affections of the head. From the pressure, also, upon the abdominal viscera, Emetics ought not to be administered to those afflicted with *hernia* or with prolapsus of the anus or of the uterus; nor are they always admissible in the advanced stage of pregnancy. The spontaneous vomitings which attend the early stage of pregnancy, shew that this precaution is unnecessary at this period.

The debilitating effects of nausea sufficiently demonstrate. that Emetics are not to be given in states of much weakness.

The ancients were much addicted to the use, or rather the abuse, of vomiting. They employed Emetics as an adjunct to personal gratification; to enable them to relish the enjoyments of the table; and so far was this custom carried, that they sometimes evacuated from the stomach what they had eaten in one course, that they might be the more capable of enjoying that which was to follow. According to Seneca, "they vomited that they might eat, and ate that they might vomit." They employed Emetics before meals that they might be enabled to eat more plentifully; and often, they concluded a feast with an Emetic, to prevent the bad consequences of their gluttony*. They also regarded vomiting as a means of preserving the tone and vigour of the body; and therefore it formed part of the discipline of the Athletæ. But experience has fully proved the fallacy of this mode of reasoning, and the injurious effects of a frequent repetition of Emetics; which invariably produces debility and such an irritable stomach, that vomiting is often excited by the smallest change in the food: indeed, no means are so likely to induce dyspepsia as this custom.

* In one of Cicero's Epistles to Atticus, he describes a visit which he had made to Cæsar at a villa near Rome; and he states that Cæsar paid him the high compliment of taking an Emetic before dinner, when he understood that Cicero intended to spend the day with him.

With respect to the period for the administration of Emetics, we must be guided by the circumstances of the case which demand their employment. If there be no immediate urgency, the evening is the best time; for, as after the operation of an Emetic the body is exhausted, and there is an inclination to sleep, it can then be indulged. To produce vomiting with the least suffering, the dose of the Emetic must be sufficient, otherwise nausea with retching only, not full vomiting, follows the administration of the medicine.

It is the custom to give warm water during the operation of an Emetic. This certainly promotes its action, if the water be drank after each time of vomiting: but it is requisite to be cautious that too much be not given at a time. The stomach, when overloaded with fluid, is oppressed; and does not respond to the action of the abdominal muscles, but suffers greatly from the straining, and is in danger of laceration. There are several instances on record of this having occurred; but a query may be put—whether rupture of the stomach ever happened without the existence of previous disease? The quantity of fluid for an adult should not exceed two thirds of a pint for a draught: the fluid should be tepid; and when there is reason to suppose that there is debility of the stomach, some bitter infusion should be employed to aid the action of the Emetic. If the operation of vomiting be severe and long-continued, it may be checked by solutions of neutral salts, especially sulphate of magnesia; or by citrate of potassa, formed and given in a state of effervescence; or by a tea-spoonful of magnesia in a glass of sherry wine; or by solid opium in small doses; and by the cautious administration of hydrocyanic acid.

When emetic substances are taken in excess, they sometimes produce very singular consequences; and these seem to be wholly independent of the nature of the substances: one of these effects, of not unfrequent occurrence, is inflammation of the extremities, followed by gangrene. The following case, illustrative of this effect, is detailed in the Journal de Medicine (tome xxxviii)—"A woman of a costive habit of body had unsuccessfully employed many means of purging herself: a surgeon, to whom she applied, administered a violent remedy, which operated both upwards and downwards. Cramps, convulsions of the extremities, and extreme anguish supervened. Immediately afterwards, she was attacked with severe lancinating pains of the extremities; and ecchymoses appeared on different parts of the body. Gangrene attacked the cartilaginous part of the nose; the lower lip; the skin of the chin; the points of two toes on the right foot, and the great toe of the left foot: all of which successively dropped off." M. Barbier, who quotes the above case, relates the following, which came under his own notice:—"A woman of the Fauxbourg d'Amiens, having received

a purgative remedy from an herborist, was attacked, after taking it, with incessant vomiting and purging, which rapidly reduced her strength: she was carried to the Hotel-Dieu: next day the point of the nose, the ears, and the cheeks became of deep violet hue; and soon afterwards the same colour spread over the feet and the hands; and gangrene rapidly attacked all these parts: she lost one of her feet, and several toes of the other foot*."

All substances employed to produce vomiting may be ranged under two heads—*Direct Emetics* and *Indirect Emetics*.

Direct Emetics may be defined "substances which produce vomiting by an immediate impression on the nerves of the stomach." It may be asked—how can any direct action upon the stomach produce vomiting, if the stomach be a passive agent in this operation? I reply that, by the term passive agent, I do not mean to assert that the stomach is perfectly inert and insensible to the stimulus of all emetic substances; on the contrary, all irritants, whether chemical or mechanical, are capable of exciting the stomach to vomiting; but, nevertheless, in this operation, the stomach is not the active agent. This seeming inconsistency may be thus explained. When the stomach is in the performance of its natural function, the digested food is pushed forward to the pyloric orifice; but, if the chymification be not complete, it is again thrown back into the fundus; and, occasionally, even into the pharynx, producing eructation—a circumstance, however, which occurs only when the secreted juices of the stomach are in a morbid state; and, under this condition, the ejectment of the food is produced by circumstances resembling, in every thing but degree, that produced by Emetics. In a similar manner, when a large dose of sulphate of zinc or sulphate of copper, for instance, is swallowed, its immediate application to the nerves of the fundus of the stomach produces a spasmodic contraction, which throws the whole contents of the viscus, mixed with the sulphate, upon the pylorus; but these are as rapidly returned, even before the relaxation, which must follow the spasmodic contraction, have taken place; and by this means the emetic substance, being applied to the nerves of the cardiac portion of the stomach, the muscles and every other part necessary for effecting vomiting are simultaneously called into operation, and vomiting takes place.

The suddenness with which direct Emetics operate is no argument against the truth of this explanation, which I offer as the only theory which, in my opinion, is capable of explaining the immediate influence of sulphate of zinc, sulphate or acetate of copper, carbonate of ammonia, and all other matters which cause immediate vomiting. These substances, when taken into the

* Traité Elémentaire de Mat. Médicale, par J. B. G. Barbier, t. iii, p. 328.

stomach, first hasten that action of the organ which carries the food forward to the pylorus; and there operating, *contra naturam*, instead of opening the pyloric valve, they cause it to shut, and are thrown back upon the cardiac portion, the nerves of which, being suddenly impressed, call into play all those sympathies which operate to produce the action of vomiting. This theory may be applied to explain not only the vomitings which powerful irritants produce when swallowed, but those also that occur in cancerous affections of the pylorus, and those which attend the early stages of pregnancy. In cancer of the pylorus, when food is taken into the stomach, no vomiting occurs until it is pushed forward to the pylorus, which, being morbidly excitable, throws it back, mixed with acrid matters, the result of the disease, which acting on the extremities of the eighth pair of nerves spread on the cardiac portion of the stomach, the muscles of the abdomen and those of the respiration are instantly called into action to relieve the stomach of the offending matter. During the early stage of pregnancy, again, the sympathy between the stomach and the uterus is such, that the disturbance of the former is in the direct ratio of the energy of the latter; digestion, therefore, becomes depraved; the chyme is imperfectly formed, and, being mixed with the acrid secretion of the stomach, is thrown back from the pylorus, and vomiting necessarily excited. Substances that act in this manner scarcely enter the stomach ere they are ejected from it: they constitute *Direct Emetics*. Their operation is neither preceded nor followed by nausea. They are adapted for producing full and immediate vomiting in those conditions of the habit in which the exhaustion caused by nausea would be injurious, but in which it is nevertheless necessary to unload the stomach. They are also most useful in cases of poisoning, not only on account of the rapidity of their operation, but from their action not being followed by absorption, which in such cases would prove highly prejudicial.

2. *Indirect Emetics* are substances which enter the circulation previous to vomiting being excited: and, on this account, a certain space of time elapses after they are taken into the stomach before vomiting occurs. Their influence is directed to the stomach, even when they are injected into the veins. They consist both of organic products and inorganic substances. Indeed, whatever disturbs the energy of the brain to a degree sufficient to affect the stomach by nervous sympathy, and to call into action the muscles necessary to establish the act of vomiting, may be regarded as an *indirect* Emetic. Thus, the mechanical irritation of the uvula with a feather or the finger; the motion of a carriage; swinging; whirling; sailing; and many narcotics, produce nausea and vomiting: and the same effects result from the inhaling of some gases.

TABLE OF EMETICS.

A. DIRECT EMETICS.

a.—AMMONIA.
b.—SULPHATE OF ZINC.
c.—SULPHATE OF COPPER.
d.—ACETATE OF COPPER.

B. INDIRECT EMETICS.

* *Organic Products.*

a.—ACRID VOLATILE OIL, in		
Sinapis *nigra*	15. 2.	Cruciferæ.
Anthemis *nobilis.*	19. 2.	Compositæ.
b.—CYTISINA, in		
Asarum *Europæum*	11. 1.	Aristolochiæ.
c.—EMETINA, in the roots of		
Cephaëlis *Ipecacuanha*	5. 1.	Cinchonaceæ.
Psychotriæ *emetica.*	—. —.	———
Richardsonia *Brasiliensis.*	—. —.	———
d.—SCILLITINA, in the bulb of		
Scilla *maritima.*	6. 1.	Asphodeleæ.
e.—NICOTINA, in the leaves of		
Nicotiana *Tabacum*	5. 1.	Solaneæ.

* * *Inorganic Substances.*

a.—HYDROSULPHURET OF AMMONIA.
b.—SALTS OF ANTIMONY.

SUBSTANCES WHICH OPERATE AS DIRECT EMETICS.

a. AMMONIA. *Solution of Ammonia.* CARBONATE OF AMMONIA. L. E. D.—This preparation has been already described. If half a drachm of the officinal solution be administered in a cupful of cold water, and the same quantity of tepid water be swallowed immediately afterwards, vomiting will be instantly excited. But the acrid nature of pure Ammonia, when given in the quantity necessary for exciting vomiting, and some untoward circumstances which have occasionally followed its administration, have led to the employment of the Carbonate in its stead, in doses from ʒss to ʒi. Both preparations, in smaller doses, and very largely diluted, may be used to quicken the operation of other Emetics.

In large doses, Ammonia and its Carbonate act as irritant poisons, causing inflammation of the mucous membrane. Among

other recorded cases of the fatal effects of the improper use of Carbonate of Ammonia, Huxham mentions that of a young man who had acquired the habit of chewing the solid Carbonate. It produced hæmorrhage from the gums, nose, and intestines: his teeth dropped out; hectic ensued; and, although he discontinued chewing the poison, yet he died of extreme exhaustion, after lingering for several months. When the Carbonate has been taken by mistake, or in an over-dose, the best antidote, if immediately administered, is vinegar.

As an Emetic, Ammonia and its Carbonate have been found serviceable in those stages of chronic catarrh, in greatly debilitated habits, in which expectorants cannot with propriety be administered. In such a condition of the system, vomiting aids in unloading the bronchial tubes: at the same time, the Ammonia affords a salutary stimulus to the nervous system; and the expectoration is restored. In the variety of phthisis, distinguished by the term asthmatic, Ammonia as an Emetic always proves useful.

b. SULPHATE OF ZINC. *Zinci Sulphas.* L. E. D.—This is a powerful and certain direct Emetic, more safe than ammonia, and equally energetic. The emetic influence of Sulphate of Zinc seems to depend on the local irritation which it excites on the nerves of the stomach. It creates no nausea, and operates as soon as it enters the stomach, effecting a single but copious ejectment: it is well adapted for cases of poisoning, and in the commencement of a paroxysm of ague, when we are desirous of breaking the morbid association which keeps up the disease, by giving such an impulse to the system as will propel the blood to the surface and equalize the circulation. In cynanche tonsillaris, when an abscess forms in a situation not readily reached by the knife, and yet not disposed to break, if an Emetic be prescribed merely to burst the abscess, the Sulphate of Zinc is preferable to all other substances. Dr. Marley recommends it strongly, in combination with alum, for pulmonary oppression and hæmoptysis. He recommends it to be given in doses of six grains, in the morning fasting. He says that it produces vomiting instantaneously, but not violently, leaving the stomach invigorated*. Dr. Senter, Dr. Burton, and Dr. Roberts, severally, bear testimony to its utility as an Emetic in phthisis. It is also an useful Emetic in dyspeptic affections†. The dose to produce full vomiting in an adult, is from gr. xv to ʒss.

* Treatise on Tropical Diseases. London, 1804, p. 557.

† A curious fact regarding this salt is mentioned in the 12th volume of Thomson's Annals of Philosophy. We are informed that a spider fed and was supported on this salt alone for a considerable time. It is, nevertheless, poisonous to man, when given in doses intermediate between the largest administered to produce a tonic effect, and those given to excite vomiting. In large doses, its emetic properties prove the safety of those who take it. The antidotes for poisoning by it are milk, albumen, and the chalk mixture, after the use of the stomach pump.

c. d. SULPHATE OF COPPER. ACETATE OF COPPER. *Cupri Sulphas.* C. *Acetas.* L. E. D.—Both these salts of Copper operate as powerful direct Emetics, producing vomiting almost as soon as they are swallowed, without exciting nausea. They have been employed in the incipient stage of phthisis; and it is a curious fact that in this disease the sulphate will sometimes lie in the stomach for upwards of half an hour without causing vomiting, and then operate at once and as forcibly as when it acts in the usual manner. I cannot pretend to account for this effect. Among other physicians who have prescribed these salts of Copper in phthisis, Dr. Mackittrick Adair held a very sanguine opinion of their salutary influence. He gave first, as an Emetic, a pint of warm water, then a grain of Sulphate of Copper with a drop of diluted Sulphuric Acid, in half an ounce of water every other evening for three days, and then every morning. Although I have had no experience of this mode of treating phthisis, yet, if Emetics are to be employed, the Sulphate or Acetate of Copper may be administered. Before the use of the stomach pump, both these salts of Copper were very frequently employed in cases of poisoning by opium and other narcotics, when the Sulphate of Zinc failed to rouse the stomach into action. The dose is from ten to fifteen grains dissolved in three fluid ounces of water.

In cases of poisoning by the salts of Copper, after the stomach pump has been used, the best antidotes are milk, albumen, and ferrocyanate of potassa. In using the stomach pump, milk and water might be substituted for simple water.

2. SUBSTANCES WHICH OPERATE AS INDIRECT EMETICS.

* *Organic Products.*

a. ACRID VOLATILE OIL.

The Volatile Oil in this case is probably merely the vehicle of a peculiar acrid principle; but, as we have never been able to obtain this in a separate form, I feel authorized to adopt the term *Acrid Volatile Oil.* It is the emetic principle in the two following substances.

a. MUSTARD. *Sinapis Nigræ Semina.* L. D.—The analysis of M. Thieberge ascertained the existence of an Acrid Volatile Oil in Mustard, which is obtained by distillation of the marc after the expression of the seeds to free them from the fixed oil, in the manufacture of the flour of Mustard. This Acrid Oil is powerfully excitant, and to its impression on the nerves of the stomach must be attributed the emetic property of Mustard. It operates quickly; but, from the powerful excitement which it induces on the vascular system, there is reason for supposing that the acrid principle is taken into the circulation;

and thence, that the act of vomiting is the result of its secondary influence, not that of its direct impression on the gastric nerves.

Mustard is a useful Emetic in cases of intoxication threatening apoplexy; and in Cholera *asphyxia*, in which its excitant property proves beneficial after its emetic operation is over. In atonic gout, also, in which no irritation is more hurtful than that arising from crude, undigested matters in the stomach, a mustard emetic proves highly useful. If the flour of Mustard be genuine, a dessert-spoonful, about two drachms, mixed in a sufficient quantity of water, will be found the dose for an adult.

2. CHAMOMILE FLOWERS. *Anthemidis Nobilis Floræ.* L. E. D.—A strong tepid infusion of these flowers, administered in doses of from f℥iii to f℥iv, operates as a powerful Emetic, and is well fitted for dyspeptic affections. A weaker infusion is a useful diluent in promoting the operation of other Emetics, when the stomach is weak and likely to be too much oppressed by the use of simple water.

b. CYTISINA.

This substance is the active emetic component of Asarabacca. It was discovered by MM. Chevalier and Lassaigne, who named it from having obtained it first from the seeds of the Cytisus *laburnum*. Besides Cytisina, Asarabacca contains an acrid oil, which probably aids the emetic powers of the plant. The plant is now rarely, if ever, employed, as it loses much of its activity by drying and keeping.

c. EMETINA, OR EMETIA.

This substance was discovered by M. Pelletier in 1817. It is procured by treating the powdered root of ipecacuanha with cold water until all the soluble matter is separated: the infusion is then to be concentrated by evaporation in a water bath, and subcarbonate of magnesia added in excess, after which the evaporation is continued to dryness. This residue is next to be treated with strong alcohol, which takes up only the Emetina and resin, and the tincture evaporated to an extract; which being again treated with water, and the solution evaporated to dryness, the emetina forms in brown semitransparent scales, having an odour resembling caromel, and a bitter, slightly acrid taste. They attract moisture of the air, and are consequently deliquescent.

In order to obtain pure Emetina, calcined magnesia is used instead of the carbonate, and the mixture boiled. The precipitate is then washed in the filter with cold water, dried, reduced to powder, and acted on by strong alcohol. The emetina thus procured is next to be decoloured by pure animal charcoal, and the filtered solution decomposed by calcined magnesia. The precipitate being dried and powdered and acted on by alcohol,

the Emetina is obtained from the alcoholic solution by careful evaporation. In its pure state, it is white, pulverulent, unalterable in the air, scarcely soluble in cold water, more soluble in hot water; soluble in alcohol, but not in ether. Its taste is slightly bitter; it displays an alkaline reaction, and forms with acids neutral salts, which, however, are little disposed to crystallize. Its taste is slightly bitter. It closely resembles uncrystallized narcotina; but the solubility of the latter in ether readily distinguishes it. According to Dumas and Pelletier, it consists of

Carbon	64.57
Hydrogen	7.77
Oxygen	22.95
Nitrogen	4.00
	99.29
Loss	71
	100.00*

Sulphuric acid carbonizes and destroys Emetina: nitric acid changes its colour to a deep red, then to yellow, much nitrous gas is evolved, and the Emetina is converted into oxalic acid. Muriatic, phosphoric, oxalic, tartaric, and acetic acids, dissolve it without altering it: gallic acid precipitates it from its solutions either in water or alcohol, and forms with it an insoluble, inert compound. The tincture of galls, owing to the presence of tannin, precipitates it with more energy than gallic acid. The tincture of iodine also throws down a precipitate in the solution of Emetina, the nature of which is not well understood. It is completely precipitated by subacetate of lead: the precipitation with the acetate is less complete; the acetic acid opposing itself to the precipitation. It is also slightly precipitated by the protro-nitrate of mercury, the bichloride of mercury, and the muriate of tin. The effects of these reagents are sufficient to characterize Emetina as a vegetable principle, sui generis.

When given in doses of from a grain to three grains, Emetina produces full vomiting; and, as none of the other principles of Ipecacuanha root produce this effect, there is no doubt that its emetic power is owing to this substance. It is also contained in the roots of some other plants besides those of Ipecacuanha.

There are three kinds of Ipecacuanha known in commerce, the *brown*, the *grey*, and the *white*; but they may be, with more propriety, arranged into two kinds, *annulated* and *striated*. Of the first kind there are three varieties, the *brown*, the *grey*, and the *red*.

* Annales de Chim. et Phys. t. xxiv, p. 181.

1. *Annulated Ipecacuanha.*

a. Ipecacuanha Root. Cephaëlis *Ipecacuanhæ* Radix. L. E. D.—This is brown Ipecacuanha. Before describing it, I may remark that Decandolle's explanation of the word Ipecacuanha, which he says implies *vomiting root*, is incorrect. The two first syllables, *ipe*, is the Peruvian word for *root*, and Cacuanha, the name of the district where it was first procured; so that the name simply means the *root of Cacuanha:* but, under this name, very different roots are designated, all of them possessing the property of exciting vomiting. Ipecacuanha root was introduced into Europe, as an Emetic, towards the middle of the seventeenth century; but so little was known of the plant which yielded it, that Ray believed it was the root of a species of *Paris;* Morison and Linnæus, that of a species *Lonicera*, or honeysuckle. At length, in the commencement of the present century, M. Brotera, professor of botany in the University of Coimbra, in Portugal, published, in the Transactions of the Linnæan Society of London, for 1800, a description of the plant, and figured it under the name Callicocca *Ipecacuanha*. Decandolle* afterwards examined it, and ascertained that it belonged to the genus Cephaëlis, and gave it the specific name of the Peruvians, *Ipecacuanha*†. The genus Cephaëlis belongs to the natural order Cinchonaceæ. *Ipecacuanha* is a perennial plant, growing in forests and shady, moist places, in Brazil and various parts of South America, where it is also cultivated, especially, according to Humboldt, in Badillas in New Granada. The *roots* are creeping and horizontal, representing threads strung with small tubercles or rings, closely pressed together. The cuticle is brown, with a white parenchyma beneath it, and, in the centre, a filiform woody axis. The roots are termed *Raicilla* in the places where the plant grows.

A very vague and imperfect description of this plant was given by Margrave and Piso in their History of the Brazils, published in the sixteenth century: and the plant was unknown to European botanists until a dried specimen was sent, in 1764, by Mutis to the younger Linnæus, who described it under the name of Psychotria *emetica*‡. But the most satisfactory information has been communicated by Dr. Martius, who travelled in the Brazils under the auspices of the King of Bavaria.

The root of *annulated* Ipecacuanha (see cut) is seldom so

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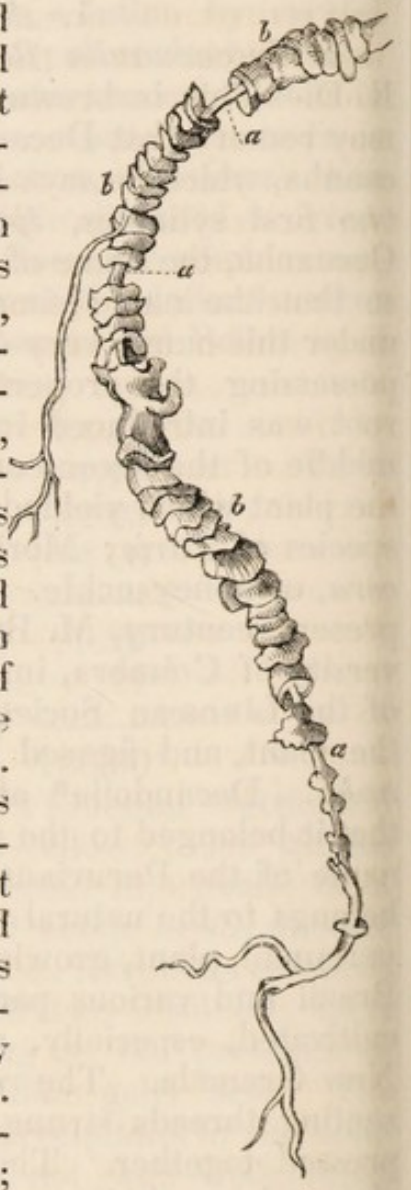
* See his Memoir, published in 1802.

† Woodville's Med. Bot. third edition, vol. v, p. 14. London Dispensatory, art. Cephaëlis. Richard, Hist. Nat. et Med. des differentes Espèces d'Ipecacuanha, 1820.

‡ This plant was then erroneously supposed to yield the true Ipecacuanha.



thick as a goose-quill; is unequally and irregularly knotted and branched; and is covered with a brown epidermis. It consists of two parts: *a*, an *inert*, ligneous axis; and *b*, an *active*, cortical portion. The fracture is brownish and resinous; yet the root contains no resin. The taste is bitterish, acrid, and nauseous; the odour faint and herbaceous. In one thing this species is distinguishable from all the others, namely, the root is not a continuation of the underground, horizontal stem, but offsets from that part of the stem. This species of Cephaëlis supplies what is termed *brown*, *grey*, and *red Ipecacuanha*, which were long considered as the roots of distinct species of Cephaëlis; but they are those of mere varieties of the same plant.

The *striated* Ipecacuanha, which is the root of a distinct genus, the Psychotria *emetica*, is now seldom brought to Europe, although it is more employed in Peru than the root of the Cephaëlis *Ipecacuanha*. The genus Psychotria resembles the Cephaëlis, yet it sufficiently differs to constitute it a distinct genus. The Psychotria *emetica* is a small undershrub, found in Peru and New Grenada; the root is nearly horizontal, as thick as a swan's quill, jointed at irregular distances, and furnished with a few fibrous radicles: but it is not knotted like that of the Cephaëlis; is a little branched, and smooth. The epidermis is of a deep brown colour, striated; the fracture brown and slightly resinous. It is nearly inodorous; scarcely bitter; and its acrimony is felt only after it has been for some time swallowed. It is much less active than the root of the Cephaëlis.

From what has been said, it is perfectly evident, that although these different kinds of roots had been so long regarded as varieties of the same plant, yet even their physical, or natural characters are sufficient to mark their generic difference. Another description of Ipecacuanha has also been occasionally introduced into commerce, under the name of *White Ipecacuanha*. Its characters are too distinct to allow it to be mistaken for either of those already described. It is tortuous, sometimes branched, and occasionally rough; of a pale whitish colour; the odour is nauseous and herbaceous; the taste starchy, insipid,

and remarkably acrid: the axis is thicker than the cortical part, and yellow. It is the root of the Richardsonia *Brasiliensis* of Gomez. Several other roots—as, for instance, those of several species of viola; in particular V. *Ipecacuanha*, V. *canina*, and V. *parviflora*, two species of Ionidium; the Cynanchum *Ipecacuanha*, and Euphorbia *gerardiana*—are also used as Ipecacuanha, and mixed with the roots of the Cephaëlis.

Such are the roots of the various plants which have been used under the name of Ipecacuanha. Those of the Cephaëlis alone demand our particular notice. Let us now see what part of this is *active* and what *inert*.

Various analyses of Ipecacuanha had been made at different periods; but it was not until 1817, when M. Pelletier published his analysis, that any thing satisfactory had been offered upon this point. He ascertained that the active constituent of the Brazilian root is Emetina, which is in the proportion of 16 per cent. in the best specimens of the root: the other components exert no emetic influence, and are an oily or fatty matter, wax, gum, starch, traces of gallic acid, and woody fibre. The analysis of the ligneous portion afforded 1.15 only of Emetina, and that perhaps belonged to some portion of the cortical part imperfectly separated. Thence the propriety of separating the cortical from the ligneous part.

In Ipecacuanha procured from the Psychotria, there are 14 per cent. of Emetina: in the White Ipecacuanha, only 5 per cent. There are two methods of separating the Emetina; the simplest is that which I have described.

The soluble substances contained in Ipecacuanha are rendered evident in the aqueous infusion of the powder by reagents: thus, the infusion of galls or tannin throws down the Emetina; iodine causes a reddish precipitate, which is a compound of iodine and Emetina: subacetate of lead throws it down in conjunction with the gum: the salts of iron detect traces of tannin by deepening the colour; and bichloride of mercury displays the albumen. From these results, it is evident that infusions containing tannin should not be ordered in composition with Ipecacuanha, neither should Ipecacuanha be prescribed in combination with acetate of lead, the salts of iron, or iodine*.

Ipecacuanha is exhibited in many forms; at present we have no occasion to notice any but those employed for emetic purposes. The powder is the preparation most used as an Emetic: it should be that of the bark; for, as the ligneous fibre is perfectly inert, it should be separated in the pulverization—100 parts of the

* The presence of the starch in the insoluble part in cold water is rendered evident by boiling a portion of this residue in water and testing it with Iodine.

root should yield 30 of the cortical substance and 20 of the ligneous part. The powder is of a bright grey colour, with a nauseous, disagreeable odour, and a bitter, acrid taste, which adheres to the throat. The dose of the powder, to produce full vomiting, is from ℈i to ʒss. The watery solution is more active than the powder. The full dose, ʒss, is rubbed up with fʒvi of water; ½ of it is a dose, which may be repeated at the distance of half an hour, if the first do not produce vomiting. The only pharmaceutical preparation of it, used as an Emetic, is the wine of the British Colleges. That of the London College, however, contains no wine—a feature peculiar to the medicinal wines of this learned body. In the wine of the two other Colleges, the proportions of the root is one part to fifteen and sixteen of white wine. It would be preferable to employ Emetina in these preparations, as the other components of the Ipecacuanha root cause fermentation and injure the vinous solution, The wine of Ipecacuanha operates mildly; and is useful, in diseases of children, when full vomiting is required.

As a medicine to produce vomiting, the first effect of Ipecacuanha on the mucous membrane of the stomach is that of a local irritant; the Emetina is then separated and absorbed, and causes that simultaneous action of the muscles of the abdomen, the thorax, and the diaphragm, which constitutes vomiting. Sometimes, even in a large dose, it fails to produce vomiting—a circumstance which can only be attributed to idiosyncracy. In administering it as an Emetic, it may be given with the view of simply unloading the stomach, or of acting sympathetically on more distant organs, after it has performed its emetic effect.

When prescribed with the first intention, it frequently operates also on the bowels, owing to some of it being forced beyond the pylorus in the first effort of vomiting; and, on this account, when added to jalap, the purgative properties of this drug are much augmented. Sometimes it determines to the surface after exerting its emetic effect. With regard to the dose of Ipecacuanha requisite to produce full vomiting, I have already stated the quantity for an adult to be from ℈i to ʒss: it is unnecessary to say that this must vary according to the sex and temperament of the patient. The dose for a young infant is a grain: for children from six to ten years of age, from 8 to 10 grains: and for advanced youth of both sexes, from 12 to 18 grains. Of the infusion made by triturating ʒss of the powder with fʒvi of water, fʒii administered at intervals of half an hour generally cause full vomiting; for children, fʒii of the vinous infusion may be given and repeated every fifteen minutes, until vomiting be produced. A question has frequently been discussed—Is it always indifferent whether Ipecacuanha or tartar-emetic be given as an Emetic? The answer is not difficult. Ipecacuanha is pre-

ferable in every instance in which the powers of the stomach are required to be maintained and yet vomiting is indicated; and, in cases in which there exists a chronic diarrhœa, there can be one opinion only as to the superiority of Ipecacuanha over tartar emetic*.

With respect to the substitution of *Emetina* for Ipecacuanha, M. Majendie made several experiments, the results of which demonstrated that the former acts more quickly than the latter: its emetic effect is generally followed by sweating, and a tendency to sleep. It has not been much employed in this country; but the French physicians prefer it to Ipecacuanha. It is ordered in a solution of four or five grains in f℥vi of water, of which f℥ii are ordered to be taken every half-hour until full vomiting be procured. That it operates through the medium of absorption has been demonstrated by injecting a minute portion of its solution into the jugular vein; into the cavity of the pleura; into the tissue of the muscles; and into the anus of a dog. In all these cases vomiting was produced. If Emetina be overdosed, it excites, independent of violent vomiting and purging, the most dangerous, and often fatal, results. The lungs are found gorged with blood, and in a state approaching to hepatization; and the mucous membrane, throughout the whole intestinal canal, exhibiting appearances of inflammation. The powder of the root acts in a similar manner when it is overdosed. When such symptoms occur, either from Emetina or from Ipecacuanha, the best remedy is infusion of galls, or decoction of uva ursi or of rathany root, which, forming insoluble precipitates with the Emetina, neutralize its action and render it inert.

The powder of Ipecacuanha loses much of its activity by keeping, especially when it has been exposed to the light; and it is rendered inert also by long boiling in water. Owing to a peculiar idiosyncracy, some individuals suffer from severe dyspnœa by inhaling the odour of Ipecacuanha: Emetina is not liable to this objection. Much advantage, indeed, might result from substituting Emetina for the powder of Ipecacuanha, were an easy method of obtaining it discovered: its dose is more easily regulated; and it is more certain in its operation.

2. *Striated Ipecacuanha*, Psychotriæ *emeticæ* radix (see cut), differs from the ordinary or annulated Ipecacuanha in the cylindrical form of the root, which, instead of the rings, present stran-

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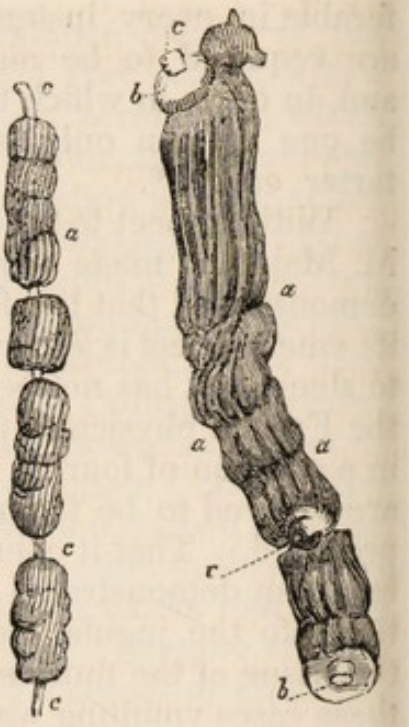
* The employment of Ipecacuanha as an Emetic was first noticed by Piso, in 1618. A quantity of it was brought to Europe by a physician of the name of Legras, in 1672; but its introduction was opposed, and would have continued to be so, had not a French merchant of the name of Grenier, who transported one hundred and forty pounds of it to Paris in 1686, engaged Adrian Helvetius, a physician of Rheims, to examine its effects. Louis XIV aided Helvetius in introducing it as a remedy in dysentery. Helvetius received £1000 for his discovery. Soon afterwards it was used in England and Germany.

gulations, *a*, *a*, *a*, at moderate distances, with the intervening spaces striated. The cuticle has a reddish-grey colour, the cortical part, *b*, is dark coloured, especially when moistened, and the woody axis, *c*, is white. The root breaks with a brown or blackish, scarcely resinous, fracture; impresses a feeble taste of pepper when long chewed, but has no bitterness, and almost no odour. According to the analysis of M. Pelletier, 100 parts of this root furnish nine only of Emetina; twelve of fatty matter, with a large proportion of gum and fecula; and traces of gallic acid. On this account, it is considerably less active than the root of Cephaëlis; and consequently is little employed, even in France, where it was introduced to the notice of the profession by Merat*.



The roots of several species of Ionidium and Richardsonia, and that of Polygala *Poaya*, are also employed as Emetics in Brazil. The similarity of some of these roots to Cephaëlis Ipecacuanha root is shewn in the lower cut, copied from a plate of Von Martius†. The nearest figure is the root of a Richardsonia; but of what species Von Martius could not determine: it resembles the root of true Ipecacuanha in its epidermis, *a*, and the annular structure of its bark, *b*, which is also thick in proportion to the centre, *c*. The further figure is the root of Ionidium *parviflorum*; and although it is less annular than the first, yet, from the thread-like aspect of the ligneous axis, *c*, and its cortical part, *b*, it might readily be mistaken for true Ipecacuanha. These roots are unknown in Europe; and neither they nor those of Iodinium *parviflorum*, I. *Ipecacuanha*, I. *brevicaule*, and I. *urticæfolium*, and of Richardsonia *emetica*, have been analysed. M. Pelletier examined those of Richardsonia *Brasiliensis*, and procured 6 per cent. of Emetina—a proportion too small to ren-

* Dictionnaire des Sciences Med. art. Ipecacuanha.

† Specimen, Mat Med. Brasiliensis, &c. 1824. Tab. 8.

der the root of any value as an Emetic. M. Vauquelin found 9 per cent. of it in viola *Ipecacuanha**.

d. SCILLITINA.

This substance, which has already been noticed as the active principle of the bulb of the Squill, is not employed, except as it exists in the Squill. The bulb of the Squill is ovoid-round, and is composed of fleshy concentric scales, covered with a thin brown coat. It often attains to a very large size, sometimes greater than that of the human head. The scales, which overlap one another, are cut across and dried in a stove. The fresh bulb, when much handled, inflames and ulcerates: both in this and in its dried state, it is extremely bitter to the taste, nauseous, acrid, and inodorous. The acrimony is greatly diminished by drying. If the fresh juice of the squill or the decoction of the dried bulbs be tested with subacetate of lead, a curdy precipitate indicates the presence of gum: tannin is demonstrated by gelatin and persulphate of iron; and the salts of lime by oxalate of ammonia. If the insoluble part of dried squill be digested in muriatic acid, and liquor potassa added to the diluted filtered solution, a precipitate falls down, which is citrate of lime. Ether, when digested on dried squill and evaporated afterwards on water, leaves on the surface a thin pellicle of intensely bitter resinous matter, whilst a soluble matter mingles with the water. Notwithstanding the experiments of Vogel, I am disposed to regard this pellicle the active principle both of the squill and of the Scillitina. According to the analysis of Vogel, squill contains 35 per cent. of *Scillitina*, 24 of *tannin*, 6 of gum, traces of citrate of lime and saccharine matter, and 30 of ligneous matter. Tilloy, who also analysed squill, found a fatty matter, besides those components which Vogel described.

Squill is seldom employed as an Emetic; and is indeed a very uncertain Emetic, sometimes scarcely producing any influence, at other times a very few grains produce violent vomiting. When emetics are thought to be serviceable in ascites and anasarca, Squill has been supposed to be particularly indicated; but it is in no respect superior to tartar-emetic in such cases. Alcohol and vinegar are the menstrua usually employed to take up the *Scillitina;* but the dried bulb may also be given in the form of powder to excite vomiting, in doses of from gr. iv to gr. xvi, or in that of tincture, from m. xxx to f℥i; and of the syrup, which is preferable to the oxymel, from f℥ii to f℥ss, repeating the dose at short intervals until vomiting is procured. From the effects of reagents, it is obvious that the salts of iron and of lead, sulphuric acid, tartar-emetic, and gelatin, cannot with propriety be prescribed in conjunction with Squill.

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* Journ. de Pharm. Juin 1828.

When Squill is overdosed, it operates as a narcotico-acrid poison, causing vomiting, diarrhœa, griping, and bloody urine; and occasionally it also exerts narcotic effects. Vogel details some instances of poisoning which proved fatal, in which doses of the powder of Squill did not exceed gr. xxiv. Sometimes the ordinary dose of the syrup has been followed by vomiting, purging, and pain. In one instance, I saw an eruption resembling nettle-rash follow the administration of Squill: but this might depend on idiosyncracy. In Orfila's experiments, the dogs on whom he tried the poisonous effects of Squill, after having sustained the effects of the poison for some hours, suddenly became tetanic, and almost instantly died. Orfila thinks that Squill exerts both its beneficial and injurious effects through the medium of the nerves.

e. NICOTINA.

Tobacco, of which Nicotina is the active principle, has a very powerful emetic influence, whether taken into the stomach or inserted into the rectum, or even applied to the surface of the body; but its operation is too difficult to controul, to permit it to be prescribed, under any circumstances, as an Emetic. The manner in which its poisonous properties display themselves has been already detailed; and I mention it here rather to caution against its employment than to recommend it as an Emetic; and this is the more requisite, as it lately has been recommended as a remedy in dropsy. Its poisonous effects, however, are more likely to follow the employment of it as an enema than as an Emetic. When an accident of this kind occurs, it is proper to know that the infusion or the tincture of galls throws down the Nicotina, and renders the infusion of tobacco inert: consequently it should be instantly administered.

** *Inorganic Substances.*

a. HYDROSULPHURET OR HYDROSULPHATE OF AMMONIA.—When a current of sulphuretted hydrogen gas is passed through a solution of pure Ammonia, an union between the gas and the Ammonia takes place, and Hydrosulphuret of Ammonia is formed. It is of a greenish-yellow colour, exhaling a fœtid odour and impressing an acrid, disagreeable taste. It precipitates the solution of all the metallic salts: those of iron and of lead, black; of copper, a deep brown; of antimony, orange; of mercury, brick red; and of arsenic, yellow. In very moderate doses, this Hydrosulphuret causes nausea, vertigo, and vomiting. It is seldom, however, employed as an Emetic, unless it be requisite to produce at the same time a powerful sedative effect on the system. It is prescribed in one disease which is peculiarly distinguished by the augmented secretion of the kidneys and a change in the properties of the urine, diabetes

mellitus. The dose is from m. v to m. viii ; but the number of minims may be gradually augmented, until vertigo or vomiting be produced.

b. ANTIMONIAL PREPARATIONS.

* *Sulphurets and Oxysulphurets.*

1. SULPHURET OF ANTIMONY. *Antimonii Sulphuretum.* L. E. D.—Grey Sulphuret of Antimony is found native. In order to purify it, the Sulphuret is first separated from the impurities with which it is naturally combined, then covered with charcoal and smelted in a reverboratory furnace, and the refuse removed; it is next run into moulds, in the form of loaves, which are grey externally, and internally foliated or striated and brilliant. The largeness of the striæ, the compactness, weight, and volatility of the Sulphuret, mark the goodness of the specimen. Lead may be suspected in it when the texture is more foliated than striated; arsenic, by a garlic odour when the Sulphuret is thrown upon hot coals; iron, when a brown colour is the result of its deflagration. The quantity of Antimony in the Sulphuret varies; but the average proportion is about 70 per cent. Sulphuret of Antimony consists of one equiv. of Antimony = 62.6, + one and one half of sulphur = 24, making the equivalent 84.6*. It is, therefore, a sesquisulphuret. When Sulphuret of Antimony, in a state of minute division, is thrown into a bottle of chlorine, a powerful action is immediately induced, and a sesquichloride of Antimony results.

Prepared Sulphuret of Antimony (*Antimonii Sulphuretum preparatum* of the Pharmacopœias) is the sulphuret of commerce levigated with water on a porphyry stone. It is inodorous, insipid, of a dark leaden-grey hue, and stains the fingers when it is handled†. It is insoluble in water and in alcohol; but is partially soluble in the vegetable acids, consequently in wine. An emetic wine was formerly prepared by putting wine into cups formed of the sulphuret, on which the acid of the wine acted and acquired emetic properties. When aided by heat, the sulphuret decomposes the sulphuric and the nitric acids; when the muriatic is poured upon it, the water of the acid is partly decomposed, the Antimony oxidized, and the oxide uniting with the acid forms a muriate; whilst the sulphur combines with the hydrogen, and escapes as sulphuretted hydrogen gas.

The emetic power of Sulphuret of Antimony is uncertain: if the stomach be acescent, it is violent; when there is little or no acid present, it is feeble. This sulphuret was formerly much

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* Berzelius.

† It was with the Sulphuret of Antimony that the Greek and Turkish ladies, to use a scriptural phrase, "Put their eyes in painting." When applied within the eyelids, it produces a peculiarsoftness of expression.

employed in scrofulous diseases and cutaneous affections; but the uncertain manner in which it operates has almost discarded it from modern practice. The dose, to produce full vomiting, is from a scruple to half a drachm.

2. Precipitated Sulphuret of Antimony. *Antimonii Sulphuretum præcipitatum.* L. E.—To form this preparation, liquor potassæ is boiled on Sulphuret of Antimony, and the solution strained and precipitated by diluted sulphuric acid; this precipitate, washed with hot water, dried and rubbed to powder, is the precipitated Sulphuret of Antimony. It is an inodorous substance, of a bright orange colour, and a slightly styptic taste, insoluble in water, and not readily acted upon by diluted acids. Chemists vary in their opinion of the nature of *Kermes mineral**, which this preparation resembles. Berzelius fused Sulphuret of Antimony with black flux, and boiled the residue in water: he thus obtained Kermes, which, he affirms justly, is a hydrated sulphuret; but the precipitated sulphuret contains also some oxide of Antimony, the result of the process: thence it is an oxysulphuret. In washing the precipitate, the water should be merely tepid: boiling water partially decomposes it. This preparation is scarcely ever employed as an Emetic, owing to the uncertainty of its operation. If the stomach be acescent, it operates violently: when this is not the case, it has been given to the extent of ten grains for a dose, three times a day, without any obvious effect.

3. Glass of Antimony. *Antimonii Vitrum.* L.—When the sulphuret is exposed to heat, gradually raised, a large portion of the sulphur is driven off, in the form of sulphurous acid gas, and the Antimony is partially oxidized; and, on suddenly raising the heat, the whole is fused. It is then poured out and allowed to cool: and is thus obtained in the form of vitrified, semitransparent, deep hyacinthine coloured plates, inodorous, and insipid. It is an oxysulphuret, harsh, violent, and dangerous in its operation; thence it is never used except for the purpose of preparing other antimonials.

* * *Protoxides with Acids.*

4. Tartrate of Antimony and Potassa. *Antimonium Tartarizatum.* L. *Antimonii Tartras.* E. *Antimonii Tartras et Potassa.* D.—According to the directions of the British Pharmacopœias, this salt is prepared by combining the excess of acid in the bitartrate of Potassa with a sesquioxide of Antimony, so as to form a triple salt. In a comparison of the

* M. Cluzel says that the finest kermes is formed by boiling, for half an hour, one part of powdered Sulphuret of Antimony and twenty-two parts of crystallized carbonate of soda in two hundred and fifty parts of water: then filtering the solution in a hot vessel, in order that it may cool slowly:—the kermes is deposited as it cools.

three formula of the British Colleges, that of the London is the simplest, that of the Dublin College the best*. In the former, equal parts of the Glass of Antimonium and Bitartrate of Potassa are ordered to be powdered, mixed accurately, and boiled in a sufficient quantity of distilled water for a quarter of an hour; then filtered when cold, and evaporated so as to form crystals. In this process the oxide of the Glass of Antimony is dissolved in the excess of acid of the bitartrate of Potassa, and unites with the tartrate of Potassa, forming a triple salt, whilst some reddish sulphuret remains undissolved along with the silica which the glass of Antimony usually contains. One material objection to this process is, that the result must be necessarily modified by the nature of the glass of Antimony, and the quantity of the result be more or less, according to its purity. Mr. Phillips advises $\frac{1}{10}$ more of glass of Antimony than is ordered in the Pharmacopœia to be used, and the solution to be boiled for a longer time than is directed. Care must be taken not to push the evaporation too far, otherwise crystals of uncombined Tartrate of Potassa are formed in the mass of crystals of the Tartrate of Antimony and Potassa.

In the last edition of the Dublin College this salt is ordered to be prepared by boiling four parts of an oxychloride, or nitro-muriatic oxide of antimony†, with five of bitartrate of potassa in fine powder, in thirty-four parts of distilled water, filtering while the solution is hot.

This process has many advantages over the London process. In the first place, the oxychloride is always the same; for the impurities of the sulphuret from which it is formed, the zinc, iron, or lead, being converted into muriates, remain in solution in the large quantity of water employed to precipitate the oxychloride of antimony. The theory of the formation of the Tartrate of Antimony and Potassa is very obvious. The oxychloride, when brought into contact with the water and bitartrate of potassa, decomposes a portion of the water, and is itself decomposed: the hydrogen of the water unites with the chlorine, and forms muriatic acid, whilst the oxygen combines with the Antimony and forms the sesquioxide, which dissolves in the acid of the bitartrate. The muriatic acid which is formed acts upon a part of the bitartrate, and, forming muriate of potassa, tartaric acid and muriatic acid are found in a free state in the solution.

Tartar Emetic, properly prepared, is in regular crystals, the

* The Process of the French Codex requires 125 parts of Glass of Antimony, 185 of bitartrate of Potassa, and 1500 of water: from these, 195 parts of tartar-emetic are procured.

† The sub or protochloride is prepared by boiling 20 parts of sulphuret of antimony in 100 parts of muriatic acid and one part of nitric acid, and pouring the strained fluid, when cold, into a large quantity of water, and washing the precipitate until every trace of acid be gone.

primary form of which is an octohedron with a rhombic base: they are transparent when newly prepared, but become opaque when kept. These crystals are white, inodorous, and have a styptic, metallic taste. They are decomposed when exposed to a high temperature in conjunction with charcoal or any carbonaceous matter, and metallic antimony is left. Tartar Emetic dissolves in about fourteen and a half times its weight of water at 60°, and thrice its weight of boiling water. The newly made aqueous solution reddens the tincture of litmus; but, when kept, it is gradually decomposed. It is also slowly decomposed by the pure alkalies; but rapidly by the alkaline carbonates, the hydrosulphurets, the acetate of lead, lime water, the salts of lime, hydrocyanate of potassa, and some of the metallic salts; the mineral acids; all metallic salts, the bases of which form insoluble compounds with tartaric acid; the decoctions of yellow cinchona bark, and of all vegetable astringents. The precipitate is a tannate of the sesquioxide. It is not, however, decomposed by meeting in the same solution sulphate of soda, or permuriate of baryta, or any perfectly neutral salt, acidulated nitrate of silver, or acidulated acetate of lead: but if the salt be a double salt—as, for example, alum—then a copious precipitate is thrown down. According to the analysis of Mr. Phillips and others, the constituents of this salt are—tartaric acid 44.21, + protoxide of antimony 39.76, + potassæ 16.03, = 100.00; or 1 tart. potassæ = 113.15, + 1 tart. of sesquioxide of antimony = 219, + 2 water = 18, equivalent 350.15*. Berzelius makes the proportions of these components in 100 parts of the salt to be oxide of antimony 27.10, + potassa 12.53, + tartaric acid 53.20, and water 7.17. It is a double salt, in strict language, or contains both a tartrate of antimony and a tartrate of potassa.

Tartar Emetic is very apt to be adulterated with bitartrate of potassa, sulphate of potassa, and similar salts. The crystals of Emetic Tartar can, however, be easily distinguished from those of bitartrate of potassa; for if the Tartar Emetic be dissolved in only fourteen parts of distilled water, the bitartrate or sulphate of potassa will remain undissolved. The quantity of Tartar Emetic may be also guessed at by dropping the suspected crystals into a solution of sulphuretted hydrogen gas: if they be the antimonial salt, an orange-coloured deposite will be formed on them, which will not occur if they be bitartrate of potassa. Or a solution of the suspected salt may be tested with a diluted solution of hydro-sulphuret of ammonia, and its goodness judged of from the quantity of orange-coloured precipitate afforded. These tests, however, are far from being delicate, and lead to approximations only to the truth: but $\frac{1}{120}$ of bitartrate in Tartar Emetic may be detected by testing the solution of the suspected

* Turner, from the analysis of Thomson, Phillips, and Walquist.

salt with acetate of lead suitably acidulated. This test is formed by adding to eight parts of the solution of acetate of lead three parts of *strong* acetic acid. The precipitation by this test is slowly formed: but it is certain, if any of the bitartrate be present. If any sulphate be present, it will be readily detected by muriate of baryta; if a muriate, by acidulous nitrate of silver. Its purity may be also suspected if the crystals deliquesce. The most frequent adulteration is bitartrate of potassa; in consequence of which, the drug should never be bought in a state of powder.

Tartar Emetic was first discovered by Adrian Mynsicht, and made known as a medicine in 1631, in his Treatise, Thesaurus Medico-Chemicus; but it was invented before that period. It was originally prepared by boiling the bitartrate of potassa with an impure oxysulphuret, the *Crocus* metallorum, as it was termed.

The Tartrate of Antimony and of Potassa excites locally the surfaces to which it is applied, as is rendered evident by applying it in solution to the skin, and by the acute pain which it induces when taken in very large doses into the stomach. But Tartrate of Antimony and Potassa operates as an Emetic through the medium of the nerves; and perhaps never until it reaches the circulation. It proves Emetic, or purgative, or sudorific, according to the extent of the dose and the frequency of its repetition. Thus, when a grain, dissolved in a moderate quantity of water, is given every ten or fifteen minutes, it produces full vomiting: the same quantity repeated every three hours, purges; and every five or six hours, operates as a powerful sudorific. It is, perhaps, the best of the emetic substances for producing vomiting in the commencement of continued fevers. It is also given with advantage as an Emetic wherever continued nausea is likely to prove useful. Were this the place to extend our remarks on this preparation, beyond its influence as an Emetic, it would be easy to prove that it might supersede all the other antimonial preparations.

When overdosed, it excites violent vomiting, hiccough, a burning sensation at the stomach, with other spmptoms of inflammation of the mucous membrane of the alimentary organ. When this occurs, the stomach should be directly evacuated by the stomach pump, and, in addition to the means employed, the patient should be urged to drink freely of a decoction of yellow cinchona bark, or of galls, or catechu. It is difficult, however, to say what is an overdose of Tartar Emetic, as the most extraordinary doses have been prescribed by Rasori in Italy, and other Continential physicians. It was a common practice to prescribe it in large doses, in the seventeenth century; but this custom fell into disuse and was only lately revived. Twenty grains, and in one case forty-eight grains, were given, in divided

doses, in twenty-four hours, by Laennec, without producing any deleterious effect, and even without producing vomiting after the first day. I have frequently prescribed it in doses of from gr. ii to gr. iii every three hours, and have seldom found that vomiting was caused after the third dose. Dr. Christie, in a Treatise on the Nature and Treatment of Cholera, asserts that he has given ℈i at once, with the effect of exciting some vomiting and several watery stools. M. Rasori explains the power of sustaining such large doses, on the principle that a peculiar diathesis accompanies diseases of excitement, in which only such doses can be borne; and he affirms that it ceases as the recovery takes places. Laennec, however, says that this power of endurance does not cease at the close of the fever, although it is diminished. It is probable that the absence of vomiting, after the first or second dose, depends on the topical excitement which it induces at first preventing the absorption.

When Tartar Emetic proves poisonous, the symptoms closely resemble those of cholera; violent vomiting, diarrhœa, great pain and tension in the region of the stomach, and delirium: the body swells, convulsions supervene, and death sometimes results. I have seen these symptoms follow the administration of moderate doses in some habits. On the examinations of the body after death, the only appearances to explain the fatal result, are slight congestion in the brain, with a red, thickened state of the villous coat of the stomach, which has also been found covered with a tough mucus. Similar appearances in the duodenum are all the marks of previous excitement that have been observed.

From what has been said of the action of the cinchona bark, there can be no hesitation in believing that that infusion, and such astringent vegetable infusions and decoctions, are the best antidotes in poisoning by Tartar Emetic. Cases related by Serres, in the work of M. Orfila, and by Dr. Sauveton of Lyons, were saved by these means. In cases, even of severe vomiting, from ordinary doses of Tartar Emetic, I have checked this inconvenience at once, by administering two tea-spoonfuls of tincture of cinchona bark in a small portion of water, every ten minutes until the vomiting ceased.

To prove that poisoning has taken place from the administration of Tartar Emetic, the following simple plan, suggested by my learned colleague, Dr. Turner, is perhaps the best that can be adopted. Collect the vomited matter, or the fluid that has been taken, dilute it with distilled water, and acidulate with a little muriatic and tartaric acids, in order to coagulate any animal matter that may be present, and to bring, as it were, the whole of the antimony into the fluid. The fluid is next to be filtered and treated with sulphuretted hydrogen gas, and the precipitate collected and dried. This is now placed in a

tube, and a stream of hydrogen gas passed slowly over it, which, carrying off the sulphur, leaves the antimony in its metallic state. To determine that the metal is antimony, Dr. Christison proposes to dissolve it in nitric acid, and again precipitate it by sulphuretted hydrogen to obtain the orange precipitate.

Tartar Emetic is administered either in the entire state, or in solution in water, or in solution in wine.

The Antimonial Wine, Vinum Antimonii Tartarizati of the London Pharmacopœia, is not a vinous solution. In former editions of that work, wine was ordered to be employed as a menstruum for holding in solution either the protoxide of antimony or the Tartrate of Antimony and of Potassa; and this is still the case in the Edinburgh Pharmacopœia. In the present editions of the Pharmacopœias of London and Dublin, no wine is ordered. This change has arisen from the varying strength and quality of the wine employed, which rendered the preparation uncertain in its powers. There was also another objection to the use of wine—the tartaric acid which it contains is attracted by the potassa of the triple salt, and, this being converted into a bitartrate, the affinity which retained the potassa as a compound of the antimonial salt is thus broken, and decomposition results. The antimonial oxide, when an inferior wine was substituted, was precipitated in combination with vegetable extractive; and the supernatant fluid, Dr. Paris remarks, was so destitute of any trace of the antimonial salt, that it displayed no evidence of it when tested with sulphuret of potassa. The composition of the preparation now under our consideration does not undergo such changes; but some alteration is likely to take place by time, in a preparation which, notwithstanding one fourth part of rectified spirit is added to the quantity of water employed, must still be regarded as an aqueous solution. An extemporaneous solution of Tartar Emetic is a better and more manageable and certain medicine than either the real wine of tartarized antimony or the solution now under consideration*: even if an emetic wine be necessary in the cases of children, and the Tartrate of Antimony and Potassa be preferred to ipecacuanha as the active ingredient, it is better to make the solution at the time when it is wanted, than to keep it ready prepared in either wine or weak alcohol.

THERAPEUTICAL EMPLOYMENT OF EMETICS.

The effects of vomiting, as I have already stated, are not

* Originally, the wine of antimony was prepared by putting wine into cups made of sulphuret of antimony: the acid of the wine acted upon the oxide of the sulphuret, and dissolved enough of it to acquire an emetic property. It was afterwards prepared by dissolving glass of antimony, the fused protoxide of the metal, in wine. In both cases the character of the preparation varied with the strength and acidity of the wine.

confined to the stomach; they extend to the surface of the body and contribute to the due distribution of the blood, when the balance of the circulation has been disturbed and congestions occur, such as are found in intermittents: they cause, as it were, a revulsion from the head and the chest, and aid absorption by the impulse which they give to the capillary system. In these periodical fevers, Emetics have been much and beneficially employed; often succeeding in checking at once the catenation of morbidly associated actions that constitute the paroxysm in agues. It is, however, in the commencement of such fevers, before the habit, which often keeps up the disease, is fixed, and when the strength is yet unimpaired, that Emetics prove salutary. They may, nevertheless, be requisite at later periods of the disease: but, then, they are rather indicated to relieve a loaded state of the stomach consequent on its weakened powers of digestion, than to check the progress of the disease.

With regard to the time of giving Emetics in intermittents, especially those of this climate, there can be no doubt that the best period is that before the commencement of a paroxysm, as the cold fit is approaching; or, if this period pass, as soon as the cold stage is formed, unless spontaneous vomiting supervene, in which case diluents only are required. This was the practice of the ancients, as related by Celsus*; and its propriety has been amply confirmed. How the vomiting in this case tends to cut short the cold stage and to induce the hot, I will not venture to explain; the common explanation is, that it depends upon the sympathy between the stomach and the surface; and that the vomiting proves a general excitant to the system. The sympathy between the various parts of the habit —as, for example, the diaphragm and the muscles of respiration, and the pituitary membrane of the nostrils—is very obvious: the same sympathy operates in the action of vomiting; and thence it is probable that the benefit which the Emetic produces may arise from its general excitant influence. We admit this explanation for want of a better; but it is sufficient to know that an Emetic administered at the commencement of the cold stage of the intermittent paroxysm frequently prevents its accession, and even removes the disease. But if Emetics do not produce this desirable effect, they always tend to diminish the violence and to shorten the duration of agues. They have been given during the hot stage, which is also thus sometimes cut short, and the sweating stage brought on; but this practice is attended with some risk; and the general state of the disease is not altered: for it is a fact, that the paroxysm, as far as regards its violence and duration, is much regulated by the se-

* De Medicina, lib. iii—passim.

verity and the duration of the cold stage. Something also depends on the type of the fever: thus, the most benefit from the use of Emetics is derived in tertians.

With regard to the kind of Emetic to be employed in intermittents, I may say that, as the shock given to the constitution, although partly, yet, is not solely the cause of the benefit derived from their use, we should employ those that determine most effectually to the surface: namely, ipecacuanha and tartar-emetic. The choice of either must be regulated by the condition of the patient. The antimonial produces fuller vomiting, but its ultimate effect is more debilitating; thence, in delicate habits, ipecacuanha is to be preferred. The usual method of employing tartar-emetic, in such cases, is to dissolve six grains in six fluid ounces of distilled water, and to administer a table-spoonful every ten or fifteen minutes until vomiting be induced: if this do not soon take place, diluting with acidulated fluids will give activity to the medicine and bring on vomiting. If an intermittent be not checked by the exhibition of one Emetic, at the period I have pointed out, it is improbable that the immediate repetition of it will prove useful: on the contrary, the debility which results is directly calculated to render the type of the fever of a worse description, that is, to change a tertian into a quotidian, and thereby, in shortening the intermissions, to protract the cure of the disease.

The same reason which renders Emetics serviceable in intermittents, authorizes their use in continued fevers. We are not, however, to take this term in its most general signification; but, under continued fever, to discriminate whether the symptoms, in each variety, indicate or contraindicate the employment of vomiting: we must also attend to the intentions which should induce us to prescribe Emetics, as well as the choice of the substances to be employed as such, and their mode of operating. With regard to the variety of fevers of the continued kind in which Emetics are indicated, it is evident that in pure inflammatory fever little can be expected from them; and much danger may arise from the determination of blood to the head, which always attends the action of vomiting. In all cases, therefore, in which the phlogistic diathesis is present, blood-letting should be employed previously to the administration of an Emetic, if it be at all allowable; but, in general, in these fevers, nauseating doses of emetic substances are preferable to their full action as Emetics. In synochus, or mixed fever, also, some caution is requisite, particularly in the commencement of the disease: in the latter stage, when the excitement is diminished, Emetics might be given with less risk; but in this period of a fever they will seldom fail to disappoint the expectations of the prescriber. It is in low fever, and especially in typhus, that this determination is not present in the

commencement of the disease; and therefore Emetics are advantageously given, with the view either of cutting short the disease, or, if this cannot be effected, of alleviating the symptoms and facilitating our power of conducting the fever to a favourable termination.

In the majority of the instances of remittent and continued fevers, not purely inflammatory, the first approaches of the diseases closely resemble those of mild intermittent fever. If there be not a shaking fit, there are sensations of chilliness and partial rigors, followed by heat of skin, and this by perspiration; and, in this state of the case, many instances are recorded in which the early exhibition of an Emetic has at once cut short the disease. It must, however, be admitted that other remedies have as much power, if not greater influence, in cutting short continued fevers: for example, the cold effusion; and it is perhaps the most useful practice to employ the effusion first, and then the Emetic.

To produce the desired effect of cutting short a fever by an Emetic, we must look to those circumstances which constitute the natural crisis of fever, particularly the determination to the skin; and, in choosing an emetic substance, to select that which will not only induce full vomiting, but affect the skin. Hence the most useful Emetic in continued fevers is the Tartrate of Antimony and Potassa. But every kind of Emetic has occasionally been used in continued fever: if full vomiting only be wished for, perhaps Ipecacuanha is preferable to the Tartar Emetic; but the diaphoresis which follows the employment of the Tartar Emetic, and which is highly beneficial in continued fever, is seldom produced when Ipecacuanha is administered, and therefore the anatomical preparation is preferred. Another objection to Ipecacuanha is, that it frequently passes off by the intestines—an effect which it is of importance to avoid in this class of fevers. On the contrary, Tartar Emetic possesses every requisite for producing vomiting, nausea, and powerfully determining to the skin.

But, besides being given with the view of cutting short fever, Emetics are also given with a curative intention after the fever is actually advanced; and this has been the practice from the time of Hippocrates forwards. But it is in vain to attempt to cut short or cure fevers which have run on beyond the fifth or sixth day. All that a practitioner can effect in such cases, is to moderate the severity of symptoms; and, to borrow the language of a distinguished teacher*, "to avert the tendency to death." The circumstances, therefore, which authorize the use of Emetics in continued fever, are an early period of the disease, in which we may hope to cut short or to arrest its progress; affections of

* Dr. James Gregory.

the stomach; foul or loaded tongue; thirst, and a dry, hot skin. Those which contraindicate their use are an inflammatory or phlogistic diathesis, determinations of blood to the head, an advanced period of the disease; an irritable state of the stomach, demonstrated by frequent vomitings; stupor; coma, and severe diarrhœa.

With regard to the period of the day for administering Emetics in continued fever, in almost every case there is an exacerbation towards mid-day and another towards the evening; but these are not always obvious, generally one only is clearly observed: the exacerbation takes place towards evening, and the remission towards morning. The exacerbation is particularly marked by an increase of the pulse, thirst, headache, and dry heat of skin; and it is immediately prior to this accession of fever that Emetics are useful, sometimes preventing it altogether, at other times diminishing its violence. The best time, therefore, for the administration of an Emetic, in continued fever, is the evening.

With regard to the modus operandi of Emetics in continued fevers, they may cut fever short in the commencement, by removing offending causes from the stomach; by giving such a general concussion to the system as may rouse all its vital powers into new action; and by restoring that balance of the circulation. An equable distribution of the blood, particularly to the surface, seems indeed essential to health, in promoting the cooling of the body and assisting the due secretion of the bile, saliva, pancreatic and similar fluids; and therefore an Emetic, by aiding these, contributes greatly to remove thirst, heat, and delirium, in fever. Upon the whole, the usefulness of Emetics in continued fevers is undoubted, when they are administered at a proper period of the disease, under proper circumstances, and when the emetic substance employed is of a nature calculated to maintain the effect on the animal œconomy which the vomiting induced has commenced.

The same state of the habit which forbids the indiscriminate administration of Emetics in inflammatory continued fever, equally demands the same caution in all diseases of febrile character connected with local inflammation. Emetics have, nevertheless, been much employed in this order of diseases. In all the species of cynanche, or affections of the throat, accompanied with fever, Emetics are frequently prescribed. In cynanche trachealis, or croup, in particular, they are supposed to be specially indicated. Some writers, as, for instance, Dr. Crawford, who wrote on the use of Emetics in this disease in 1770, and many subsequent writers, recommend them to be given in the earliest stage of the disease, whilst others urge the use of them to be delayed until the inflammatory state of the disease is in some measure subdued. Now it often occurs that

symptoms of croup arise not solely from inflammation, but from spasm of the muscles of the larynx and glottis; and it is in this state that Emetics are found to be most beneficial. When the disease is not of a spasmodic character, it is always advisable to begin with blood-letting, and large, repeated doses of calomel and purgatives, before giving Emetics. At the same time I must bear testimony to the efficacy of the early employment of Emetics, even before blood-letting had been employed, in many instances which have come under my notice, in families predisposed to the disease. In these cases, the parents of the children, being aware of the nature of the disease, gave an Emetic to the little patient before sending for medical advice; and, in every instance where this practice was followed, much less assistance has been required from the lancet than in those cases in which it was not adopted. In cases, however, in which a practitioner is early called in, and when the excitement and inflammatory symptoms are sufficiently obvious, the preferable practice is to abstract blood before having recourse to the use of Emetics.

In ordinary inflammatory sore throat, cynanche tonsillaris, Emetics given early have often cut short the disease; and they seldom fail to afford considerable relief. This is particularly the case when there is much fever, and sometimes even when the system generally is but little affected: an Emetic sometimes affords more relief to the inflammation of the fauces than any local remedy that can be employed. In a more advanced stage of the disease, however, particularly if the inflammation run very high, they do harm: this remark, however, must be taken with some reservation. Lieutaud, and several other credible authors, have stated that they have seen patients labouring under acute inflammatory sore throat snatched from the jaws of Death by an Emetic; and I can conscientiously add my feeble testimony to the truth of this remark. If abscess have formed, in a situation beyond the reach of the knife of the surgeon, as soon as the abscess is ripe, nothing is so likely to cause its evacuation as the exertion of vomiting; and under such circumstances you may always prescribe an Emetic with a certainty of success. In this case, as there is no necessity for desiring an effect from the Emetic beyond the bursting of the abscess, sulphate of zinc is to be preferred to any of the vegetable emetic substances, and to tartar-emetic. It sometimes happens that the abscess bursts in the night, and the greater part of its contents finds its way into the stomach; or other irritating matters—as, for instance, acrid mucus or saliva—may be accumulated in that viscus: in either case, the use of an Emetic is indicated, and its administration is always attended with beneficial effects. In the malignant species of cynanche, that state of the throat in which the attending fever is of the typhoid type, and the tonsils are covered with sloughing ulcers, advantage is derived from the

early use of Emetics; but in the advanced stage of this disease the debility attending their employment is a sufficient reason for proscribing their use.

The remarks which have been already made, on the injurious effects of Emetics in cases attended with determinations to the head, point out the impropriety of employing Emetics in phrenitis. The same reasoning might be supposed to apply to ophthalmia; but in no disease, when it resists local blood-letting, purging, and blisters, have I seen so much benefit derived from Emetics. Something, perhaps, is due to the kind of the Emetic employed: I have generally given the tartar-emetic, both with the view of exciting full vomiting and also of keeping up a state of nausea and of perspiration after its action. With this view, I have generally ordered the Emetic to be administered in the morning before the patient rises from bed; and its use to be followed by a moderate purgative in the after part of the day. In noticing the effects of Emetics in ophthalmia, it is proper also to mention their influence in relieving or rather preventing amaurosis. Although it is a disease in which there is often greatly diminished excitability of the optic nerve, and a consequent nearly complete or total loss of sight, without any evident disease of the eye—for, in general, there is both dilatation and an immoveable state of the pupil—yet some cases evidently depend on gastric causes; and it is in these that Emetics prove so beneficial. The practice of treating such cases by vomiting originated with Richter; and such was his success in the treatment of amaurosis, that patients resorted to him from every quarter of the world. I cannot add the weight of my own experience in determining the value of Emetics in amaurosis; but I have had frequent opportunities of observing the effect of an Emetic in clearing the sight of those who had suffered in this respect from accumulations in the stomach and the first passages.

In some local swellings—as, for example, indolent buboes—Emetics have been found peculiarly well calculated to discuss these glandular swellings; and their influence in this respect is not confined to the venereal swellings alluded to, but to many other tumefactions of the glands.

With respect to the propriety of employing Emetics in inflammation of the contents of the thorax, particularly in peripneumonia, physicians have been divided in their opinions. I should say that their employment is certainly not advisable in the commencement of the disease; as, in the act of vomiting, the blood being as it were accumulated in the heart and large blood vessels, its free transmission through the lungs must be impeded, and thence the inflammatory state augmented. In after stages of the disease, however, especially after the excitement has been reduced by a proper use of the lancet, when the cough is kept up by irritation in the bronchial tubes, when the

expectoration is viscid, and difficult breathing is the consequence of the loaded state of the lungs, then Emetics prove highly beneficial. In infants thus affected they are particularly useful, as the stomach is generally disordered from the expectorated matter being swallowed; and, in clearing out the stomach, the pressure exerted upon the air tubes of the lungs in the act of vomiting, also, tends to unload the pulmonary tubes of the viscid mucus with which they are clogged. In convulsive coughs, such as characterize hooping-cough and spasmodic asthma, experience has amply verified the utility of Emetics. In both of these affections there is much probability that the diseases have their origin in some morbid state either of the spinal cord or of the ganglionic plexus. In these cases, Emetics may prove useful by the impression which they make on the stomach, operating nearly in the same manner as a counter-irritant. In another affection of the pulmonary system, phthisis, Emetics have been regarded as specific. They have been given in every stage of the disease. "It is remarkable," says Dr. Young, "that a very great majority of the cures of consumption, which are related by different authors, have either been performed by Emetics or by decidedly nauseating remedies*." They were employed by Hippocrates, by Galen, and Diocles, among the ancients; and by Bennett, Morton, Etmuller, Wainwright, Russell, Bryan Robinson, Marryat, Donald Monro, Macbride, and others, among the moderns. Dr. Reid, from his own experience, never found their frequent repetition prove hurtful in phthisis, although he often gave them, daily, for weeks together: on the contrary, he remarks, "I have scarcely met with one instance in which the general health was not materially improved†." The confidence of Dr. Reid and Dr. Simmons in the use of Emetics was unbounded: they sometimes used the tartar-emetic, at other times ipecacuanha; and they assert that they have not only relieved, but cured the disease by these emetics: but their method of treating this formidable malady has not succeeded in the hands of other practitioners. It is true that full vomiting mitigates many of the symptoms; as, for example, it lessens the cough, checks diarrhœa, and diminishes hectic. A sea voyage proves beneficial perhaps, in some degree, owing to the continued nausea it keeps up. In the early stage of the disease, the efficacy of a sea voyage has been amply demonstrated; it undoubtedly merits our confidence as a curative agent; but the same cannot be averred of a continued course of Emetics; and, in the more advanced stages of the disease we have no grounds for placing confidence upon any plan of treatment which has been hitherto suggested. Indeed, the debilitating effects of

* Practical and Historical Treatise on Consumptive Diseases, &c. p. 65.

† Essay on the Nature and Cure of Phthisis Pulmonalis. London, 8vo, 1782.

Emetics would always prove an insuperable bar to their employment in the advanced stages of phthisis, notwithstanding the assertions of Dr. Reid and Dr. Foart Simmons to the contrary. If, however, Emetics be necessary in this stage of phthisis, it must be very obvious that the sulphates of zinc and copper, from the mode in which they operate, are more likely to prove less hurtful than either ipecacuanha or tartrate of antimony and potassa.

In gastritis, nothing can be more injurious than Emetics, even when it is of importance to expel the contents of the stomach. The same objection exists to their use in inflammations of the intestines; indeed, in such cases, the nausea and vomiting which accompany the inflammation of any portion of the alimentary canal render it almost impossible to administer any remedy by the mouth.

In dysentery, the indications are the reduction of the inflammatory action locally affecting the large intestines; the evacuation of the acrimonious matters in the alimentary canal, so as to effect the restoration of the natural fæces, and the restoration of the tone of the abdominal viscera. As far as regard the use of Emetics in dysentery, there is no difference of opinion among practitioners; the early periods of the disease are those in which they have been found most useful: the effect of contagion has been prevented: and in many instances, as in other fevers, the disease has been cut short. They are especially indicated when the excitement is considerable and the skin dry and parched: thence the necessity of selecting those substances which by their nauseating qualities tend, besides unloading the primæ viæ, to determine to the skin, and also to relax the bowels. Both tartar-emetic and ipecacuanha, particularly the latter, have been judiciously selected for this purpose by the best practitioners. A set of experiments, to ascertain the comparative value of tartar-emetic and ipecacuanha in this disease, were instituted by Sir George Baker*. He found that the vegetable Emetics, especially ipecacuanha, were rather better adapted to answer all the indications required than the antimonial. Whichever is employed, it should be given, in the first instance, to excite full vomiting; and afterwards in smaller doses, in combination with purgatives. To affect the surface, still smaller doses are requisite, and the combination is opium.

In acute rheumatism, some writers recommend the use of Emetics. They may prove beneficial after the excitement is moderated by cathartics and blood-letting, in plethoric habits; but I have had no experience of their employment; and the disease

* Transactions of the Royal College of Physicians, vols. i and ii.

generally yields to other means better calculated to relieve this painful affection than vomiting. In gout also, unless the stomach be much loaded, Emetics are not indicated; and although Dr. Macbride and some other writers think that they are serviceable at the commencement of the disease, yet, I have no hesitation in stating, that, in most cases of this complaint, in its acute or regular form, Emetics are quite unnecessary. In the atonic form of the disease, in which no irritation exists more debilitating than that caused by the morbid contents of the stomach, an Emetic will be found useful for the purpose of clearing out the stomach; but, in the choice of an Emetic for this intention, we must bear in recollection the necessity of selecting it from those that are of a warm and stimulant nature, and the operation of which is not followed by debility. Thus mustard and chamomile flowers are preferable in this case to ipecacuanha or the emetic-tartar.

In the practice of the ancients, Emetics were employed to propel the supposed morbific matter, which was supposed to drive the eruption from the interior to the surface in the Exanthemata. As the theory was untenable, the practice could not be supported on that ground; yet, at the same time, it must be admitted, that, in many cases of this order of diseases, Emetics may be given with advantage. They are useful, for instance, in the eruptive fever of small-pox, when the stomach is loaded; and, even when this is not the case, experience has clearly demonstrated their utility in casual small-pox. In confluent small-pox, attended with inflammatory symptoms, nauseating doses of emetic substances are admirably adapted for reducing the excitement; but full vomiting is neither advisable, nor in every intance is it safe. In measles, Emetics have been seldom employed; and, indeed, except for the removal of peculiar symptoms which may arise incidental to the particular case, and the management of which does not come under the general plan of cure, there is nothing in the measles that is likely to demand the employment of Emetics.

In hæmorrhage, when the effusion of blood is accompanied with an inflammatory state of the habit, Emetics are likely to prove injurious; particularly if the flow of the blood be from any of the branches of the ascending aorta. The effort of vomiting occasionally causes epistaxis, or bleeding from the nostrils: when this already exists, therefore, Emetics would be improperly ordered; and they would be equally so in hæmoptysis, or spitting of blood: as it is well known that the pulmonary system is much irritated in the action of vomiting. But if full vomiting is prejudicial in hæmorrhages, nauseating doses of emetic substances have been found highly beneficial. Much of their utility, in this form of administering them, arises from

the determination they produce to the skin, and the necessary result of this in promoting a more equable distribution of the circulating mass.

In almost every species of dropsy, Emetics have been employed; and this has arisen from the fact that the disease has been occasionally cured by spontaneous vomiting. Their use, however, in hydropic affections, is not free from disadvantages: and the idea of a continued course of them is so revolting to most individuals that few can be brought to submit to it. Some species of dropsies—for example, ascites and anasarca—are much benefited by their use*: and particularly when these watery depositions are the result of obstructions in some of the abdominal viscera, as the liver or pancreas. Squill has been particularly used in these cases; but it is certainly not superior to tartar-emetic, nor any of the stronger Emetics. When benefit arises from Emetics in dropsy, the abstraction of the effused serum is rapid, and consequently the parts require to be supported by bandages: whilst, during the intervals of their exhibition, and when the disease is evidently on the wane, tonics must be administered, and the habit supported by diet and proper regimen.

Jaundice is produced by obstruction of the duct which conveys the bile from the liver and gall-bladder into the duodenum: the bile which should be thrown out of the habit is reabsorbed, and a yellow colour given to the skin. This obstruction often arises from calculi passing from the gall-bladder, where they are formed, into the duct, and, being too large to pass, remain impacted there. The mechanical pressure upon the ducts, caused by the action of vomiting, may push the calculi forward into the duodenum; but the relaxation of spasm, which generally follows vomiting excited by substances that leave the sensation of nausea after producing vomiting, tend still more to accelerate the passing of such calculi; thence the antimonial Emetics, in particular, have been found useful auxiliaries in the treatment of jaundice.

Emetics are very generally employed in maniacal cases. Many of the best writers upon these diseases contend for the propriety of their employment in all cases, if the strength of the patient be not much exhausted; and assert that the bodily health visibly improves under their influence. The latest writer upon this subject, Dr. Burrows, accords to a certain extent only in the opinion of the older writers, and adds that emetics do not produce the beneficial effects which follow their use, so much from their acting simply as evacuants, "but rather

* "Oportet quidam, hic monere quod leniara emetica nil agunt in Ascite, sed fortiere ex brevibus intervallis repetita palmam reliquis præripiant."—Boerhaave in Pract. Med. Ars. Art. Hydrops.

from the well-known effect vomiting produces on the circulation." The candour of Dr. Burrows, however, does not permit him to give more credit to the operation of Emetics than his own experience warrants; and he therefore says, "I must conscientiously declare that, after several years' perseverance, my confidence in Emetics alone, in cases of insanity, has been entirely dissipated. Still," he adds, "I have occasionally recourse to Emetics, but only as I would in other diseases—to free the stomach from troublesome ingesta, accumulated phlegm, or morbid bile; and sometimes to give activity to torpid viscera, and to rouse and emulge the general system." My limited experience confirms these remarks. I have often been disappointed in their employment; and, unless under peculiar circumstances, have long discontinued their administration in insanity. In some diseases of a mental kind, however—as, for example, that species of hypochondriasis which borders on melancholia, and melancholia itself—the use of Emetics has proved more beneficial than in mania. In hypochondriasis, not only are the bowels torpid, but the gastric juice being unequal to the process of chymification, the stomach is deficient in the ordinary powers of digestion, and becomes loaded with viscid mucus. In this case, an Emetic, by clearing away the offending cause, invigorates the digestive faculty, and the influence of the remedy extending beyond the stomach, and improving the powers of assimilation, conduces greatly to the re-establishment of both corporeal and mental health. "Emetics," says Dr. Burrows, "are occasionally useful too, by interrupting intense abstractions and morbid hallucinations, and capricious resolutions. Where the urine has been retained from obstinacy, the operation of an Emetic will generally evacuate the bladder. In like manner it will sometimes act on the rectum when the fæces are withheld." With regard to the choice of an Emetic in insanity, the best is tartar-emetic. It is said that much larger doses are required than in most other diseases; and that a scruple often produces no effect while the congestion of the brain remains; whereas, if this be previously removed by the abstraction of blood from the head, a grain or two will produce full vomiting. I am of opinion that the latter dose would act with more certainty under any circumstances. In melancholia, however, tartar-emetic is improper, even when full vomiting is requisite, on account of the nausea that follows its operation; for, as the system is already much enfeebled, to produce a further state of debility would be injurious, if not attended with dangerous consequences.

In one affection of the head, cephalea, which is characterized by periodical returns of excruciating pains, attended by an exquisite tenderness of the scalp, nothing is so serviceable as the administration of an Emetic at the commencement of the

attack. Indeed, the whole disease has appeared to me to be a modification of intermittent fever attended with local pains, connected with a morbid condition of the stomach; and the result of the administration of Emetics for its relief has fully confirmed me in the view which I had taken of the disease. The similarity between this affection and tic douloureux is so close, that the nerve has been divided with the view of obtaining permanent relief from its attacks, but without any benefit. Even in the genuine tic douloureux, several of the American physicians have employed Emetics, and consider that they are decidedly, "above all other modes of treatment, the most useful in this painful and often intractable affection."

SECTION XIV.

CATHARTICS—MEDICAMENTA CATHARTICA.*

Syn.—Purgatives.

THE term Cathartic may be applied to any medicinal agent which accelerates the peristaltic movements of the intestinal canal, and promotes the evacuation of its contents. When any such substance is taken into the stomach, it excites a slight degree of nausea; which, after a short time, is followed by an uneasy sensation in the abdomen, accompanied by a rumbling sound, and a fulness in the lower bowels; slight rigors are sometimes felt; and, just before the dejections take place, the pulse fills and the skin feels hot and dry. It is not, however, always requisite that the substance should be taken into the stomach; the same effects result if it be introduced into the rectum; or, in some instances, if it be applied to the skin. A Cathartic, therefore, operates both by a local and sympathetic impression on the intestinal canal: it excites purging; but its influence is not confined to the alimentary canal; it is extended to the neighbouring viscera, and, in many instances, to the whole system.

In order to understand correctly the manner in which Cathartics operate, we ought to have some idea of the organization and natural functions of the part on which their influence is exerted.

The alimentary canal includes the stomach, the small and the large intestines. It is lined throughout with a mucous

* From the Greek verb, καθαιρω, I cleanse or purge.

membrane, which forms, in some parts, undulated plaits, or *valvulæ conniventis*, that greatly augment the extent of its surface. This membrane is studded with follicles for secreting a viscid mucus which lubricates the surface of the canal, and which is greatly increased by the action of Cathartics. Covering this mucous membrane is a muscular coat, consisting of circular and longitudinal fibres. The whole is well supplied with blood-vessels and nerves, the arteries are secondary vessels from the aorta; the nerves are derived from the superior and inferior mesenteric plexus and connected with the great sympathetic; thence the intestines communicate, sympathetically, both with the brain and spinal column. Our knowledge of this nervous connection between the intestinal canal and the rest of the system enables us to explain the general effects of Cathartics. With respect to the functions of this canal, when the chyme passes out of the stomach into the duodenum, it is there mixed with the bile and pancreatic juice; and moved into the jejunum, through which it passes slowly downwards; whilst the chyle, being separated from the fæces, adheres to the villi, and is absorbed and carried into the circulation: this progress and absorption are continued through the whole remaining length of the smaller bowels, until the now nearly completely digested mass, mixed with the natural mucus of the passage, is pushed forward into the cœcum, whence, being received into the colon, the cells of this bowel give lodgement to the fæces, retain them, and prevent their too rapid descent into the rectum. In these cells, when the great intestines are torpid, scybala or hard fæcal balls are formed, by the fæces remaining too long in them; and it is only by the pouring out of the secretions of the intestine, when it is stimulated to increased action, that these are loosened or dissolved, and ejected from the body. But, besides the fæces and the secretions, a large quantity of gas, consisting chiefly of azote and sulphuretted hydrogen, is always present in the canal.

The intestines perform two distinct movements—a *vermicular* and a *peristaltic*. Upon looking into the abdomen of an animal suddenly killed by a blow on the occiput, or by hydrocyanic acid, we perceive a movement in the intestines, a drawing-in of one part, and an inflation and elongation of another, resembling, in some degree, that motion which proceeds from a snake or long worm coiled up: this is the *vermicular* motion. But, besides this movement, there is a direct contraction of the diameter of the gut, by the action of the circular fibres, occurring in a regular series, from above downwards, through the whole length of the canal; each successive portion contracting before the former is completely relaxed: this is the *peristaltic* motion. By the joint action of both, the food is passed along the canal and ejected from the body. It has been supposed that, when

any cause obstructs the progression downwards of the contents of the bowels, or the successive series of constrictions of the circular fibres are interrupted by any means, the natural action is then inverted, and an *antiperistaltic* movement takes place. Even in the natural or ordinary action of the intestines, the food is partly carried backwards as well as forwards; and thus it is more extensively applied to the mouths of the absorbents; whilst, nevertheless, the natural action is downwards.

The intestines are stimulated to action by matters within the canal: the immediate impression upon the mucous membrane is communicated to the muscular coat, and causes it to contract, by which the contents of the gut are pushed forward to stimulate another portion, whilst the former relaxes; thence, by such alternate contractions and relaxations, the ingesta traverse the whole of the canal with more or less rapidity, according to the degree of stimulus exciting these movements. Substances, therefore, which excite the increase of the natural action, are regarded as Cathartics; and during their operation, if the natural accordance which exists between the contractions of the longitudinal and circular fibres be disturbed, colic pains result, which are more or less severe according to the energy of the Cathartic. When the stimulus is moderate—as, for instance, when it arises from the natural contents of the bowels—the villi, each of which is accompanied with an artery, and a vein, a lacteal or an absorbing vessel, and a nerve, are erected and absorb the chyle; if it be in a small degree augmented, the interior coat pours out a greater quantity than usual of its natural secretion, or *liquor entericus*, a watery fluid resembling the gastric juice, and of mucus secreted by follicles on the interior surface of the canal; if the stimulus be still greater, the peristaltic motion of the bowels is accelerated, and their contents are hurried through them; while, at the same time, there is a still more augmented excretion both of the *liquor entericus* and the mucus. Like every other organ, however, the intestines are stimulated, in the manner that has been described, within a certain limit only: beyond this point, inflammation is the consequence, and the results are altogether different. Substances that stimulate the intestines only within the limits alluded to can be regarded as *Cathartics*.

Cathartics act *locally* on the intestines; but, as already stated, their influence extends to the neighbouring viscera; sometimes to the whole system. When their action is confined to the intestinal canal, they prove beneficial, by restoring its suspended function. The first stools that occur after a purgative has been taken are similar to those caused by the natural movement of the bowels; they are the contents of the cœcum, the colon, and the rectum; the next are chiefly fluids, resulting from the irritation of the mucous follicles and the exhalants of the intestinal

tube, mixed with bile, and the drink taken to aid the action of the Cathartic. But, besides their topical operation, Cathartics influence the stomach, propelling its contents into the duodenum: and they promote and increase the flow of bile and of the pancreatic fluid, by stimulating the excretory ducts of the pancreas and liver: for the stimulus applied to the excretory ducts of these organs is communicated to the organs themselves; thence a greater quantity of blood is determined to them, and an increased secretion is the consequence. The knowledge of this fact enables us to account for a result of frequent purging, which is too little attended to: the secretions, instead of being improved, are deteriorated, owing to the constant irritation communicated through the excretory ducts, hurrying the natural function of the liver, and thereby rendering the secretion imperfect, if not vitiated. I know a lady of rank who has too little to occupy and fill up her time; and therefore is so susceptible of every corporeal feeling as to imagine that she always requires the aid of purgative medicines, and actually takes a dessert spoonful of castor oil every morning. The consequence is, that the egesta never present a healthy appearance; and look as if she were suffering under what is termed a bilious attack. Cathartics also influence the kidneys, the secretion of which is generally diminished by their continued use, as the fluids which they cause to be discharged by the bowels would have been excreted by the kidneys. Their influence upon the uterus is more decisive, owing to the contiguity of that organ to the rectum rendering it susceptible, especially in a diseased state, of the influence of stimulants affecting the rectum; thence some Cathartics, which are supposed to act specially upon the rectum, are regarded as Emmenagogues.

Cathartics differ with respect to the part of the intestinal canal upon which they act: some particularly stimulate the duodenum, and thus promote the discharge of the contents of the biliary ducts—as, for instance, calomel and rhubarb; others, as aloes, exert their action on the colon and rectum; whilst the saline and oleaginous purgatives increase the peristaltic motion of the whole intestinal tube. No satisfactory explanation of the cause of this difference of action has yet been advanced; but the knowledge of the fact is of great importance in a practical point of view.

Cathartics are said to act generally when, besides the evacuation of the bowels, they cause a copious discharge of serous fluid from the circulating mass; the suddenness of which, combined with the quantity discharged from the exhalants, produces a powerfully sedative effect upon the whole frame; the force and velocity of the pulse are diminished, and febrile and inflammatory action greatly lessened. In some instances, indeed, as when Elaterium is administered, the discharge of watery fluid

is so excessive, that alarming and even fatal effects have resulted. If the purging be long continued, the chyle is evacuated; and thence, in protracted diarrhœa, the blood loses its red colour, the surface of the body becomes pallid, and symptoms of exhaustion supervene. They are also supposed to excite the general action of the absorbents; and on this principle is explained the removal of extravasated fluids: even solid matters, the product of disease, are frequently removed by active purging; an effect attributable to a law of the system, by which a great discharge of serum is followed by an *apparently* increased action of the absorbents; for it is problematical whether the absorbents be excited, or the common capillaries stimulated. In either case the effect is the same.

Although the primary influence of Cathartics, that of exciting the alimentary canal, is shared by all of them, yet they differ considerably in their secondary effects. Some operate quickly, others very slowly; some produce nausea, griping, and tenesmus; others operate with less sensible impression; some cause one copious evacuation only; others repeated stools. The dose also, in which Cathartics are administered, greatly modify their action. Some, when given in large doses, only slightly augment the peristaltic motion of the bowels: others, when given in minute doses, produce numerous watery stools, with pain and great irritation; some act so violently as occasionally to excite inflammation. Cathartics have been accordingly divided into *Laxatives*, *Purgatives*, and *Drastic Cathartics*. But, besides these divisions, the frequent necessity of administering Cathartics by the rectum, renders a fourth division requisite, namely *Enemata*.

But Cathartics also cause purging when they are only applied to the skin. Thus, if a cataplasm of rhubarb be laid upon the pit of the stomach of a child, the bowels will be emptied; and aloes applied to any abraded surface, causes the same effect upon the rectum as if the medicine had been taken into the stomach. This method, however, of exhibiting cathartics is rarely or never employed, although it might be advantageous under certain circumstances; when the patient, for example, obstinately refuses to take medicines by the mouth, and when more harm than benefit would follow the employment of force. On the same principle, placing one or two drops of Croton oil on the tongue purges briskly when the powers of deglutition are suspended and injections do not fulfil the intention of the practitioners.

Before describing each of the divisions above enumerated, it is proper to make a few remarks upon the nature of the matters evacuated. They vary considerably in *colour;* they are either brick-red, brown, yellow, greenish, slate-coloured, clay-coloured, black, or nearly white; in consistence firm or scybalous, soft, pultaceous, or watery: and with respect to odour, more or less

fœtid. They may be also mucaginous or puriform: the former depending on the excitement of the secretory action of the crypts of the mucous membrane; the latter on ulcerations of that membrane. According to the character which the discharges presented, the ancients classed purgatives under the heads *hydragogues*, *phlegmagogues*, *cholagogues*, and *panchymagogues*. If watery stools were produced by the excitement of the intestinal exhalants, the cathartic which caused it was regarded a hydragogue*: if the stools were glairy, owing to the excitement of the mucous follicles, it was a phlegmagogue†; if much mingled with the secretion of the hepatic organ, a cholagogue‡; and, finally, a panchymagogue§, when the evacuations which it caused were mixed nearly equally with the humors of the intestinal canal. But it was an error to ascribe this effect to the substances employed; the same cathartic will produce bilious stools in one person, mucous or serous in another; and, even in the same person, at different times or under different circumstances, it will produce distinctly opposite effects. Nevertheless, as I have already stated, some cathartics act upon one portion of the intestinal, others upon another; and effects result connected with the secretions of the portion acted upon, which greatly modify the character of the evacuations. This truth was firmly grasped by the ancients, who ascribed almost all diseases to some peccant humor which required to be expelled; and they believed that purgatives could effect this expulsion. The cathartic was therefore selected which was best fitted to expel the particular humor on which the disease was supposed to depend. If, after employing it for a proper length of time, the disease still continued, it was then concluded that something else remained to be thrown out, and a new course of purgatives was resorted to.

Let us now examine the characters of each of the divisions of cathartics.

1. *Laxatives* are *partially digestible* substances, which gently stimulate the intestinal tube and moderately quicken the peristaltic action. They merely remove irritating matters from the bowels, and thereby diminish what has been termed the tension of the system, and abate the disposition to febrile action: they are on this account employed in cases in which active purging is unnecessary. A state of the bowels requiring such aid frequently occurs, independent of disease. Thus, in the ordinary state of the habit, the accumulation of the fæces in the rectum generally occurs daily at the same hour, and a sensation is excited which indicates the necessity of evacuating the bowels; but if this period be permitted to pass, the contents of the rectum are again partly thrown back upon the colon: the habit of eva-

* From ὕδωρ, water, and ἄγω, I eject.
† From φλεγμα, phlegm, and ἄγω.
‡ From χολὴ, bile, and ἄγω.
§ From παν, all, χυμος, juice.

cuating them at a certain time having been interrupted, a torpor of the great intestines follows, and some additional stimulus, such as that afforded by a laxative, is required to re-excite their ordinary action. In children, and also in individuals of delicate habits of body, the debility which, more or less, always follows the use of the more active cathartics, would often prove highly detrimental, and therefore laxatives are employed. Some of these owe their effects to a mechanical property; as, for example, bread made of flour which has not been bolted or freed from all the bran, proves laxative, owing to the spiculæ of the horny testa of the grain which have been left in the flour. These pass the pylorus unaltered, and stimulate mechanically the alimentary canal. Many laxatives, also, owe their influence to their chemical properties; this is the case with almost all vegetable substances containing the saccharine principle, such as sugar, manna, honey, the juices of ripe, particularly subacid fruits, malted grain, fermented liquors, bland fixed oils, sulphur, and magnesia. Laxatives owe little of their purgative powers to quantity.

2. *Purgatives* are *indigestible* substances, which, taken into the stomach or introduced into the rectum, augment their peristaltic movement. The action of purgatives is, therefore, merely an increased degree of that of laxatives; but, besides augmenting the peristaltic action of the intestinal canal, they stimulate their secreting surfaces, so that a larger quantity of fluids than is usual is excreted by the intestinal exhalants.

The necessity of employing Purgatives is founded on the same circumstances as those which demand the use of laxatives; but as their operation also reduces the powers of the system, they are indicated in diseases of excitement; in which the mere evacuation of the alimentary canal of its contents is a secondary consideration. In continued torpor of the bowels, giving rise to an accumulation of fæces in the larger intestines, more active stimulants of a cathartic nature than simple laxatives are requisite; thence, in such cases, Purgatives are employed. But, as I have already said, the most important application of Purgatives is not to obtain their operation on the intestines themselves, but the influence which they exert upon the other parts of the system. In this respect they form a part of what has been termed the antiphlogistic plan of treatment, that which is chiefly applicable to inflammatory diseases. By diminishing arterial action, they promote absorption: it is this effect which renders their frequent use productive of wasting of the body: they accelerate the pulse before they operate; they develope animal heat, cause thirst, diminish perspiration, and, after their operation, induce sleep.

3. *Drastic Cathartics* are also indigestible substances, which operate in the same manner as purgatives, but with greater

energy, and affect the nerves of sensation more than either laxatives or purgatives, frequently causing griping or tormina, nausea, and vomiting. This influence, however, on the sensitive nerves is not essential to the fulfilment of the intention with which Drastic Cathartics are administered. Drastic Cathartics are generally resinous or resino-extractive substances.

Cathartics have been described as belonging to three genera; yet it is impossible to mark the limits where one set terminates and the other commences; for all, with a few exceptions, may be arranged under one head; the difference depending rather on the energy of their action than on any specific or peculiar mode of operation. The effects, indeed, of Cathartics depend on such a variety of circumstances, that laxatives may operate in some cases with violence, and a mild and scarcely sensible action may follow the administration of the most drastic Cathartics. A question here presents itself, namely, are Cathartics absorbed? We know that the colouring matter of rhubarb can be detected both in the urine and in the cutaneous perspiration; we know, also, that an infant at the breast of a nurse who has taken a dose of senna is purged; the flesh of birds who feed on the berry of the Rhamnus *catharticus* has a purgative property; and inorganic cathartic substances, such as sulphate of potassa, have been detected in the blood contained in the venæ portæ, the inferior cava, and the right ventricle of the heart*. The fact of absorption, therefore, must be admitted; but, at the same time, it is undoubted that Cathartics operate independent of absorption.

Let us now enquire what are the circumstances which modify the operation of this class of medicines.

a. Quantity modifies the operation of Cathartics; and this is so obvious as scarcely to require any comment. The rule, however, is not general: some drastic purgatives, for instance, elaterium and croton oil, exert their full effects in such minute doses, that it is impossible to reduce their action to that of a laxative. On the other hand, some laxatives, for example, sugar, manna, and magnesia, cannot in any dose be brought to operate as drastic Cathartics. Within a certain range, however, *quantity* has a considerable influence. Another circumstance which tends to influence the operation of Cathartics is *mechanical division*. The resinous Cathartics, when coarsely powdered, cause griping and even tenesmus; while in a state of more subtle division, they operate with less sensible effect—a circumstance at variance with the law which regulates the action of most other substances. Thus, if camphor be combined with senna or colocynth, the purgative properties of these substances are augmented; but at the same time their influence on the

* Teidemain and Gmelin.

sentient nerves is greatly diminished. By such a combination, the colocynth is rendered more soluble; but in the case of the senna, the activity of which is augmented when the camphor is added to the decoction, some other explanation must be sought for. No satisfactory explanation of the influence of division in modifying the action of Cathartics has yet been attempted. Were I to hazard an opinion, I should say that it depends upon some change effected in the substance, when so great a surface is exposed to the action of the air as necessarily must be the case when resinous substances are reduced to impalpable powders. Whether any thing like oxidizement occur, future experiments must decide. The opinion, however, is not improbable, when we observe the great change which even light produces upon impalpable powders. If a powder, for instance, rhubarb, be preserved in a glass bottle, the side always exposed to the light will be changed in colour, rendered nearly white, and prove less active, while that which is shaded from it remains unchanged both in colour and medicinal property. The last circumstance to be mentioned, as influencing the operation of Cathartics, is *combination*. Excitants augment the energy of purgatives, by elevating, as it were, the vitality of the torpid bowels; the purgative substance makes a more powerful impression in the ratio of the increased susceptibility to impression of the mucous membrane. In this the cathartic action is more rapid and more forcible, while, at the same time, nausea and gripings are abated. Emollients, on the other hand, diminish the influence of Cathartics; and the same is the effect of acidulated fluids. Narcotics, under ordinary circumstances, weaken or retard the operation of purgatives; but, in cases of spasm affecting the intestinal tube, the addition of an opiate, by allaying this, tends to augment the powers of the narcotics. Sydenham frequently combined opiates with Cathartics, and found that the narcotic, by resolving spasm, aided greatly the peristaltic movement of the canal.

Cathartics differ as to the time necessary for producing their effect: some operate in a few hours, others require from eight to twelve. These differences are supposed to depend in a great degree on the solubility of the substance in the gastric juice and fluids of the alimentary canal. The time required is said to be exactly in the inverse ratio of the solubility of the purgative; from which circumstance, the saline purgatives operate in the shortest time, and the resins, from their insolubility, require the longest time. It is probable, also, that this difference of solubility enables them to act on different parts of the canal. If, for example, they are altered by the juices of the stomach, as in the case of calomel, which acquires activity from meeting with muriatic acid in that viscus; or if they be very soluble in the juices of the duodenum, as in the case of jalap, they will act

immediately there: their action will not, however, be confined to that part, but will be extended through the whole canal, increasing the excretion of the fluid secretions of the part. The resinous Cathartics, on the contrary, being much less soluble in the animal juices, dissolve more slowly, and therefore operate upon the lower intestines. But, in admitting the plausibility of this explanation, truth obliges us also to admit that it is not satisfactory: aloës, for example, if applied to an ulcerated part on the surface of the body, still exerts its purgative influence chiefly on the rectum; and aloës is more soluble than jalap, which acts on the duodenum.

It is of importance, in a practical point of view, to be intimately acquainted with the *time* required for the operation of purgative medicines; as it enables us to adopt our remedies more decidedly to certain cases than to others. Thence the saline purgatives, owing to the rapidity of their action as well as their influence in emptying the vessels of the system, are best adapted for acute diseases, especially those of a febrile and inflammatory character; while the resinous purgatives of an opposite character are better calculated for chronic affections.

Cathartics differ considerably in their ultimate effects upon the system. In general, they induce a subsequent costiveness, which is supposed to depend on the evacuation of the fluids of the intestines, being so considerable that some time is requisite to replace them; but it is more probable that it is the result of that law of the constitution which determines that almost every increased action must be necessarily followed by a state of inactivity or collapse. The more general, also, the action of a purgative, the more likely is costiveness to follow. The saline purgatives, owing to their operation on the whole intestinal canal, often leave more sluggishness of the bowels than existed before their employment. Rhubarb has the same effect; but, on the contrary, as an exception to this rule, castor oil, which operates on the whole length of the intestinal canal, tends to produce the opposite effect; and the same property belongs to croton oil. Those resinous Cathartics which operate on the lower intestines often leave the bowels in what is termed a more soluble state, that is, more open than before.

In the administration of Cathartics, some attention is required to the following circumstances.

1. Cathartics are generally more necessary and serviceable in warm than in cold climates, owing not only to the greater vitiation of the contents of the bowels and the augmented secretion of bile in high than in low temperatures, but to the great determination of fluids to the skin in warm climates favouring the formation of scybala. As to the influence of season, it is an old maxim that purgatives should be given in spring and autumn, or as the term is, in the decline and fall;

and it is true that more inflammatory diseases prevail at these seasons than other periods of the year; but the custom should not be followed by persons in health, as it might induce a habit which would prove hurtful.

2. The constitution of the patient must be attended to. In general, Cathartics are more required by persons of a melancholic than those of a sanguine temperament, the bowels being generally more torpid in the former than in the latter. There are, however, exceptions to this rule: women, although they are more commonly of the sanguine temperament, yet are more generally disposed to costiveness than men; they do not, however, bear the operation of Cathartics so well. In pregnancy and during menstruation no drastic Cathartic should be administered: for it is well known that medicines which cause abortion do so by their cathartic influence on the rectum; nor should they be freely administered in conditions of debility. Where any idiosyncracy exists connected with the operation of Cathartics, it should not be disregarded; as much injury may follow the employment of certain kinds of purgatives in such instances: thus, in some individuals, a dose of rhubarb will cause convulsions, closely resembling those of epilepsy; in others, the smallest dose of calomel will produce alarming syncope. The readiness with which ptyalism is induced in some individuals by calomel is also a circumstance which requires consideration.

3. Although a costive habit should be strictly guarded against in childhood, yet we must keep in remembrance that children bear the action of Cathartics worse than adults. On account, also, of the depressing effects of saline purgatives, those of a warm nature are best adapted for aged persons; but, in attending to this general rule, we must also recollect that debility may arise from very opposite states of the system and also from very opposite causes; and by removing these the strength is increased.

4. Cathartics ought not to be too frequently taken; as, by the excitement they produce on the mouths of the hepatic and pancreatic ducts, they cause a hasty, irregular, and imperfect secretion of the bile and pancreatic juice, which is highly injurious to the digestive function.

5. As a general rule, Cathartics are inadmissible in inflammatory states of the alimentary canal which have gone on to ulceration, or where there is a great tendency to dysenteric affections.

6. The nature of a Cathartic determines the period in which it should be administered. If it require a long time to operate, it should be given at bed-time; if it be of quick operation, in the morning, or at any time during the day: thus, saline purgatives, senna, castor oil, croton oil, and elaterium, are best

administered in the morning; the gum-resins, sulphur, and calomel, in the evening. But the action of Cathartics may be at any time quickened by copious dilution with warm aqueous fluids. When spasm is present, the Cathartic may be combined with opium or some narcotic; for although opium may retard the quick operation of the Cathartic, yet, when spasm affects the intestinal canal, this addition secures and promotes its operation.

7. During the operation of Cathartics, cold applied to the surface must be avoided, as the body at this time is more liable to be affected by it.

8. During the operation of Cathartics, it is necessary to distinguish carefully the differences in the alvine discharges which are the result of disease and those produced by the Cathartic. Calomel always causes the evacuations to appear unnatural; and, in order to ascertain their real aspect, the use of the medicine should be suspended for a few days. During the operation of colchicum, the stools are of a bilious character; during that of saline purgatives, daily repeated, they assume a peculiar colour; and the effect of elaterium is to produce stools resembling water in which meat has been partially boiled. The nature of these appearances and their distinctions shall be pointed out in treating of particular Cathartics.

TABLE OF CATHARTICS.

A. LAXATIVES.

* *Organic Products.*

Animal.

a.—HONEY, prepared by			
Apis *mellifica.*	4.	12.	Diptera.

Vegetable.

b.—SACCHARINE MATTERS, contained in			
Manna.—Fraxinus *ornus.*	23.	2.	Oleaceæ.
Pulpa Cassiæ. C. *fistula.*	10.	1.	Leguminosæ.
c.—ACIDULOUS FRUITS, of			
Tamarindus *Indica.*	10.	1.	Leguminosæ.
Prunus *domestica.*	12.	1.	Amygdaleæ.
d.—FIXED OIL, procured from			
Olea *Europæa.*	2.	1.	Oleaceæ.
Amygdalus *communis.*	12.	1.	Amygdaleæ.
Linum *Ussitatissimum.*	5.	5.	Lineæ.

** *Inorganic Substances.*

e.—SULPHUR.

f.—MAGNESIA (*a hydrated oxide*).

g.—SALTS.

Magnesiæ carbonas (*bicarbonas*),
——— subcarbonas (*carbonas*).
——— Acetas.

B. PURGATIVES.

* *Organic Products.*

a.—FIXED ACRID OIL, from			
Ricinus *communis.*	21.	9.	Euphorbiaceæ.
b.—OLEO-RESIN, from			
Amyris *Gileadensis.*	8.	1.	Amyrideæ.
Copaifera *officinalis.*	10.	1.	Leguminosæ.
Pinus *Larix.*	21.	6.	Coniferæ.
—— *Canadense.*	—	—	———
—— *sylvestris.*	—	—	———
Pistacia *Terebinthus.*	22.	5.	Anacardiaceæ.
c.—RESIN, contained in			
Convolvulus *Jalapa.*	8.	1.	Convolvulaceæ.
Rheum *palmatum.*	9.	3.	Polygoneæ.
——— *undulatum.*	—	—	———
——— *Australe* vel *Enodi.*	—	—	———
Rumex *Aquaticus.*	9.	3.	———
——— *Obtusifolius.*	—	—	———
d.—RESINO-EXTRACTIVE, in			
Aloës *spicata.*	6.	1.	Asphodeleæ.
—— *vulgaris.*	—	—	———
e.—CATHARTINE, in leaves of			
Cassia *Senna.*	10.	1.	Leguminosæ.
—— *lanceolata.*	—	—	———

** *Inorganic Substances.*

a.—METALLIC OXIDES.

Pilulæ Hydrargyri.
Hydrargyrum cum Magnesia.

b.—CHLORIDES.

Sodii Chloridum.
Hydrargyri Proto-chloridum (*Calomel*).

c.—SALTS.

Magnesiæ Sulphas.
Sodæ Sulphas.
—— Phosphas.
—— Tartras.
—— Tartras et Potassæ.

Potassæ Bisulphas.
——— Sulphas.
——— Bitartras.
——— Tartras.
——— Acetas.

C. DRASTIC CATHARTICS.

* *Organic Products.*

a.—GUM-RESINS, procured from			
Cucumus *Colocynthis.*	21.	10.	Cucurbitaceæ.
Convolvulus *Scammonia.*	5.	1.	Convolvulaceæ.
Stalagmitis *Gambogioides.*	23.	1.	Guttiferæ.
Rhamnus *Catharticus.*	12.	1.	Rhamneæ.
Gratiola *officinale.*	2.	3.	Labiatæ.
b.—OLEO-RESIN.			
Helleborus *niger.*	13.	7.	Ranunculaceæ.
c.—FIXED ACRID OIL, from			
Croton *Tiglium.*	21.	8.	Euphorbiaceæ.
Euphorbia *lathyris.*	11.	3.	———
d.—NICOTINA, from			
Nicotiana *Tabacum.*	5.	1.	Solaneæ.
e.—VERATRIA, from			
Veratrum *album.*	23.	1.	Melanthaceæ.
Colchicum *Autumnale.*	6.	3.	———
f.—ELATINA, from			
Momordica *Elaterium.*	21.	10.	Cucurbitaceæ.

* * *Inorganic Substances.*

Antimonii Sulphuretum precipitatum.

D. CLYSTERS.

All Purgatives.

ORGANIC VEGETABLE PRODUCTS WHICH OPERATE AS LAXATIVES.

Animal Substances.

a. HONEY. *Mel.* L. E. D.—Honey is produced by several species of bees, but most abundantly by the Apis *mellifica**. Bees collect the sweet juice or honey secreted in the nectaries of flowers, they swallow this and again excrete it; but whether it undergo any elaboration in the body of the bee, has not yet been determined. It is probable that the change, if any, cannot

* See the works of Huber, Dr. Bevan, and others.

be very great, as both the odour and the taste of honey is influenced by the nature of the flowers from which it is selected. Thus, when bees have been placed in fields of thyme, or lavender*, or rosemary†, or any of the plants belonging to the natural order *Labiatæ*, rich in volatile principles, the Honey preserves the odour of the flower, is of a high flavour, and of excellent quality; on the contrary, it is very bad when the bees feed on buck-wheat. The Honey of various parts of the world is consequently known by its peculiar flavour—that of Minorca differs from that of Narbonne; this from the Honey of England; and that of the southern parts of our island from the Heather Honey produced from the heath of the Scottish mountains. The finest Honey in the world is made on the Peak of Teneriffe: the bees feed on the Ratama, the white broom of the Canaries, the Spartium *nubigenum*. In some instances it is even imbued with poisonous properties from the flowers on which the bees have fed—a fact noticed by Xenophon in his account of the retreat of the ten thousand; and it is curious that Turneforte, when travelling in the same country, near Trebisonde, two thousand years after Xenophon, ascertained that the Greek soldiers were poisoned by the bees collecting the Honey which produced that effect from the flowers of the Rhododendron *ponticum* and Azalea *pontica*, beautiful plants which cover the mountainous district of Asia Minor. Poisonous Honey is also met with in various other parts, both in Asia and America. The Pollistes *lecheguana* make a poisonous Honey in Brazil; probably, says M. St. Hilaire, from the flowers of Paullinia *Australis*‡. Poisonous Honey is found in Maragnon and Paraquay, produced from unknown plants. Thence the wholesomeness of Honey depends on the plants on which the bees feed; and many persons can eat one kind of Honey with impunity, but not another: thus, the Heather Honey of Scotland agrees well with many, who suffer severely if they even taste that of Narbonne. The effects of poisonous Honey on the habit are vertigo, nausea, and delirium.

Honey is either smooth and homogeneous like syrup, or it consists of brilliant, granular crystals, dispersed through a clear, uncrystallizable fluid: the colour varies from pure white to a deep brownish-yellow: its odour is somewhat aromatic; its taste sweet, sharp, and slightly acidulous. When long kept, Honey acquires a deeper colour, and more sharpness of flavour and taste. It is completely soluble in water, but only partially in alcohol, which takes up the fluid or syrupous part, and leaves the crystallizable untouched. The quantity of crystallizable varies in different kinds of Honey, but abounds most in the best

* Lavender yields the Honey of Haute Provence.
† Rosemary supplies the White Honey of Narbonne.
‡ Plantes remarq. de Brezil, vol. i.

kinds. M. Guibourt alleges that it contains, also, *Mannite*, a peculiar kind of sugar, which constitutes a large part of manna; and I would add, it contains an acrid matter, which probably is the source of its laxative property. It may be regarded as consisting of saccharine matter, or sugar and mannite; mucilage; an odorous principle; an acrid principle; and a free acid. Like most other vegetable products of a saccharine nature, nitric acid converts it into oxalic acid.

Honey is laxative; but, it is apt to gripe and prove flatulent when given in quantity sufficient to move the intestines: and the older the Honey, the more likely these effects are to be produced. It is, therefore, seldom employed in this country for purgative purposes.

Vegetable Productions.

a. SACCHARINE MATTERS.

Under this head I have placed all those laxative substances, medicinally employed, which contain a large proportion of sugar. The greater part of the sugar used in Europe is procured from the sugar cane, Arundo *saccharifera*. When well purified, it is solid and brittle, white, inodorous, sweet, and persistent in the air. It is soluble in its own weight of cold, and to any extent in hot water. According to the analysis of Dr. Prout, 100 parts of loaf sugar consist of 42.85 parts of carbon, 50.8 of oxygen, and 6.35 of hydrogen, or 1 prop of carbon = 6, + 1 of water = 9, making its equivalent 15. The alkalies combine with it and form compounds, which do not taste sweet. Sulphuric acid changes it to charcoal; nitric acid to oxalic acid. The Saccharine Matter in fruits does not readily crystallize; and a sugar resembling that of fruits is made from starch by the action of sulphuric acid.

1. PULP OF CASSIA. *Cassiæ Pulpa*. L. E. D.—This is the pulp of the fruit of a tree, a native of the East Indies, and of Egypt, where it was called Chiavxambar, the name Cassia *fistula* being applied by the ancients to cinnamon. The tree is now named Cathartocarpus *fistula*: it is cultivated in Egypt, but found in a wild state in Hindostan, throughout the Indian Archipelago, in Cochin China, the Antilles, and in South America, where, however, the fruit differs in several respects from that of the tree of the old Continent. It belongs to the natural order Leguminosæ*. The fruit is a long, woody, dark-brown pod, nearly two feet in length, the diameter about an inch, cylindrical, with two longitudinal furrows on one side, and one on the other. It is internally divided by transverse partitions; in each of the cells will be found a smooth, oval,

* Woodville's Med. Bot. 3rd edit. p. 160, pl. 455. London Dispensatory, art. Cassia. Richard, Hist. Med. Nat. t. ii, p. 525.

shining, yellowish seed, with red lines dividing it longitudinally, imbedded in a soft, black pulp.

The pods are permitted to remain on the tree throughout the year. Prosper Alpinus says that they are to be kept four months before they can be used. In choosing them, the heaviest pods and those which do not rattle are to be preferred.

The pulp is the only part in use as a medicine. It has a slightly sickish odour, and a sweet, mucilaginous taste; is soluble in water; partially soluble in alcohol and ether. The watery solution yields a precipitate with subacetate of lead, marking the presence of gum; with alcohol, denoting the existence of gelatine; and, although none of the mineral acids affect it, yet chlorine throws down a yellow-coloured precipitate, which is insoluble in ether. From an analysis of this pulp, Vauquelin says that it contains nearly one half its weight of water, rather more than one fourth part of sugar, some gluten, gelatine, gum, and extractive matter: but, according to M. Henry, its components are 12.20 of sugar, + 1.55 of gum, + 2.86 of tannin, with other matters not made out*. The Pulp of Cassia fistula is seldom used in this country, being apt to induce nausea, griping, and flatulence; it is an ingredient in the Confectio Cassia, and the Confectio Sennæ. When taken alone, the urine becomes tinged of a brownish colour; but this is merely a separation of the colouring matter. In doses of from ʒiii to ʒi, it proves gently laxative; but, it is a medicine which does not deserve to be retained in the Pharmacopœias.

b. MANNA. *Succus Concretus Fraxini orni.* L. E. D.—The Fraxinus *ornus* is a native of the South of Europe, and of Mount Parnassus, and the loftiest mountains of Greece. It is a low but a handsome tree, belonging to the natural order Oleaceæ†. But two other species of Fraxinus, *rotundifolia* and *excelsior*, the Tamarisk, and a species of Eucalyptus, also yield Manna. It exudes from the bark of the stem and branches, upon which it concretes; but to obtain it for medicinal purposes incisions are made into the bark of the Fraxinus, on one side only in the same season. Sometimes the Manna is collected on straws and chips fastened near the incisions, by which a finer kind is procured. In this state it is called canulated Manna, *Manna in Canoli.* The best Manna brought to this country is closely packed in chests, and is known by the name *Flake Manna.* It is in flakes, or oblong pieces, evidently moulded by the branches on which it has concreted: it is light, friable, of a white or very pale yellow colour, and is in some degree diaphanous. It has a slight, peculiar odour, a sweetish taste, and leaves a bitterish impression on the tongue. The finer

* Journ. Chim. Med. tome ii, p 376.

† Woodville's Med. Bot. 3rd edit. pl. 200, p. 589. London Dispensatory, art. Fraxinus. Richard, Hist. Nat. Med. t. ii, p. 22.

pieces are often crystallized in the interior. It is soluble in water, without suffering any alteration, and is obtained unchanged by evaporating the watery solution. It is readily dissolved in boiling alcohol; and, when the solution cools, about three fourths of the quantity dissolved is deposited in a crystallized state, not unlike the appearance of sulphate of quinia. This has been named *Mannite;* and is ordered, by Proust, who named it, to be purified by pressing it between bibulous paper, and then redissolving it in boiling alcohol: it instantly melts in the mouth, is agreeably sweet, and completely free from the nauseous taste of the Manna, which adheres to the part retained in solution by the alcohol. Mannite is soluble in five parts of cold water; but nearly insoluble in cold alcohol. It is not fermentable, like sugar; yet, when treated with nitric acid, it is converted into oxalic acid. According to Dr. Prout, it consists of 38.7 of carbon, + 54.5 of oxygen and 6.8 hydrogen. On evaporating the spirituous solution, more mannite is obtained; and, finally, a thick extract which cannot be rendered perfectly dry, and contains the nauseous principle of the drug. When Manna is treated with nitric acid, it yields, besides oxalic, saclactic acid. According to the experiments and analysis of Vauquelin, Manna consists of about three fourths of Mannite, a little common sugar, a yellow nauseous uncrystallizable matter, which is its purgative principle, and a little mucilage; whence the saclactic acid when it is treated with nitric acid.

Manna was formerly in great vogue. It is a very mild laxative, adapted chiefly for children and very delicate females; but even for these it is seldom prescribed alone. It is ordered as an adjunct to solutions of neutral salts, castor oil, and senna; but it is rather adapted to cover their tastes than to aid their cathartic properties. It may be given in doses of ʒi to ʒiv, in any bland solution or in milk. It is one of those medicines which might be well spared.

d. ACIDULOUS FRUITS.

The laxative influence of these fruits seem to depend on a combination of sugar, gum, the tartaric, citric, and malic acids.

1. TAMARINDS. *Tamarindorum Pulpa.* L. E. D.—This is the pulp of the fruit of the Tamarindus *Indica*, a beautiful tree, a native of the East and West Indies and of Egypt, belonging to the natural order Leguminosæ*. It forms an article of diet in the countries where it is produced. West India Tamarinds are imported, preserved in syrup, after being freed from the outer shell: those sent home from the East Indies are

* Woodville's Med. Bot. third ed. pl. 161, p. 448. London Dispensatory, art. Tamarindus. Richard, Hist. Nat. Med. t. ii, p. 728.

preserved without sugar in their natural state. Unless, however, they are kept in closely covered jars, they are very apt to get musty.

Tamarinds are inodorous, and have an acid, agreeable, sweet taste. Their goodness is ascertained by their freedom from mustiness, by the seeds being hard, flat, and clean, and by the strings or fibres which embrace the pulp being entire; and a clean knife thrust into the preserve and left there for some time not appearing coated with copper when withdrawn. According to the analysis of Vauquelin, the pulp, independent of the sugar of the preserve, contains $\frac{1}{12}$ of citric acid, less than half that quantity of bitartrate of potassa, a small portion of free Tartaric, and a still smaller of Malic acid, in combination with sugar, gum, jelly, and fecula. These acids are precipitated in combination with lead, when acetate of lead is added to a solution of Tamarinds; on which account the infusion of Tamarinds should not be drank when acetate of lead is prescribed in hæmorrhagies.

Tamarind Pulp is a weak but an agreeable laxative. It requires to be given in substance: for, however strong the infusion or decoction may be, it produces no action on the intestinal canal. From the extent of the dose required to move the bowels, it is seldom given alone, but generally combined with some neutral salt, or with rhubarb or infusion of senna. It is of little value as a laxative; and should be only tolerated in the Pharmacopœia, as forming an agreeable refrigerant whey, when ʒi of it is boiled in a pint of milk.

2. PRUNES. *Pruni domesticæ fructus.*—The tree which yields this fruit is indigenous, and belongs to the natural order Amygdaleæ*. For aperient purposes, the parenchyma of the Prune is softened by putting it into hot water; and in this state it operates as a mild laxative. Prunes, however, are seldom or never prescribed as medicine in this country; nor is the employment of them as a domestic remedy so general as on the Continent. They enter into several purgative formula; but they add little to their cathartic properties.

e. FIXED OIL.

When a large dose of Fixed Oil is taken into the stomach, it is little acted upon by the digestive powers, and passes unaltered into the intestinal canal, where it excites an increased peristaltic motion, and is at length ejected, displaying its presence in the alvine evacuations. There are three of the Fixed Oils employed as laxatives, although not very frequently in this country.

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* Woodville's Med. Bot. third edit, p. 520, pl. 187. Richard, Hist. Nat. Med. t. ii, p. 448.

1. Oil of Olives. *Olivæ Oleum.* L. E. D.—This oil is procured by expression from the ripe fruit of the Olive, Olea *Europea*, a tree which is a native of Africa, and is most abundantly cultivated in Spain, the South of France, Italy, and Greece; and which belongs to the natural order Oleaceæ*. The best oil is that which is obtained by gentle pressure from the ripe drupe, previously crushed in a mill. It should be inodorous, insipid, soft, and agreeable in the mouth; the best is that which is made in Provence. According to Gay Lussac and Thénard, it consists of 77.213 Carbon, + 13.36 Hydrogen, + 9.427 Oxygen.

When an ounce or more of this oil is taken into the stomach, it resists its digestive power and passes into the intestinal canal. Besides operating as a gentle aperient, it allays colic and gripings; and thence has been found useful in dysenteric affections. It is also given with advantage as an enema, in doses of from two to three ounces or more, when the large intestines are suffering under inflammation, or from abrasions. It is also useful as a vermifuge in moving ascarides.

2. Oil of Sweet Almonds. *Amygdalæ Oleum.* L. E. D.—This oil is procured from the kernel of the fruit of the Almond tree, Amygdalus *communis*†, by expression. It ought to be inodorous, of an agreeable taste, and totally devoid of acrimony. It is of a greenish-white colour, does not congeal at a temperature of 9° Faht. It is turbid when newly drawn, but is readily clarified either by rest or filtration. When bitter instead of sweet Almonds are pressed, if heat be not employed, the oil is perfectly free from all bitterness. One hundred parts of Almonds yield forty-six of oil. And one hundred parts of the oil consists of seventy-six of *elaine* and twenty-eight of *stearine*. As a laxative, it operates exactly in the same manner as olive oil.

3. Linseed Oil. *Lini Oleum.* L. E. D.—This oil is also obtained by expression, from the seeds of the Lint plant, Linum *Ussitatissimum*‡, one of the most valuable plants which has been naturalized to our climate. It is a native of Egypt, in those parts which are subjected to the inundations of the Nile. When the oil is cold drawn, it has a greenish-white colour, and a mild, soft taste; but, when heat is employed, it is acrid, nauseous, and in every respect disagreeable. One hundred parts of Linseed yield about twenty-two of oil. It is a more certain laxative than either Olive or Almond oil. A table-spoonful of it, taken at short intervals, gently purges; but if it be mixed with syrup, it

* Woodville's Med. Bot. third edition, p. 280, pl. 98. London Dispensatory, art. Olea. Richard, Hist. Nat. Med. t. ii, p. 17.

† Ibid. p. 507, pl. 183. London Dispensatory, art. Amygdalus. Richard, t. ii, p. 439.

‡ Ibid. p. 566, pl. 202. Richard, t. ii, p. 795

ceases to operate as a laxative. It has been administered with advantage in inflammatory and spasmodic affections of the bowels. It has also been found useful in nephritic complaints.

* *Inorganic Substances.*

a.—SULPHUR. *Sulphur.* L. E. D. — The nature of this simple combustible has been already explained. The Sulphur of both England and Sicily contains several impurities; it is therefore sublimed, and rises in vapour before it is completely fused. In this way it is prepared on a great scale, by conducting the vapour of the melting sulphur into close chambers, where it is deposited in the form of fine powder; and on a small scale, by being melted in an earthen cucurbit, and the vapour collected in a series of glass vessels, named alludels.

Sublimed Sulphur is in the form of a very bright-yellow powder, which requires to be washed with boiling water to free it from a minute portion of sulphuric acid acquired from the process. In this state it is termed washed Sulphur, *Sulphur lotum.* It is obtained in another form, also, for medicinal use—by precipitation from any liquid holding it in solution; for example, by the decomposition of a sulphuretted hydrosulphuret of lime, prepared according to the formula of the London Pharmacopœia, by boiling together one part of Sulphur, two parts of quick lime, and thirty-two parts of water. When muriatic acid is added to this compound, the Sulphur, retaining a little hydrogen and water, is precipitated, and sulphuretted hydrogen evolved. Sulphur, in the same state, is procured by receiving the vapours of common Sulphur in a vessel filled with steam or watery vapour. It is much whiter than flowers of Sulphur, and is called precipitated Sulphur or Lac Sulphuris. It is evidently a combination of water and Sulphur, or a *Hydrate of Sulphur.* When heated to 218° of Faht. it melts and becomes as fluid as water, and vapours are driven off. If allowed to cool after being melted, and, as soon as the surface begins to congeal, the fluid Sulphur be poured out, the under part of the cake will be found crystallized in needle-shaped crystals of an octohedral figure. When heated to 220°, Sulphur fuses; and if the heat be increased to 320°, it becomes thick and viscid; and if then poured into water, it assumes a red colour and a ductility like wax, and its specific gravity is increased to 2.325. When heated in the air to 300, it inflames and is acidified. Alcohol, ether, and fat oils, dissolve a small portion of it.

Sulphur combines with oxygen, chlorine, iodine, hydrogen, and phosphorus; and forms various compounds, some of which are medicinal agents. It is sometimes contaminated with sulphuret of arsenic. This may be ascertained by boiling gr. 50 of the Sulphur in f℥ii of oil of turpentine, pouring off the solution whilst it is hot and leaving it to deposite the Sulphur; and

again boiling up the residue with the cold oil. By repeating this operation, as long as the oil dissolves any, the weight of the insoluble residue gives the amount of the impurity.

Such are the chemical properties of Sulphur; and it is of importance that the medical practitioner should know them, in order to understand some of the effects of this medicine upon the body. As a laxative, its operation is gentle; and it is the very best laxative that can be administered in hæmorrhoids, as, without exciting purging, it produces a soft, easily moulded evacuation, which does not irritate by its physical pressure upon the highly sensitive piles. In this case, it is usually combined with magnesia; and, in other cases, to quicken its operation, with bitartrate of potassa. In habitual dyspnœa, in which it is of great importance to keep the bowels soluble, it is admirably adapted to fulfil every indication desired. In these cases, the precipitated Sulphur is the best form of the remedy. In doses of ʒi combined with gr. x or gr. xv of magnesia, it acts gently upon the bowels, and may be continued daily until it manifest its odour on the skin, when its employment may be intermitted for a few days.

b. MAGNESIA. L. E. D.—This oxide is found native in the state of a hydrate; in which condition it is of a snow-white colour, passing into greenish-white, having a foliated fracture. It is soft; adheres to the tongue; and is soluble in acids. In this state the mineral contains about 70 per cent. of Magnesia and 30 of water. In steatite, another magnesian fossil, the proportions of Magnesia is 30 per cent. Magnesia for the purposes of medicine is prepared from the subcarbonate of Magnesia. This is submitted to the action of a red heat, the carbonic acid is driven off, and the simple oxide, or *Calcined Magnesia*, as it is termed, remains; but if too much heat be employed, the Magnesia partially vitrifies and runs into masses. In this process, the carbonic acid combines with caloric and flies off in the form of carbonic acid gas. The carbonate loses about 60 per cent. of its weight, of which from 15 to 20 per cent. are water, and the remainder carbonic acid gas. In well-prepared pure Magnesia, the components are one prop. of Magnesium = 12.7, + 1 prop of oxygen = 8, making the equivalent 20.7; or of Magnesia 60, and oxygen 40 parts, in 100. This oxide, or Magnesia, is a pure, white, inodorous, insipid powder. It is nearly insoluble in water, requiring 51.42 of water at 60° for its solution. It does not evolve heat when it is mixed with that fluid. It is reconverted into the carbonate when it is exposed to the action of the atmospherical air, owing to its powerful affinity for carbonic acid, which is always floating in the atmosphere. It is sometimes adulterated with lime; but the fraud is easily detected by dissolving the suspected magnesia in diluted sulphuric acid. The insoluble residue is the sulphate of lime.

c. SUBCARBONATE OF MAGNESIA. *Magnesiæ Subcarbonas.* L. E. D.—This substance, which was formerly known by the name of Magnesia alba, was prepared by precipitating the the mother lee of nitre. It was invented by an Italian priest in the beginning of the eighteenth century; and was sold at Rome as a nostrum for the cure of all diseases. A few years afterwards, Valentini informed the public that it might be prepared by lixivium, or the *mother ley*, which remains after the preparation of nitre. Slevoyt then discovered that it might be prepared by precipitating this ley with potassa; but the real nature of the preparation was not known until Dr. Black published his dissertation on the subject in 1753. It may be readily prepared by precipitating the sulphate of Magnesia with subcarbonate of potassa, washing the precipitate and drying it. In this process a double decomposition takes place. The sulphuric acid leaves the magnesia and unites to the potassa of the subcarbonate, whilst the carbonic acid combines with the magnesia of the sulphate. The carbonate of magnesia is insoluble and is precipitated; the large quantity of water employed holds the sulphate of potassa in solution. Carbonate of soda is preferable to carbonate of potassa, because the sulphate of soda formed is more soluble than the sulphate of potassa, and consequently more easily washed out of the precipitate. Carbonate of Magnesia is also prepared by precipitation from *bittern*, the lixivium which remains after the crystallization of common salt, and which is a muriate of Magnesia. The bittern is heated to 212°, and the impure carbonate of potassa added to it; after which the fire is withdrawn. In this process the muriatic acid leaves the Magnesia and attaches itself to the potassa, forming a muriate of potassa, which is soluble, and therefore retained in the water of the process, whilst the carbonic acid unites to the Magnesia which is set free, and forms an insoluble subcarbonate, or rather carbonate of Magnesia, which is precipitated. This precipitate is then extremely well washed, and brought to market in the form of square masses. Thus prepared, the Subcarbonate of Magnesia, is a pure white light, elastic powder, inodorous, and nearly insipid, insoluble in water, but converting the vegetable reds to blue and green. Heat does not melt it; but it becomes luminous when exposed to a very strong heat. It is a hydrated subcarbonate, composed of 47.6 parts of Magnesia and 52.4 of carbonic acid in 100; or, according to Berzelius, of 36.263 of carbonic acid, 43.956 of Magnesia, and 19.781 of water; or of 1 prop. of Magnesia = 20.7 and 1 prop. of carbonic acid = 22, making the equivalent 42.7. If it be not well washed, it will contain sulphate of Magnesia, which may be detected by dissolving the Magnesia in nitric acid and adding nitrate of baryta; if the sulphate be pre-

sent, an insoluble sulphate of baryta will be formed; but if the adulteration be lime, subcarbonate of ammonia will throw down a precipitate in the nitric solution.

This preparation, although termed a subcarbonate in the Pharmacopœias, is a carbonate. It is converted into a *bicarbonate*, which is crystallizable, by diffusing it in water and passing carbonic acid through the mixture; or, what is more convenient, by mixing together a solution of 125 parts of Magnesia and 136 of carbonate of soda, filtering and leaving the solution to spontaneous evaporation. The salt thus prepared is in the form of hexagonal prisms, nearly tasteless, dissolving more abundantly in cold than in hot water, owing to the latter expelling a portion of the carbonic acid, and reducing the salt to the state of a carbonate.

d. ACETATE OF MAGNESIA. *Magnesiæ Acetas.*—This salt, which has not a place in the Pharmacopœias, may be formed by dissolving Magnesia in acetic acid. It does not crystallize, but forms a viscid mass. It has a sweetish taste, with a slight degree of bitterness: is deliquescent, and very soluble in water and alcohol. It consists of 65.96 of acetic acid and 34.04 of Magnesia in 100 parts.

e. CITRATE OF MAGNESIA. *Magnesiæ Citras.* This salt is also readily prepared by combining its constituents, Magnesia and citric acid. It does not crystallize, though it be evaporated to the consistence of syrup; but it forms a white, spongy, opaque mass, which rises in the vessel like a mushroom. Both the acetate and the citrate may be formed as extemporaneous preparations by combining their constituents at the moment of administering them.

All the preparations of Magnesia are simple laxatives: they operate mildly, and yet with sufficient energy, when they meet with acid enough to convert them into muriates and acetates. When the acidity of the stomach is so small that the Magnesia alone is present in the stomach, it does not operate even as a Laxative; and in this case lemon juice or vinegar and water should be drank immediately after swallowing the Magnesia, which is thus rendered active. As a Laxative, Magnesia is preferable to the Carbonate, the extrication of the carbonic acid in the stomach rendering the carbonate very inconvenient. Like many other alkaline substances, Magnesia allays the irritability of the stomach and checks nausea; I have seen a dessert spoonful of Magnesia in a glass of sherry wine allay very distressing vomiting. When it does not act freely as a Laxative, and has been taken for some time, it is apt to form into concretions. Those persons, therefore, who take it in small doses with the view of obviating a tendency to the formation of urinary calculi, should frequently clear out the intestinal canal with a brisk purgative.

The magnesian preparations are well adapted for infans and children, as the prevailing acescency of the stomach and intestines insures their operation, and the irritability always attendant on dentition is greatly allayed by the Magnesia operating on the sentient nerves of the stomach. The dose of the carbonate to an adult, is from ℈i to ʒi; that of the pure oxide from gr. xv to ℈ii. The best vehicle for taking it is milk.

B. PURGATIVES.

This division of Cathartics contains no animal purgative that I am aware of; and those which are vegetable products, although they may be, in some degree, digestible substances, yet are not dietetical.

* ORGANIC PRODUCTS WHICH OPERATE AS PURGATIVES.

a. FIXED ACRID OIL.

This consists of fixed oil holding in solution an acrid principle, which is the real purgative agent.

1. CASTOR OIL. *Ricini Communis Oleum.* L. E. D.—The Ricinus *communis*, or Palma Christi, which yields this oil, is a plant generally diffused over most of the countries within the tropics; and which has been cultivated as an ornamental plant in this island since the year 1562. From its being a native of Greece, the plant was well known to the ancients, who named it *kiki* and *kroton*, from the resemblance of its seeds to the insect termed Tick, which is frequently found upon the ears of dogs; and its present name, Ricinus, is derived from the same source. It is an annual plant, belonging to the natural order *Euphorbiaceæ**, of quick growth, sometimes, in favourable situations, rising to the height of sixteen feet; but never becoming woody. The seeds abound with oil; but that contained in different parts of the seed possesses different properties. It is unnecessary to enumerate the opposite statements on this subject, by authors, from the time of Serapion to the present period. M. Guibourt has finally decided the question. He found that the testa or husk of the seed contains no acrid principle, and merely gives colour to the oil when this is expressed; that the embryon, or germ, although in taste it seems to posses more acrimony than the perisperm, yet, is not the sole seat of the acrid principle; that the perisperm, or cotyledons, contain both the acrid and the oily principle; and that the acrid principle is volatile and may be dissipated by boiling the oil in water. The oil is extracted from the seeds both by the aid of

* Woodville's Med. Bot. third edition, pl. 221. p. 624, London Dispensatory, art. Ricinus. Richard, Hist. Nat. Med. t. i, p. 590.

caloric and also by simple pressure. The first method has been employed since the time of Dioscorides, and with little alteration. The bruised seeds are put into a bag, and suspended in boiling water, until the oil is extracted and rises to the surface, when it is skimmed off. In some instances the seeds are decorticated, then beaten into a paste, which is boiled in four or five times its weight of water, and the oil is skimmed off as it rises to the surface. It is next heated in another vessel until the water is driven off, and is then passed through a strainer. In the southern provinces of India the seeds are soaked, for several days, before they are bruised. When the boiling is too long continued, the acrid principle is dissipated; if the heat be too great, the oil becomes extremely acrimonious and high coloured. The great difficulty, therefore, of always determining the exact point of temperature was the chief cause for the introduction of the press, for obtaining the oil from the seeds of Ricinus *communis*. Another disadvantage of the oil obtained by coction is the tendency which it has to become rancid; the greater part of the oil now used is procured by pressure*. The finest oil is prepared by decorticating the seeds, reducing them to a paste, either in the mortar or by grinding in a mill, and submitting this paste to the press without heat. But the expensive and tedious nature of this process prevents it from being frequently employed; thence the seeds are ground without decortication, and pressed between hot iron plates. The oil is then clarified by rest, and filtered when cold.

In whatever manner obtained, good Castor Oil is thicker and heavier than the usual fat oils, and more transparent, of a greenish-yellow or amber colour; sometimes it is reddish, when much heat has been employed in pressing the seeds. It has no odour, and at first only a slightly mawkish, sweet taste, which is succeeded by a sensation of acrimony, *arriere gout*, as the French term it. When exposed to the air, it thickens, without losing its transparency; yet it does not congeal at many degrees below zero.

In its chemical properties, Castor Oil seems to hold an intermediate space between the volatile and the fixed oils. Like the former, it is entirely soluble in twice its weight of strong alcohol—a circumstance which affords an excellent test of its purity; for if it contain any admixture of fat oil, the solution is imperfect and milky. Indeed, Castor Oil may be procured from the bruised seeds digested in alcohol, and the spirit afterwards separated by distillation. The oil thus obtained is more active than that procured by expression; but it has this disad-

* This method of procuring the oil was first employed in the West Indies about sixty years ago.

vantage, it becomes sooner rancid. In this process the whole of the acrid matter is taken up by the alcohol; whilst only a portion of it is mixed with the bland oil when castor oil is procured by coction with water or by expression*. Sulphuric ether also dissolves Castor Oil in any proportion†. Castor oil is as unctuous as fat fixed oils, boils at a temperature under 600°, forms soap with the mineral alkalies, and attracts oxygen, and becomes more viscid when exposed to the air. Like fat oils, also, it is converted into a substance something like resin when acted on by diluted nitric acid; it forms glycerine when treated with oxide of lead, and becomes rancid by keeping. When distilled, per se, it gives over three distinct substances, besides a considerable quantity of inflammable gas, which burns with a blue flame, resembling that of carbonic-oxide gas. The first product which swims uppermost in the receiver is of a deep straw colour, has a most penetrating, pungent odour, and a hot acrid taste, evidently acid; the second resembles margaric acid, in being crystallized, melting at 134°, and again crystallizing on cooling, and dissolving in alcohol, but not in water; the third, which is heavier than the other two, is as colourless as water, acid to the taste, has an oleaginous odour, and some of the pungency of the first product: what remains in the retort is black, thick, tenacious, and evidently contains much carbon. As these products are the results of a decomposition and recombination of ultimate constituents, this method of treating Castor Oil does not throw any light on the nature of its acrid and purgative principle. When, as I have already said, it is boiled in water, it loses its activity, and may be eaten as salad oil; from which it is evident that the active principle is volatile.

The ancients employed Castor Oil chiefly as an external application; and it is still used in India in ring worm, porrigo, and many other cutaneous diseases. The active principle is not confined to the fruit; for the bark, both of the root and the stem, purges powerfully; and, when made into balls in conjunction with chillies and tobacco leaves, we are informed by Dr. Ainslie, in his work on the Materia Medica of Hindostan, it is an excellent remedy for gripes in horses.

The greater part of the Castor Oil now employed is imported from India, where it is prepared by expression without heat. It is brought over in casks and skin bottles, or *duppers*. It is paler coloured, is less nauseous, and less active than the West India oil, which is generally prepared by coction with water. Scarcely any West India oil is now brought to market;

* This property of Castor Oil to dissolve in alcohol has led to its abuse in the adulteration of essential oils, particularly oil of cloves; as it cannot be detected by dissolving the oil in alcohol.

† This solution in ether has been found to be a useful local application in rheumatic pains of the joints.

instead of which, much of the East India oil is exported to the West India islands; except to Jamaica, whence it is still an article of export. A small quantity of Castor Oil is prepared in this country; and a formula for its preparation is given in the Pharmacopœia of the London College. One pound of the entire seeds expressed, without heat, yields about f℥v of a light, citron-coloured oil; but if heat be used, the same quantity of the seeds yields f℥vii. A pound of the seeds, decorticated, yields from f℥viiss to f℥viii of colourless oil. By alcohol a larger proportion is obtained.

As a Cathartic, Castor Oil operates quickly, with little irritation, and effectually clears out the bowels. The seeds, which were more frequently employed by the ancients than the oil, are more drastic in their operation, and are, therefore, now scarcely ever employed. This difference between the seeds and the oil depends on the acrid principle being separate from the bland oil in the cotyledons of the seed, and adhering more tenaciously to the farinaceous part of the seed than the bland oil. The acrid principle is dissolved in the bland oil by the process of expression; but a large portion of it is left in the marc, which is an active Cathartic after all the oil is expressed from it. From its quick and mild operation, Castor oil is peculiarly adapted for children, puerperal women, and all cases in which the evacuation of the intestines is required with little constitutional disturbance. Experience has ascertained that it is the best purgative that can be employed in that affection of the bowels which is caused by swallowing carbonate of lead, and which is known by the names of colica pictonum, or Devonshire colic, and the dry belly-ache; and it is the more useful in that disease, as it may be joined with opium and other narcotics without having its purgative properties lessened. For the same reason, Castor Oil is advantageously given in calculous affections. It has been, also, regarded by some Continental physicians, particularly Drs. Odier and Dumont of Geneva, as peculiarly well suited for expelling the tape worm, Tenia *lata*. Exhibited per anum, in large quantity, I have found it very useful against the small thread worms, *ascarides*, which often infest the rectum. No purgative with which I am acquainted can be more relied upon for combating habitual costiveness than Castor Oil, when properly administered. For this purpose, a large dose must first be given in the morning, and the use of the oil continued daily for some weeks; gradually diminishing the dose, until half a tea-spoonful only is taken: on leaving off which, the bowels continue to be relieved without further artificial assistance. One disadvantage attending the use of Castor Oil, is its tendency to excite vomiting; but this is counteracted by combining it with some aromatic. The best modes of exhibiting it, in general, has been much canvassed: it is given floated on water, with a small por-

tion of brandy poured over it; and, when this can be swallowed at once, there is no better mode: but as this cannot always be done, it has been given in warm milk, in coffee, and in ale, according to the taste of the patient, as all these vehicles cover the flavour. Where there is much objection to the taste, it may be conveniently formed into an emulsion with mucilage of gum, or the yolk of egg, and cinnamon or peppermint water. The dose for an adult, to produce its full effect, is from f℥iv to f℥iss; but, as I have already stated, Castor Oil has such a tendency to leave the bowels relaxed, that a few drops is sometimes an adequate dose for those who have long taken the medicine. When the oil cannot be retained on the stomach, an aromatic may be added: but it has been proposed to administer an emulsion of the decorticated seeds, when these can be procured free from rancidity. The seeds are first reduced to a pulp or paste, and water gradually added as long as any milky fluid is produced. This purges briskly, without much inconvenience. Upon the whole, Castor Oil is a purgative of great value, and one which, as it is in daily use, should be well understood.

b. OLEO-RESINS.

These consist of *volatile oil* in that state of combination with resin which is found in those semifluid substances known by the names of *Balsams* and *Turpentines*. All these substances agree in certain qualities, but differ in the nature of the essential oil which they contain; thence it is requisite to take a brief review of each of them.

1. BALSAM OF GILEAD. *Amyris Gileadensis Resina.* E.—This turpentine is produced by a species of Balsamadendron, the *Gileadensis*, an evergreen, which grows in Ethiopia and Arabia, belonging to the natural order Amyrideæ*. It is procured from incisions in the trunks and branches of the tree, and also by the decoction of the young branches and the leaves in water. When obtained by incisions, this turpentine has the consistence of syrup; is whitish, opaline when recent, and becomes yellow and more consistent by age. Its odour is not unlike that of Chian turpentine; its taste is aromatic, bitter, and acrid. When procured by decoction, which is sometimes the case, it is liquid, yellowish, turbid, acquiring a considerable degree of solidity; its odour is strong and agreeable, but much less than that of the oleo-resin procured by incisions into the trunk of the tree. Vauquelin has published an account of some experiments he made on this turpentine: he found that it differed from the others, in leaving, after the action of alcohol, a small residue, which swells and becomes gelatinous in the alcohol.

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* Woodville's Med. Bot. third edition, p. 603, pl. 214. London Dispensatory, art. Amyris. Richard, Hist. Nat. Med. t. ii, p. 557.

This turpentine was greatly prized by the ancients, who gave it different names, such as opobalsamum, carpobalsamum, and xylobalsamum, according as it was procured from the trunk and branches, the fruit, or from both, by decoction. The real Mecca Balsam, or Balsam of Gilead, scarcely ever finds its way to this country, or indeed to Europe: and it is of little consequence, as, notwithstanding the eulogies of the ancients, and the blind confidence reposed in its efficacy by the modern Asiatics, it certainly possesses no advantage over the other Turpentines; and its expulsion from the Edinburgh Pharmacopœia would be creditable to the learned body under whose directions that work is compiled.

2. Balsam of Copaibæ. *Copaiba.* L. E. D.—This Oleo-Resin is obtained from boring the stem of the Copaifera *officinalis*, and some other species of the same genus of plants. Indeed, all the species, which are pretty numerous, yield Copaiba; and the greater quantity of that which is brought to this country is yielded by the Copaifera *Multijuga*, in the province of Para. M. Hayne thinks this is the species referred to by Piso and Marcgrav, who first mentioned Copaiba in 1648. The Copaiba brought to this country under the name of Brasilian, is the product of another species, the C. *Jacquinii.* The C. *officinalis* is a handsome, lofty tree, a native of South America, but particularly abounding in the Republic of Venezuela. It has been naturalized in Jamaica and some other of the West India islands. It belongs to the natural order Leguminosæ*. The trunk is bored about two feet from the ground; and this operation is generally performed about three times in the season: each time it produces about ten or twelve pounds of the Oleo-Resin or Balsam, as it is termed, or each tree affords about thirty-six pounds in the year. The juice is received into calabashes. It is, at first, very fluid and colourless, but soon thickens and assumes a straw-yellow hue. At an after period, when long exposed to the action of the air, like the essential oils, it attracts oxygen from the atmosphere, thickens, dries, and gradually changes into a solid, brittle, dry resin. As we receive it, the Balsam of Copaiba has the consistence of olive oil, is clear, transparent, of a pale straw-colour, and has a specific gravity less than water, or 0.950. It has a strong, peculiar, but not disagreeable odour; and a bitter, acrid, nauseous taste. It is soluble in alcohol, but remains for some time milky, on account of some insoluble matter which is joined with it, and which the French chemists regard as Animè: it is also soluble in ether, but is completely insoluble in water. When, however, it is distilled with water, an essential oil rises, and passes over, nearly

* Woodville's Med. Bot. third edit. p. 609, pl. 216. London Dispensatory, art. Copaifera. Richard, Hist. Nat. Med. t. ii, p. 506.

equal in quantity to one-third, sometimes to half, the balsam employed. It is a light, volatile oil, of a greenish colour and a penetrating odour: the resin which remains after the oil has passed over is transparent, of a greenish-brown colour, affording a smooth fracture, but has scarcely any odour or taste; and what there is depends on its retaining, still, a small portion of the volatile oil. The oil procured is limpid, has the taste and the smell of Copaiba, but in a more powerful degree. This oil is much less soluble in alcohol than Copaiba itself, requiring eight parts of alcohol for its solution, whilst the Copaiba requires scarcely six: in other respects it has all the properties of volatile oil. It is said to assume a blue colour when the distillation has been made on an alkali. Although the oil passes over at a heat inferior to that of boiling water, yet Schomberg, a German chemist, asserts that the Copaiba is decomposed in this process, and that both the oil and the resin are new products. This opinion, however, is erroneous; Copaiba, like all the Turpentines, is a compound of volatile oil and resin.

Copaiba is scarcely affected by hydrochloric and acetic acids. Sulphuric acid, in the proportion of one part to three parts of the Copaiba, forms with it a reddish plastic mass; and this effect affords the means of detecting its admixture with castor oil, which is merely thickened by admixture with this acid: the redder, therefore, and more plastic the compound, the more free is the Copaiba from castor oil. When mixed with a larger proportion of the sulphuric acid, Copaiba is decomposed; evolves a strong odour of sulphur; and yields artificial tannin. When four parts of nitric acid and one of Copaiba are mixed, and heat applied, the acid is decomposed, nitrous fumes are evolved, accompanied often with flame, and artificial tannin is produced. When united with the pure alkalies, saponaceous compounds are formed, which produce milky emulsions when mixed with pure water. Two parts of Balsam and one part of solution of soda, or soap-boiler's ley, form a solid soap; but it attracts moisture from the atmosphere when kept. According to the analysis of Stoltze, Copaiba contains of volatile oil, procured by distillation, 38.00 + adhesive brown resin 1.66 + brittle yellow resin 52.00 + brittle resin with traces of extractive 0.75 + volatile oil left in water and loss 7.59 in 100 parts. The action of reagents enables us to ascertain the purity of Copaiba. The simplest mode is to boil to dryness any given quantity of it in water: if it be pure, a hard, brittle resin will remain; thence the consistency of this residue determines the purity of the specimen. Another simple method is to mix two parts of Copaiba with one part of an alkaline solution, consisting of three-fourths of carbonate of potassa and one of pure potassa: if the Copaiba be pure, after some hours the mixture divides into two parts: but if it be adulterated with one-eighth of castor oil, the whole

will remain as a gelatinous mass. If four parts of Copaiba and one of carbonate of magnesia be rubbed together and left at rest, the mixture will assume an appearance not unlike solution of gum acacia, if the Copaiba be pure; but it will be opaque, if the Copaiba be adulterated with oil.

Copaiba is either a simple stimulant or a purgative, in proportion to the extent of the dose. In doses of 3i, rubbed into an emulsion with mucilage of gum, it operates kindly on the intestinal canal and affords great relief in hæmorrhoidal affections; both evacuating the contents of the rectum and allaying the irritability of the inflamed surface, by lessening the determination of blood to the part. This effect may probably be in part owing to the determination which it induces to the kidneys, therefore operating as a counter-irritant. There are various methods of administering the remedy: among others, by spreading a pound of Copaiba on a dish and sprinkling over it an ounce of calcined magnesia, then mixing it intimately, and exposing the mixture to the air for fifteen or twenty days, it acquires a consistence fit for making pills, which possess the same efficacy as the pure Copaiba. The essential oil procured by distillation has the same properties as the Copaiba; but the resin is inert. When the Copaiba or the oil is moderately overdosed, it sets up fever in the system, accompanied with headache, thirst, great heat in the bowels, and a sensation of burning in the urethra while passing the urine; and the kidneys are so much stimulated that bloody urine is secreted. But, like some other oleo-resins, these symptoms do not occur when the dose is so large as to operate at once upon the bowels. A French officer at Valladolid, in 1808, took two ounces of Copaiba for a dose; it operated as a drastic Cathartic, and cured a gonorrhœa, under which he was labouring, without causing much inconvenience*.

3. TURPENTINES.—*Terebinthina Veneta; T. Canadensis; T. Vulgaris; T. Chia.* L. E. D.—These Turpentines, and others closely resembling them, are, with the exception of the Chian Turpentine, productions of the Pinus family of plants, a genus belonging to the natural order Coniferæ.

a. Pinus *Larix*†, the Larch, which yields the Venice or Briançon Turpentine, is a native of the European Alps, and now naturalized in this country. The Turpentine is deposited near the centre of the tree in minute reservoirs.

b. Abies *Canadensis*, vel Pinus *Canadensis*, the Hemlock Spruce, which furnishes the Canada Balsam, is a native of North America.

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* Revue Medicale, tome ix, p. 10.

† Woodville's Med. Bot. third edition, p. 7, pl. 4. Richard, Hist. Nat. Med. t. i, p. 457.

c. Pinus *Sylvestris*, the Scotch Fir, which yields common Turpentine, is a native of the North of Europe*.

d. Pistacia *Terebinthus*, which secretes the Chian Turpentine, is a native of Barbary and the South of Europe†, belonging to the natural order Anacardiaceæ.

All the Turpentines yielded by these trees nearly agree in their chemical as well as in their medicinal properties. Some of them are exuded spontaneously; most of them are procured by making notches in the trunks of the trees, from which they flow; and all of them are afterwards inspissated by exposure to the air. The Chian Turpentine is the most esteemed of all the Turpentines, on account of its agreeable odour and taste which is neither bitter nor acrid. All of them are semifluid, tenacious, semitranslucent, and exhale an agreeable odour. The common Turpentines have a warm, pungent, bitterish taste; they are inflammable; soluble in fixed oils, alcohol, and ether, affording, when distilled with water, volatile oil in combination with a small proportion of succinic acid, and a brittle resin. These Turpentines are seldom given as remedies, except in the form of clysters, in which they have been found extremely serviceable in languid or torpid conditions of the intestinal canal, and in the sinking state of some febrile affections, especially erysipelas of a malignant nature. They may be exhibited in doses of from ʒi to ℥ss, rubbed up with yolk of egg, or mucilage and sugar, and water, into emulsions. If administered by the mouth, the dose should not exceed ʒss, which may be made into pills with any bland powder, such as that of liquorice root; but, when thus given, they are more likely to operate on the kidneys than upon the bowels. In some peculiar states of the habit, and some idiosyncracies, the Turpentines are apt to cause an eruption on the skin closely resembling eczema; in such cases their use should be discontinued.

c. RESIN.

When turpentine and some other similar products of plants are distilled, volatile oil passes over into the receiver, and a brittle, semitransparent, inodorous body, of a greater specific gravity than water, and insoluble in that fluid, remains in the retort. This is *Resin*.

Resin can never be completely freed from other substances so as to be insipid; but its sapidity depends on some distinct principle. Resin is soluble in alcohol, ether, the fixed oils, the volatile oils, and the alkalies. Sulphuric acid dissolves it, sulphurous acid is disengaged, and charcoal deposited: nitric acid acts upon it slowly, dissolves it, and yields a viscid matter,

* Woodville's Med. Bot. third edit. p. 1, pl. 1. London Dispensatory, art. Pinus. Richard, Hist. Nat. Med. t. i, p. 460.

† Ibid. p. 29, pl 12. London Dispensatory, art. Pistacia. Richard, Hist. Nat. Med. t. ii, p. 552.

which, when well washed, is artificial tannin: muriatic and acetic acids dissolve it without changing its properties. From these facts, it is evident that resin has much affinity to the volatile oils; and as these oils, when long exposed to the atmosphere, are converted into Resin, whilst a portion of water is also formed, it is probable that the only distinction between Resin and volatile oil is that which results from the difference in the quantity of the ultimate components. According to the analysis of Gay Lussac, Thenard, and Dr. Ure, pure Resin consists of—

	Gay Lussac, Thenard.	Ure.
Oxygen . . .	13.337	12.50
Carbon . . .	75.944	75.00
Hydrogen . . .	10.719	12.50
	100.000	100.00

From this account of Resin, it is evident that, as it is insoluble in water, it is not likely to be very soluble in the salivary, gastric, and other animal secreted juices; consequently, that it can possess little medicinal power when taken into the stomach in its pure state: but Resin, modified by other agents, becomes very active, whether the other substances be naturally combined with it, or in the laboratory of the chemist. Thus, Resin, combined with volatile oil, as a proper juice of some plants, forms turpentine. If we unite Resin artificially with an alkali, the saponaceous compound which results is stimulant, and operates upon the nerves of the intestines, increasing their peristaltic movement; while, in larger doses, it excites nausea and vomiting; thereby undeniably demonstrating its influence on the animal œconomy. The natural combination of Resin with some other substances produces purgatives; these we have now to examine.

1. JALAP, *Jalapæ Radix*, L. E. D, is the tuberous root of a plant which has always, until lately, been regarded as a species of convolvulus, receiving is specific name, *Jalapa*, for Xalapa, a city of Mexico, from the neighbourhood of which it was originally brought, in 1610. It was at one time supposed by Linnæus to be the root of the Marvel of Peru, Mirabilis *Jalapa;* and then that of Convolvulus *Panduratus* or *Mechoacan:* both opinions are erroneous. Jalap is sometimes mixed with the roots of these plants, and also with the roots of bryony, sliced; but the deception is easily detected: these roots are less compact than those of Jalap, and do not burn at the flame of a candle like the latter. The root of Jalap is tuberous, egg-shaped, and, as imported into Europe, is covered with a dark-coloured, wrinkled bark. The plant belongs to the natural order Convolvulaceæ. It is, with much probability, supposed to be an Ipomœa, and this is stated to be the fact by Dr.

John Redman Coxe*, who obtained the plant from Mexico and cultivated it†.

The roots of the Convolvulus or Ipomœa *Jalapa*, as they are found in commerce, are tubers of about two or three inches in diameter, cut longitudinally, or sometimes entire, and merely notched, seldom exceeding a few ounces in weight. Sound Jalap in this state is heavy, compact, hard, breaks with a resinous fracture, and exhibits circular resinous veins or layers. The odour is heavy, and the taste sweetish and slightly pungent. Both water and alcohol extract, separately, a part of the active principle of Jalap; but neither the alcohol nor the watery infusion act in so perfect a manner as a tincture with diluted or proof spirit, which is the proper menstruum of Jalap. When pure alcohol is employed, and the solution is boiled in animal charcoal, a Resin nearly devoid of colour is obtained. This resin is soluble in oil of turpentine, ether, acetic acid, and the fixed alkalies, as if it were simple resin; yet it contains a powerful Cathartic principle, as it purges in doses of from six to ten grains. When this resin is acted on by ether, one third only is dissolved; and this, when the ether is evaporated, is soft to the touch, leaves a greasy stain on paper, and has the consistence of a plaster; the two thirds that remain undissolved have some of the characters of resin; the portion that is dissolved in ether is the active part of the Resin of Jalap.

According to the analysis of M. Cadet de Gassicourt, 100 parts of Jalap consist of resin 10.0; starch 2.5; vegetable albumen 2.5; watery extract 44.0; salts, consisting of phosphate of lime, muriate of potassa, carbonates of potassa, of lime, and of iron, and silex 3.7; woody fibre and loss 13.3, = 100. M. Gobel found that this resin contains more oxygen than any other resin. Its constituents are—carbon 36.62 + hydrogen 9.47 + oxygen 53.91, = 100. The elder M. Henry analysed the three different kinds of Jalap found in the shops; and found that they all contained resin, fecula, extractive, and woody fibre; but varied considerably in the proportions of these ingredients. He found in 500 parts of

	Extract.	Resin.	Fecula.	Residue.
Sound Jalap . . .	140	48	102	210
Worm-eaten Jalap .	125	72	103	200
Light Jalap	75	60	95	270

Thence it appears that the larvæ, which feed on the Jalap, eat the extractive part and leave the resin, the most active

* See American Dispensatory, 8th edit. vol. v. pl. 1 and 2. London Dispensatory, art. Jalapa. Annales du Museum, Hist. Nat. t. ii, p. 120, tab. xi. Richard, Hist. Nat. Med. t. ii, p. 120.

† Dr. Coxe calls it Ipomœa *Jalapa*. I am indebted to Dr. Coxe for a living specimen, which is now (November 1832) under cultivation; and I am happy in having an opportunity of publicly acknowledging his polite attention, and returning him my thanks.

principle of the root; so that it is advantageous to select those tubers which are worm eaten. As the extractive and fecula are also slightly purgative, it has been supposed that the combination of these with the resin is essential for the due operation of Jalap; but I am of opinion that the fecula and the extractive serve only to obtund the activity of the resin. The fecula is perhaps in larger quantity than stated in M. Cadet de Gassicourt's analysis, as it is readily detected by Iodine*.

When administered in a moderate dose, Jalap is a certain purgative, operating without griping: in large doses, it gripes and produces copious watery evacuations. When overdosed, it excites inflammation of the intestines. Placed in contact with serous membranes, injected into the cavity either of the chest or the abdomen, it purges violently, excites inflammation and gangrene, and augments greatly the hepatic secretion. When united with lard, and rubbed upon the skin, it causes severe purging; but, when injected into the veins, it produces no effect. Thence we may presume that it acts on the nerves. It is generally given in combination with calomel, bitartrate of potassa, and other neutral salts: and, as its activity is greatly modified by the fineness of the powder, it is probable that its augmented activity in these combinations is partly owing to its minute division. It is rendered more active and deprived of its griping quality by combining it with camphor. The watery extract, owing to the mildness of its operation, is well adapted for children. The simple resinous extract gripes violently, and exhibits all the characters of a drastic Cathartic without purging much. Combined with the bitartrate of potassa, it operates as a hydragogue, producing thin and watery stools, whilst the deposition of fluids in the serous cavities is diminished. It is chiefly useful, as a general purgative, in febrile affections connected with an increased action of the liver and a more than natural discharge of vitiated bile into the duodenum. The powder is the best form in which it can be administered, either alone or in combination. The dose is from ten grains to half a drachm†.

2. RHUBARB. *Rhei Radix*. L. E. D.—In the British Pharmacopœias this root is said to be that of the Rheum *palmatum* and R. *undulatum*, plants belonging to the natural order Polygoniæ. But many doubts are still and properly entertained on this subject. The first, the R. *undulatum*, was supposed to be

* Mr. Hume, an intelligent chemist in Long Acre, obtained a substance from Jalap by an operose process; and, regarding it as the active principle of Jalap, he named it *Ja'apine*. Only five grains are obtained from an ounce of the root: it has neither taste nor odour; is scarcely soluble in either cold or hot water; and completely insoluble in ether. From the result of M. Pelletier's experiments with the Sulphate of Jalapine, sent to him by Mr. Hume, it cannot be regarded as the active principle of Jalap.

† Jalap was unknown to the Greeks and Arabians, and indeed to Europe also, until after the discovery of America.

the true Rhubarb; because some plants raised in Chelsea garden from seeds transmitted by Jussieu, who received them from Russia in 1702, proved to be the R. *undulatum*. This opinion, however, was dropped in favour of the R. *palmatum*, which was first raised in the Botanic Garden of Edinburgh in 1762, from seeds sent from Petersburgh by Dr. Mounsey, as those of the true Rhubarb. But the enquiries of Pallas, and other naturalists, procured no information in favour of either of these species; on the contrary, the Bucharians, who are the dealers in Rhubarb with Russia, declared that the leaves of the *palmatum* were unknown to them*. Another species of Rhubarb, brought home by Dr. Hamilton from the Himalayan mountains, and described by Mr. Don under the name Rheum *Australe*, has been confidently asserted to be the true Rhubarb plant. The best account of it is given in the Transactions of the Calcutta Medical Society, by Mr. Royle, who states that it is found in great quantities in the Choor mountains, in lat. 30°, at an elevation of about 9000 feet. He also states that a Mr. Gerard reports that the table land of Tartary is covered with Rhubarb, at the height of 16,000 feet; and that some very fine specimens of it were transmitted to a Captain Kennedy, from Ludak, in lat. 37°: but it does not appear that the Rheum *Australe* yields the true Chinese or Russian Rhubarb†. Rheum *Australe*, the R. *Enodi* of Wallich, like the other species of the genus, is an annual plant with a perennial root. It grows to the height of from six to eight feet. The whole plant is rough and beset with bristles or small points; the leaves are alternate, supported on red, deeply furrowed petioles, they are subrotundo-cordate, and of a dull green colour. The inflorescence is a loose panicle, very much resembling that of our common dock, Rumex *patientia*. There is some reason for thinking that the Rheum *compactum* yields the Rhubarb known by the name of the East Indian Rhubarb.

There are two kinds of Rhubarb known in commerce—the *Russian*, which is the best, and the *East Indian*.

Although the real species of Rheum which yields the Russian Rhubarb be still unknown, yet it is well ascertained that the root is collected in Chinese Tartary, on the hills surrounding the lake Koko Norr, and at the source of the great river Chongcho‡. The same pains is certainly not taken to select good Rhubarb at Canton as at Kiachta, the intermediate town between

* For the botanical characters of Rheum *palmatum*, see Woodville's Med. Bot. third edition, p. 662, pl. 231. London Dispensatory, art. Rheum. Richard, Hist. Nat. Med. t. i, p. 508.

† Transactions of the Medical Society of Calcutta, vol. iii, p. 440.

‡ For the mercantile history of Rhubarb, and the method of drying it, see London Dispensatory, art. Rheum.

the Russian and the Chinese territories, where the Bucharians carry on their traffic with the Russians in Rhubarb*.

Good Rhubarb, of the variety named *Russian*, is in flatish, irregular, angular pieces, frequently pierced with a hole large enough to admit the finger of an adult. Exteriorly, it is of a lively yellow colour; interiorly, it is mottled with red, yellow, and white, very irregularly, but sometimes as if radiated. It is somewhat spongy, thence not easily cut; its odour is aromatic; its taste slightly astringent, bitter, and peculiar; it feels gritty between the teeth; and, when chewed, tinges the saliva yellow. It is easily pulverized, and affords a powder of a bright buff-yellow colour.

Chinese and East Indian Rhubarb, as it is termed, is in cylindrical, compact pieces; sometimes, but rarely, pierced with small holes, merely sufficient to pass a cord through for suspending it during its desiccation. Its colour on the exterior is of a duller yellow than that of the Russian variety, and the marbling in the interior is more of a brick red. In taste and odour it resembles the Russian Rhubarb; but it is stronger. It colours the saliva with an orange-yellow tinge, crashes more under the teeth than the Russian variety, is also heavier, and the powder is of a colour between a fawn and an orange-yellow.

These two kinds of Rhubarb differ in their chemical properties. Water, at 212°, takes up 24 parts in 60 of Russian, and 30 in 60 parts of East Indian Rhubarb. The infusion of the Russian is of a deeper colour and less turbid than that of the East Indian: both redden tincture of litmus, owing evidently to free malic or free oxalic acid. The latter is copiously precipitated on the addition of lime water to the infusion, and exists in the state of a binoxalate of lime†. With the infusion of Russian Rhubarb, persulphate of iron strikes a dark olive colour; with that of East Indian Rhubarb a more decided green: in the former, the precipitate is slowly formed; in the latter, the precipitate is copious and sudden: solution of gelatine precipitates both, but the precipitates are of different colours. From these effects, and those of other reagents, there is sufficient reason for concluding that these two kinds of Rhubarb are different, although this difference may arise from soil and climate, as well as from the roots belonging to distinct species of Rheum.

* Experiments have been made in Europe, particularly in France, to naturalize and cultivate Rhubarb; but every effort has hitherto failed:—a failure which cannot be certainly ascribed to the species being different from the Mongolian Rhubarb, but may depend either upon this circumstance, or upon our ignorance of the method of drying and curing the roots.

† Binoxalate of potassa is found in large quantity in the stems and leaves of the Rheum *palmatum*, and the recent root of that plant. The acid in this salt was mistaken for a new acid by Mr. Henderson, who named it *Rheumic acid*; but M. Lassaigne has proved its identity with oxalic acid.

Many distinguished chemists have, at different periods, endeavoured to ascertain what is the active principle of Rhubarb. Scheele, and Model of Petersburgh, failed in their attempts, but ascertained that the cause of the grittiness of Rhubarb, when chewed, depends on oxalate of lime, a substance which I found in large quantity in my analysis of both kinds; and which has been found by every one who has examined the components of Rhubarb, with the exception of Mr. Brande, who mentions neither oxalate nor oxalic acid in his analysis*. M. Henry found in both Rhubarbs—1. a yellow colouring principle; 2. a bland oil; 3. amylaceous fecula; 4. gum; 5. tannin; 6. oxalate of lime, in quantity one-third the weight of the Rhubarb; 7. supermalate and sulphate of lime, and salts of iron and potassa†. Other principles were found by Pfaff, M. Peretti, and M. Bressy; but in none of these analyses was any thing discovered which could be regarded as its purgative principle. Pfaff, by acting with water upon the root of Rheum *palmatum*, obtained a deep-brown substance, brilliant, opaque, and bitter, which displayed no acid reaction. He called it Rhabarbarine‡. Caventou obtained from the alcoholic extract a yellow crystallizable substance, insoluble in cold water, soluble in hot water, in alcohol, and ether, having the odour of Rhubarb, and a sharp, bitter taste; but even this is not the purgative principle of the drug. Another principle has been obtained by treating one part of Rhubarb with eight parts of nitric acid in a gentle heat, until it acquire the consistence of syrup; then straining and diluting with water, a precipitate falls, which is inodorous, bitter, orange-coloured, and soluble in alcohol and ether, and has been named *Rheine;* but this is not the purgative principle. It is evident, from all the analyses, that Rhubarb contains resin, rhabarbarine, extractive, sugar, gum, tannin, gallic acid, bimalate and binoxalate of lime. I am disposed to think that the purgative principle is combined intimately with the resin, as the alcoholic tincture takes up every thing active, whilst the marc that remains is altogether inert.

From the fact of Rhubarb acting on the bowels when applied to the skin, without appearing in the urine, it is evident that its operation is wholly on the nerves; and it is probable that the colouring matter only passes through the kidneys and is detected in the urine when the drug is taken into the stomach—an excellent illustration of the fact, that substances which are partially digested, and the components of which are partly carried into the circulation, may still owe their activity as remedial agents solely to their operation on the nervous energy. When Rhu-

* Thomson's Ann. of Philosophy, vol. xvii, p. 469.

† Bulletin de Pharm. tome vi, p. 87.

‡ Syst. der Mat. Med. Bot. iii, p. 30.

barb is taken into the stomach, its colouring matter can be detected a few hours afterwards in the urine, the perspiration, and, if the person be a nurse, in the milk, to which it imparts colour and some degree of bitterness.

Rhubarb, as a therapeutical agent, is administered in the form of powder, infusion, and tincture. On the Continent, an alcoholic extract and a syrup are also employed. The dose of the powder should be from ʒss to ʒi: that of the infusion, made with ʒiii of the bruised root and fʒviii of water, from fʒi to fʒii*. The tincture can scarcely be given in doses sufficiently large to prove purgative. Rhubarb in any form is a gentle purgative: its operation, however, is accompanied with gripings, although it rarely produces much excitement. In moderate doses, especially when administered in the form of powder, the influence of the tannin which it contains counteracts its purgative properties, and renders it astringent: thence, in a weakened state of the digestive organs, Rhubarb increases the appetite and affords tone to the stomach, even when the dose is sufficient to purge. It has been extolled as a vermifuge; but it is not sufficiently active to clear the intestinal canal from worms; and, therefore, requires to be combined with more efficient purgatives for that purpose. From the mildness of its cathartic powers, it is well adapted for the diseases of infancy.

Rhubarb may be advantageously combined with calomel, jalap, scammony, and sulphate of potassa. It moderates their activity, and counteracts their tendency to lower the tone of the alimentary canal. Magnesia tends to obviate the griping property of Rhubarb; and, as most of the diseases of infants, in which purging is indicated, are accompanied with an acescent state of the stomach, it is an ordinary addition to Rhubarb in these cases. In some idiosyncracies it has caused epilepsy; and, consequently, when that occurs during its use, it should be discontinued.

1. Dock Root. *Radix Rumicis.*—This is the root of Rumex *Aquaticus*, the great water dock†, a plant belonging to the same natural order as the genus Rheum; but the root of Rumex *obtusifolius*, Broad-leaved Dock, possesses the same properties. They are both indigenous plants. The *Aquaticus* is supposed to be the Herba Britannica of the ancients, a plant noticed by Dioscorides as a specific in cutaneous diseases‡.

In an analysis of the root of Rumex *acutus*, M. Deyeux found sulphur, fecula, binoxalate of lime, and vegetable albu-

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* The officinal infusion of the London Pharmacopœia acts as a tonic in these doses; that of the Edinburgh as a purgative.

† Woodville's Med. Bot. third edit. p. 658, pl. 229. Richard, Hist. Nat. Med. t. i, p. 503.

‡ Muntingin's Diss. Hist. Med. de Vera Herba Britannica.

men; and, as its properties closely resemble those of the roots of the above-mentioned species, it is likely that they contain the same principles.

Like rhubarb, Dock Roots are astringent or purgative, according to the extent of the dose; their colouring principle is taken into the circulation and excreted by the kidneys and the skin. In doses of f ʒii of a decoction, made with ʒi of the dried root, bruised, and one pint of water, it purges freely, causing bilious evacuations from its action on the orifices of the gall duct in passing through the duodenum. It is prescribed with advantage in jaundice; but it is chiefly salutary in cutaneous affections, especially ichthyosis, in which it operates almost as a specific.

d. RESINO-EXTRACTIVE.

The chemical characters of Extractive have been already noticed. In the present instance, it is combined with Resin, and forms the chief component of a very excellent class of purgatives, the Aloetic.

The genus Aloë is an extensive one, and all the species yield a proper juice, which is more or less purgative: it belongs to the natural order Asphodeleæ. The genius consists of succulent plants, with thick, firm leaves, which exhale little, but absorb powerfully by the surface*; and this function is one of great importance, as the whole family consists of plants which, growing on dry, arid soils, and in tropical climates, can imbibe little nutriment by their roots, which serve rather as props to maintain them in the erect posture than as nutritious organs.

The secreted juice of the medicinal Aloë exudes naturally from cracks in the leaves of the plants; and, concreting upon the leaves in the form of small, transparent granular tears of an obscure reddish-brown colour, they are, in this state, called *lucid aloës*. But this form of Aloës is very rare, and found only in the cabinets of natural history. There are three kinds of Aloës known in commerce: the *Soccotrine*, the *Hepatic*, and the *Caballine*.

1. SOCCOTRINE ALOES. *Aloë Soccatrina*. E. D. *Aloës Spicatæ Extractum*. L.—Soccotrine Aloës†, as its name imports, was originally obtained from the island of Zocotora, which was discovered by the Portuguese in 1503, situated in the mouth of the Red Sea, in the Arabian province of Hadramant, contiguous to Yemen; but the greater part of the best Soccotrine

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* When the leaf of an Aloë is separated from the plant and left on the ground, many weeks pass before it is shrivelled; but if it be then thrown into water, it acquires its original plumpness in a few hours.

† Woodville's Med. Bot. third edition, p. 767, pl. 260. London Dispensatory, art. Aloës.

Aloës now comes from the kingdom of Melinda and the Cape of Good Hope. The plant which yields the Aloës at the Cape is the Aloë *spicata*, which rises with a thick round stem about four feet in height. The leaves are stiff, spreading, thick, and broad at the base, gradually tapering to a point, channelled, acute, toothed, and about two feet in length. In the island of Zocotora, in Melinda, and at the Cape of Good Hope, the leaves of the plant, which are fleshy and succulent, are cut close to the stem and the juice allowed to run out. After remaining at rest, until the feculent matter subsides, this juice is poured into flat dishes and evaporated in the sun. At the Cape, the juice is inspissated by heat. These Aloës are imported in chests and casks, and sometimes in skins.

The real Soccotrine Aloës are in pieces of a dark reddish-brown colour, and glossy as if varnished, with the thin edges and small fractured pieces reddish and semitransparent. These Aloës have a peculiar aromatic odour, not unlike that of the russet apple in a state of decay, and a permanent bitter taste. They soften in the hand, and are adhesive; yet they are easily powdered, except in very warm weather. The powder has a golden yellow colour. The Cape Aloës are of a more yellow hue on the outside, less glossy, and are softer and more pliable than the real Soccotrine. The colour of the powder more resembles that of camboge than that of the true Soccotrine Aloës. If a fragment be applied to the flame of a candle, it melts, swells, and inflames.

Soccotrine Aloës are dissolved by cold water when triturated in a mortar with successive portions of the fluid, and the solution becomes frothy on being agitated. When the solution is left at rest, a deposite takes place. They are entirely soluble in boiling water; but, on cooling, a resinous matter falls, which dissolves in alcohol without leaving any residue. The portion dissolved in water contains more of the bitter principle than that dissolved in alcohol. Tromsdorff analysed Soccotrine Aloës, and obtained 75 parts of bitter, saponaceous principle, soluble in water and alcohol, but insoluble in ether; 25 parts of resin, and a trace of gallic acid, in 100 parts*. Braconot, also, analysed this kind of Aloës. He found that the aqueous solution reddens the tincture of litmus; that the alkalies and lime water deepen the colour, but cause no precipitation; the persulphate of iron produces a brown precipitate; the decoction of galls a yellow flocculent one, with a supernatant fluid which is less coloured than the solution, and loses some of its bitterness. He also found that the subacetate of lead, in causing a precipitation, throws down also a large proportion of the colouring matter. When the aqueous solution is evaporated to dryness,

* Bulletin de Pharmacie, t. i.

the extract is soluble in alcohol and not in ether. From these facts, Braconot concluded that Aloës contain no *resin*. The free acid is evidently the gallic, and the precipitate by the subacetate of lead is gum. He also found that Soccotrine Aloës are entirely soluble in alcohol; nevertheless, he too hastily concludes that they contain neither gum nor extractive. The fixed alkalies form saponaceous solutions with Aloës, which are precipitated by the mineral acids. Upon the whole, Braconot concludes that Aloës is a principle sui generis, to which he proposed to give the name Resino-bitter. Bouillon la Grange and Vogel, however, also analysed Soccotrine Aloës, and found that, besides sixty-eight parts of a soapy extractive, they contain thirty-two of pure resin, which dissolves perfectly in alcohol, and remains long unacted upon by water, but at length communicates both colour and taste to the fluid. These chemists found also that the Soccotrine Aloës are resinified in chlorine. Both Guyton Morveau and Fabroni obtained colouring matters, all adapted for dying silk, from the recent juice of the Soccotrine Aloë.

By digesting eight parts of nitric acid on one part of Aloës, until reaction ceases, and diluting the residue with water, a reddish-yellow precipitate is formed, which becomes pulverulent when washed and dried, and assumes a beautiful golden-yellow colour. This is the bitter principle of Aloës; and, according to the experiments of M. Liebeg, it consists of a peculiar substance approaching in its character to resin, and of an acid which, from its being a compound of carbon, azote, and oxygen, is termed carbazotic. The washing of this principle, when evaporated, yields yellow, rhomboidal, opaque crystals, scarcely soluble in water, which are a compound of this bitter principle and oxalic acid; most probably the result of the action of the nitric acid on the extractive of the Aloës. The bitter principle of Aloës requires 100 parts of cold water for its solution. It is more soluble in hot water. With both it forms a beautiful rose-purple solution, which, when boiled with silk, communicates to it a permanent colour, that neither soap nor any other substance affects, except nitric acid, which changes it to yellow; but it again assumes its proper colour when washed with water. By the aid of mordants, it dyes flannel of a beautiful black, which is not altered by light. With potassa this bitter principle forms a purple salt, which precipitates the salts of baryta, those of lead, and the peroxide of iron, of a deep purple hue, and the protonitrate of mercury of a deep red. Whether this bitter principle is the cathartic principle of the Aloës, requires yet to be determined. I took one grain of it at bed time, and was freely moved next morning; but, as I was anticipating such an effect, I do not consider that much dependence can be placed upon this trial. When the Soccotrine

Aloës are distilled, a volatile oil is obtained, which is not procured from the Barbadoes Aloës: it is this oil that gives the peculiar odour to the Soccotrine Aloës.

2. *Barbadoes Aloës*, *Aloë Hepatica*, E. D.—is the production of the Aloë *vulgaris*, the Aloë of Dioscorides and the Greek physicians*; a native of the island of Cyprus and other parts of the Levant, the coast of Barbary, and the island of Barbadoes. For the preparation of the Barbadoes Aloës, the leaves of the plants, which are more succulent than those of the spiked Aloë, are cut close off at the stem and disposed in tubs to permit the juice to run out; after which it is boiled until it acquire the consistence of honey, when it is run into calabashes, that is, empty gourd shells, each of which contain from sixty to seventy pounds weight. They have an odour which is thought to resemble that of the human axilla; the taste is more nauseous and intensely bitter than that of the Soccotrine Aloës; the fracture less smooth, but more splintery; the surface of the pieces of a duller brown colour and less glossy. The colour of the powder is a dull olive-yellow. They do not dissolve so completely in boiling water and in alcohol as the Soccotrine; and by this means the substitution of the one for the other is readily detected. M. Tromsdorff found that 13 parts in 16 are taken up by water; that the solution displays acid properties, and precipitates salts of iron. The residue left by the aqueous solution is only partially acted on by alcohol, which dissolves one third, leaving two thirds, which are coagulated vegetable albumen: but, with the exception of this albumen, they are completely soluble in alcohol: thence Tromsdorff concludes that the chief distinction between this kind of Aloës and the Soccotrine is the presence of vegetable albumen; and this partial solubility in alcohol readily distinguishes Barbadoes from *Soccotrine* Aloës.

Tromsdorff concludes, from all his experiments, that Soccotrine Aloës consist of

a saponaceous bitter principle . .	75
Resin	25
Traces of gallic acid	00
	100

That Barbadoes Aloës consist of

a saponaceous bitter principle .	81.25
Resin	6·25
Albumen	12.50
Traces of gallic acid	00.00
	100.00

* Woodville's Med. Bot. third edit. vol. v, p. 98. Richard, Hist. Nat. Med. t. i, p. 391.

3. *Fœtid, or Caballine Aloës.*—I am ignorant of any plant which only yields this variety of Aloës. It is easily distinguished from the two former varieties by its rank fœtid odour. It resembles common resin in its fracture. It is only used in veterinary medicine: and is supposed to be the refuse of the process for making Hepatic Aloës.

Aloës is a warm, stimulating purgative, which exerts very little, if any, action on the duodenum and small intestines, but affects the colon and especially the rectum, evacuating the latter fully, yet without causing watery stools. This peculiarity in the operation of Aloës has been referred to its little solubility in the fluids of the intestinal canal, permitting it to pass nearly through the whole length of the canal before it is sufficiently dissolved to exert its stimulant effect. But those who reason in this manner have forgotten that Aloës, when applied to an ulcer on the neck, acts on the rectum. In whatever manner the effect is to be explained, this fact is undoubted. All the kinds of Aloës exert the same medicinal influence. The ancients employed the Barbadoes Aloës, and used it both internally and externally. As an internal medicine, they regarded it less hurtful than any other purgative, "ideoque," says Celsus, "omnibus Catharticus Aloë miscenda est." They applied it to ulcers and wounds, combined with other medicines; and as a lotion in some species of ophthalmia, a practice which is at this day followed by the Tamool physicians, in India, who also use it, toasted, in some bowel complaints of puerperal women. When Aloës are administered in moderate doses, the functions of the digestive organs are improved; but when these are labouring under excitement, when the tongue is dry, and there is thirst, heat, and pain in the abdomen, then their employment should be intermitted. They are said to act equally well in small and in large doses; but this assertion does not accord with my experience. The usual dose of Aloës is from five to ten grains; a dose which does not require to be increased, even under the daily custom of taking the medicine to relieve habitual costiveness. In such cases, and in the costiveness of dyspeptics, particularly those of sedentary and hypochondriacal habits, the intestines require a stimulus, being generally in a sluggish and insensible state; consequently Aloës is a very useful evacuant, as it is a warm and stimulant medicine, and does not produce flatulence. It has been thought peculiarly well adapted for cases of jaundice, on the supposition that it may supply, to a certain extent, the bitter of the bile which is deficient. It is certainly useful in obstructions of the biliary duct; but in such cases it requires the combination of alkalies, and of calomel or the blue pill, to stimulate the orifices of that duct, which is little affected by the Aloës alone in its passage through the duodenum.

Dr. Cullen*, nevertheless, asserts that nothing is gained by combining Aloës with other substances; but this opinion is at variance with the results of experience: no medicine is more modified by combination than Aloës. When combined with soap or an alkaline salt, it operates more quickly, and with less violence and considerably less irritation on the rectum, than when uncombined. Its action is also modified when it is combined with scammony, colocynth, aromatics, salts of iron, myrrh, and fœtid gum-resins. One of the best forms of combination, when it is desirable to improve the power of the digestive organs, and at the same time open the bowels, is the following:

℞ Myrrhæ ʒvi
Sodæ Subcarbonatis ʒiii
Ammoniæ ʒivss
Aloës extracti ʒvi
Vini albi (Anglice, Sherry) fʒxxiv,
Macera per dies septem et cola.

Two table-spoonfuls may be taken, twice a day, in a fluid ounce of a solution of extract of liquorice.

From the peculiar action of Aloës on the rectum, they are supposed to be contraindicated in hæmorrhoids and in pregnancy. In the former, if the dose be small, I have never seen any increase of the pain or irritation excited; and many of the numerous nostrums, under the name of dinner pills, into which Aloës enters, are daily taken with impunity by those liable to piles. It is not necessary, however, to order Aloës to patients labouring under hæmorrhoids, in the face of a prevailing opinion; but, when other circumstances indicate their use, we need not be prevented from ordering them. In the same manner Aloetics are generally condemned in pregnancy; but Dr. Denman has remarked that "they are in common use among the lower classes of persons, because they are cheap and conveniently given in the form of pills;" and no bad effects are observed to follow their use. Aloës, however, ought not to be administered during the menstrual discharge; nor in those cases in which there is much uterine irritation and a tendency to larger and more frequent discharges from the uterus than is natural.

Aloës enters into various officinal preparations; and, in almost every form they constitute a valuable purgative. Should the bitter principle be found to act with certainty and in much smaller doses than crude Aloës, the preparation of it would be so far valuable that it might be obtained from the worst species of Aloës as well as the best; and, therefore, in equalizing their operation, it would prevent those inconveniences which sometimes arise from employing the more irritating kinds of this drug.

* Materia Medica.

It is usually stated, that, owing to their bitter, nauseous taste, pill is the best form of exhibiting Aloës; but I know of no medicine that is so soon reconciled to the palate, even of children, as the preparation with the alkalies and the wine which I have described, when it is given in a solution of the extract of liquorice. The dose is from six to sixteen grains; but, if taken daily, it should not exceed six grains: in larger doses, if the use of the medicine be continued for some days, it is apt to induce tenesmus.

e. CATHARTINE.

This principle was discovered by MM. Lassaigne and Feneulle in senna*, in which it is combined with extractive and other vegetable constituents. It is crystallizable, of a reddish-yellow colour, has a peculiar odour and a bitter nauseous taste. It is soluble in water in every proportion, attracting moisture from the atmosphere: it is insoluble in ether. Heat decomposes and resolves it into carbonic acid, acetic acid, hydrogen gas, empyreumatic oil, and charcoal. The solution of Cathartine is precipitated by infusion of galls in yellow floculi; the subacetate of lead also precipitates it; but the acetate does not affect it. The alkalies and the persulphate of iron deepen the colour of the solution, but do not throw down precipitates in it.

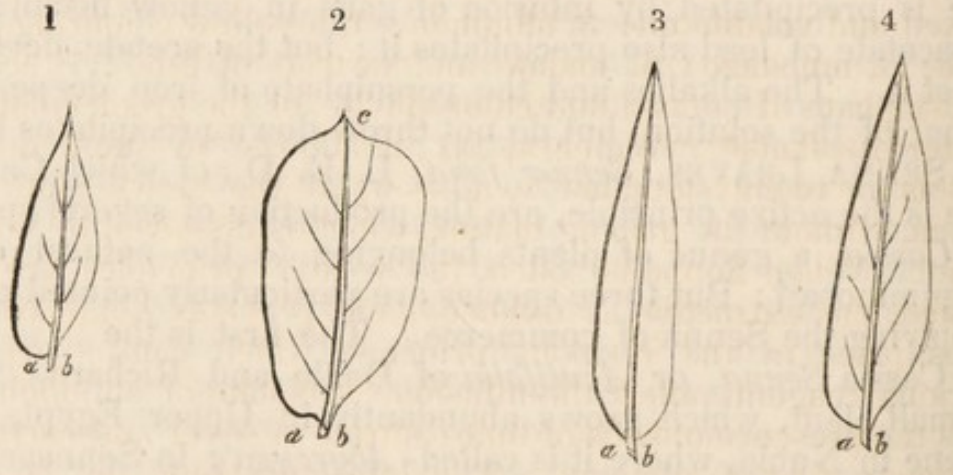
Senna Leaves, *Sennæ folia*, L. E. D., of which Cathartine is the active principle, are the production of several species of *Cassia*, a genus of plants belonging to the natural order Leguminosæ†: But three species are particularly pointed out as supplying the Senna of commerce. The first is the

Cassia *Senna*, or *Acutifolia* of Delile and Richard. It is a small plant, which grows abundantly in Upper Egypt, near Syene in Nubia, where it is called *Abyreyga;* in Sennaar, and at Bornou in Central Africa. Its leaves are alternate, accompanied with two awl-shaped stipulæ at their base, and consist of from four to eight pair of opposite, oblong, acute, entire nearly sessile leaflets: the flowers are yellow, in axillary, pedunculated spikes; and the fruit an elliptical, obtuse, not curved legume, containing many heart-shaped seeds. The leaflets are the true Alexandrian Senna. The Alexandrian Senna, however, as we receive it, is a mixture of the leaflets of this plant, the footstalks of the leaves, and the pods; with an admixture of leaflets with which the Senna is adulterated at Alexandria; namely, those of the Cassia *obovata*, those of the Cynanchum *oleæfolium*, and occasionally those of the Colutea *arborescens*, or Bladder

* Ann. de Chimie et de Phys. t. xvi.

† Woodville's Med. Bot. 3rd edition, p. 442, pl. 159. London Dispensatory, art. Senna. Richard, Hist. Nat. Med. t. ii, p. 518.

Senna. M. Bouver and Dr. Callodon inform us that Alexandrian Senna is compounded at Boulac of the following leaflets: five parts of Cassia *acutifolia;* three parts of Cassia *obovata;* and two parts of the leaves of Cynanchum *oleæfolium*, or Arguel, a plant belonging to the Apocyneæ. The leaflet of the true Senna (see fig. 1) seldom exceeds nine lines in length, is oblique at the base, and unequal on each side of the midrib, *a*, *b*, pointed and veined on the under side. The leaflets of the Cassia *obovata* (fig. 2) are, as the name of the plant implies, obovate, obtuse, with a minute point, *c*, which is the prolongation of the mid rib; unequal, and somewhat cuneiform at the base, *a*, *b*, and slightly pubescent. The leaves of the Cynanchum (fig. 3), or Arguel are an inch, or fourteen lines in length, pointed, equal at the base, but with one side, *b*, straighter than the other, *a*, and without any lateral nerves on the under disk. The Senna known by the name of *Tripoli Senna*, consists also of the Nubian Senna, the Cassia *acutifolia;* the leaflets are smaller than those in the Alexandrian Senna, and more broken; but they are free from any admixture either of pods or the leaves of the obovate Senna, or those of Arguel.



The C. *obovata* is a smaller plant than the C. *acutifolia:* it is a native of Syria, Egypt, and Senegal. I have already described the form of the leaflet: the pod is curved. It constitutes the Senna known by the name of Aleppo Senna, which is rarely brought to this country, unless in mixture, as I have already stated, with Alexandrian Senna.

The third species of Senna, the Cassia *lanceolata* of Forskahl, is known in this country by the name of *East Indian Senna*, although it is not a production of India, but grows at Abuarish, in Arabia Felix, and is exported from Mocha. Its leaflet (fig. 4) is upwards of an inch in length, and unequal at the base, *a*, *b*. It is known in the Indian bazaars by the name of Sena Mekki. The same species of Senna is cultivated in considerable quantity at Tinnivelly, on the Malabar coast: it is imported in large quantity into this country under the name of Tinnivelly or East Indian Senna, and fetches a high price in the

London market. It is milder in its operation than the Alexandrian drug; is as certain a purgative, and operates without griping. It has not, however, been adopted into general use in Great Britain. Cassia *Marilandica*, a plant found over all the United States, seems to be a variety of the C. *lanceolata*. It differs from the C. *acutifolia* and the C. *obovata*, in having glands at the base of the petioles of the leaflets, and by the smoothness and length of the leaflets, which are nearly two inches long, straight, and almost subulate.

Senna is collected twice a year, in the vale of Bicharie, near Syène. The plants are cut down and dried in the sun; the leaflets are then separated, packed in bales of date leaves, and sent to Boulac, where the admixture which I have described takes place. The quantity of Senna sent to Boulac is about two millions of pounds, and nearly double that quantity is imported into Europe.

Senna leaves, as the leaflets are termed, have a faint, sickly, disagreeable odour, and a slightly bitter, aromatic, sweetish taste, very nauseous to the palate of most people. Besides Cathartine and Extractive, analysis has discovered in them—1, a fat oil; 2, a fixed and volatile oil; 3, albumen; 4, a yellow colouring principle; 5, mucilage; 6, malate and tartrate of lime; 7, acetate and sulphate of potassa and chlorophylle, or the green colouring matter of plants*. Water at 96°, if allowed to stand on the leaflets for twenty-four hours, takes up all the active matter of Senna, without the griping matter, which is dissolved in boiling water. When Senna is boiled, the volatile principles are dissipated, the extractive is oxidized, and probably some change takes place in the resinous principle which causes griping. Various reagents affect the infusion. Oxalate of ammonia detects the presence of salts of lime; nitrate of silver and corrosive sublimate, that of albumen. The infusion should not be kept ready made, as the extractive becomes oxidized and the cathartine decomposed, and the medicine is thus rendered inert as a purgative, but gripes violently. When the infusion is shaken in chlorine gas, the extractive combines with the chlorine, forming a compound, which is insoluble in water, but soluble in alcohol, the mineral alkalies, and in ether, thereby indicating its approximation to resin. If the infusion with hot water have a pale yellow colour and an astringent taste; if gelatine throw down a white precipitate; and the precipitate by corrosive sublimate and emetic tartar be great; if sulphate of iron produce a blue precipitate; and nitrate of silver a black; whilst, at the same time, the nitro-muriate of gold produces an instantaneous black; or caustic potassa a gelatinous precipitate; M. Guibourt has ascertained

* Journ. de Pharm. t. vii, p. 548.

that these appearances indicate an adulteration with the leaves of the Coriaria *myrtifolia*, a poisonous shrub.

Senna is a useful and very general purgative, there being scarcely any disease in which it cannot be administered. Infusion is the best form of administering the medicine; but it should be made with tepid water. The nauseous taste, so disagreeable to many, is said, by Dr. Paris*, to be covered by infusion of Bohea tea; milk and sugar being added in the same proportions as in common tea. The purgative property of the infusion is increased by the addition of camphor mixture, or the decoction of guaiacum. The infusion is seldom given alone; but the incompatibles should be well known to the prescriber, as some of them are in common use—such, for example, as magnesia, rhubarb, and the carbonates of the alkalies, which destroy its properties. The griping quality of the drug renders an aromatic necessary, when the nature of the disease does not forbid its use. The dose of the infusion is from f℥iss to f℥ii. The tincture is, also, a good form of preparation of Senna to combine with the infusion; but the raisins ordered in the London formula are useless, and have been judiciously left out in the Dublin Pharmacopœia. The confections or electuaries into which Senna enters are so compounded of other purgative substances, that it is difficult to say what part the Senna acts in these preparations. The syrup is a bad form for Senna, but the powder is worse, although it continues to hold a place in the Pharmacopœia of the London College.

** INORGANIC SUBSTANCES OPERATING AS PURGATIVES.

a. METALLIC OXIDES.

The only Metallic Oxides which are employed as purgatives are the protoxide of mercury, and a combination of mercury and oxygen which approaches to the state of the protoxide, the Hydrargyrum cum Magnesia of the British Colleges. I am aware that the nature of the latter is regarded as problematical; but my reasons for considering the mercury in it a protoxide remain unaltered.

1. THE MERCURIAL, OR BLUE PILL. *Pilula Hydrargyri.* L. E. D.—In this pill the oxide of mercury is combined with vegetable matter. It purges in some cases in any dose; but in such instances its activity depends either on some peculiarity of habit or idiosyncracy; or on an acescent state of the stomach, in which the muriatic acid of the gastric fluid probably gives the pill activity. It is seldom trusted to as a purgative: it is given in moderate doses at bed-time, and carried off by a purgative in the morning, according to the plan pursued by Mr.

* Pharmacologia.

Abernethy. It is most useful in diseases connected with a diminished secretion of bile.

2. MERCURY WITH MAGNESIA. *Hydrargyrum c. Magnesia.* L. E. D.—In this preparation the Mercury is also oxidized. It is very mild in its operation, and is seldom employed except in cases where an alterative is required; or as a purgative for children, in whom there is much acidity of stomach, and at the same time some glandular obstruction. In such cases it is a useful purgative.

b. CHLORIDES.

These are combinations of chlorine and metallic bases.

1. CHLORIDE OF SODIUM. *Sodii Chloridum. Sodæ Murias.* L. E. D.—The nature of this salt has been already examined under the head of Tonics; but as it operates also as a purgative, particularly as it exists in sea water, it is again necessary to direct attention to it. Sea water has been examined by different chemists, and although its constituents are found to be the same wherever it is taken up, yet the quantities of these differ greatly according to the part of the ocean, its distance from land, and the depth at which it is procured. It was also demonstrated, by Dr. John Murray, that the salts obtained from sea water differ according to the mode in which the water is analysed. Its specific gravity is 1.0269 to 1.0285; and it requires a temperature nearly four degrees under the freezing point, or 28.5° Faht. to freeze it. The average quantity of saline matter in it is three per cent., which consists of Chloride of Sodium, sulphate of magnesia, sulphate of soda, muriates of magnesia and of lime; and hydriodic and hydrobromic salts in minute quantities. The active purgative principle is undoubtedly the common salt, or Chloride of Sodium: or rather muriate of soda, which it becomes in solution. Sea water has a bitter, saline taste. When taken into the stomach in doses of half a pint, repeated twice or three times at the interval of half an hour, it operates as a mild but very effectual purgative; and from its continued use in this quantity, for some weeks successively, very beneficial effects have been produced, with less reduction of strength than follows the continued use of any other purgative. It has been successfully employed as a vermifuge, particularly when the worms are the ascarides, or thread worms; and in this case it has the advantage of giving tone to the system, whilst it clears the canal of the worms already existing in it. Sea water has been frequently taken, with advantage, in habitual costiveness, particularly in those of full habits who lead a sedentary life. In this instance its stimulant properties are as useful as its purgative qualities. When it is to be given to children, they are easily persuaded to take the dose if its nauseous taste be covered with a little port wine. It is a cu-

rious fact, that by the continued employment of sea water as a purgative, although for a short time it produces emaciation, yet its secondary effect is to promote obesity, which must be attributed to its stimulant properties, acting on the glandular system, and thus increasing the powers both of the digestive and the assimilating functions. Although the Chloride of Sodium is undoubtedly the most active ingredient of sea water, yet it is true that the solution of this salt does not possess the same purgative qualities as sea water, nor can any artificial admixture of its components, in the average proportions in which they have been found by the best chemists, produce a compound of powers equivalent to those of natural sea water. It is not easy to account for this fact; but it has prevented the employment of artificial sea water, even to the extent that artificial mineral waters have been used. In cases of ascarides, sea water is most efficacious when exhibited in the form of enema.

Although sea water cannot be regarded as a purgative of much power, yet in some constitutions it operates when no other Cathartic will take effect. This is to be attributed to idiosyncracy; but it is a fact, the knowledge of which is of great practical importance. When sea water fails to purge, which it does in some habits, it produces fever of a low kind, accompanied with purple spots on the skin: this, however, cannot be attributed to the Chloride of Sodium alone; since, as I have already stated, sulphate of soda, muriate of magnesia, and muriate of lime, all of which are purgative, are also components of sea water.

2. Protochloride of Mercury. *Hydrargyri Submurias. Calomel.* L. E. D.—When intended to operate as a purgative, Calomel should be given in much larger doses than are usually prescribed; since, in such doses only, it allays the irritability of both the stomach and the bowels. Mr. Annesley, in his work on the Diseases in India, remarks that Calomel in large doses combines with and renders fluid, and detaches the viscid, mucous secretions adhering to the alimentary canal; it diminishes the vascular state of the stomach when this is in excess; and increases the vascular and capillary circulation in the mucous coat of the large intestines. The operation of Calomel, however, as a purgative is very uncertain; and it should be followed by a brisk purgative to prevent its action on the glandular system. It may be regarded as operating beneficially when the secretions are improved, without any effect being induced on the salivary glands. Experience informs us that, during the administration of Calomel, the appearance of the evacuations is rarely natural, being either greenish or slimy, and inodorous or fœtid: in more than one instance, I have seen them clay-coloured. During a course of Calomel, therefore, as a purgative, the medicine should be frequently intermitted for a

few days, to ascertain the real state of the contents of the intestines when the stimulant is withdrawn. Like every other active remedy, it proves useful or otherwise, according to the manner of prescribing it and the condition of the habit of the patient at the time.

c. SALTS.

1. SULPHATE OF MAGNESIA. *Magnesiæ Sulphas.* L. E. D.—Sulphate of Magnesia is found ready formed in many mineral waters, and was first prepared by the evaporation of those of Epsom. A large proportion of what is now used is manufactured from the bittern, the mother ley remaining after the crystallization of sea-salt; the quantity contained in the ley is about one-eighth. The salt thus obtained is again dissolved and recrystallized: but it still contains some muriate of Magnesia; and, therefore, it is deliquescent. To remedy this objection, Sulphate of Magnesia is prepared, in Italy and some other parts, from Magnesian Schistus, which contains Magnesia and a sulphuret of iron. By roasting this mineral the sulphuret is decomposed and the iron oxidized, whilst the sulphuric acid, formed by the oxygen evolved during the decomposition of water, with which the roasted mineral is moistened, combining with the sulphur, unites with the Magnesia as well as with the oxide of iron, and forms Sulphate of Magnesia and sulphate of iron. The addition of lime decomposes the sulphate of iron, and forms an insoluble sulphate of lime, at the same time that it renders the iron insoluble, by reducing it to the state of an oxide; and thus it enables Sulphate of Magnesia to be readily separated by lixiviation and crystallization. In this country it is prepared by calcining magnesian limestone, then treating it with muriatic acid, in a quantity sufficient only to take up the lime; and, lastly, adding sulphuric acid to convert the Magnesia into the Sulphate, and crystallizing. In this process, the magnesian limestone contains carbonates of magnesia and of lime; the calcination expels the carbonic acid, and leaves Magnesia and lime; muriatic acid, diluted with ten or twelve times its weight of water, is then added in quantity sufficient only to take up the lime; the muriate of lime formed is held in solution, whilst the Magnesia, being insoluble, precipitates; the two products are now easily separated by decantation, and the Sulphate of Magnesia is formed by the addition of sulphuric acid to the Magnesia. This process was invented by Dr. Henry; and the salt so prepared, containing no muriate of Magnesia, is not deliquescent. When slowly crystallized, it forms either irregular, six-sided, or quadrangular prisms, surmounted by six-sided or quadrangular pyramids, or by dihedral summits: but the crystals vary according to circumstances; and, as the usual form of the crystals is acicular, it is preferable to crystallize it in this form, which is effected by evaporating the

solution to a pellicle. Whatever may be the modification of form of the crystals, they are all doubly refrangent; and slightly efflorescent. The taste of Sulphate of Magnesia is extremely bitter; but it nevertheless agrees better with the stomach, in its most irritable state, than any other salt. It dissolves in its own weight of water at 60°, and in three-fourths of its weight at 212°. In solution, the salt increases the bulk of the fluid $\frac{4}{10}$ths of its volume: thus a solution of ℥i of Sulphate of Magnesia in f℥i of water will measure f℥xi and ¼. When heated, it undergoes the watery fusion, and loses its water of crystallization; but it is decomposed only in a white heat. Its constituents are sulphuric acid 32.52 + magnesia 16.26 + water 51.22 in 100 parts; or 1 equiv. sulphuric acid = 40; 1 magnesia = 20.7; 7 water (9 × 7) = 63, making the equivalent 123.7. This salt, notwithstanding its cheapness, is occasionally adulterated with sulphate of soda. To determine the quantity of pure Sulphate of Magnesia which any specimen of the salt contains, Mr. Phillips recommends the following process. Dissolve 100 grains of the salt in distilled water, and add to it an equal weight of subcarbonate of soda in solution; boil the mixture, and wash and dry the precipitate: the result should be thirty-four grains; and any deficiency is caused by an admixture of sulphate of soda. Or this adulteration may be ascertained by precipitating the Magnesia by hydrate of potassa, and the potassa by hydrochlorate of platina; after which the supernatant fluid is to be evaporated, to ascertain whether it contains muriate of soda. Sulphate of Magnesia is decomposed by carbonate of ammonia, by carbonate of potassa, lime-water, salts of baryta, salts of lead, and muriate of lime.

As a Purgative, Sulphate of Magnesia is a very valuable article of the Materia Medica. It purges without causing griping; but it often proves flatulent; and therefore requires to be conjoined with some aromatic tincture, or bitter infusion, such as cascarilla or calumba, or quassia. An elegant form of prescribing Epsom salts is in the infusion of confection of roses, acidulated with diluted sulphuric acid; in which form it allays the vomiting that often occurs in fevers, when other means fail. It operates chiefly on the duodenum; and when exhibited in a full dose, from ℥iv to ℥vi, in a small quantity of water, and a large quantity of tepid water drank half an hour afterwards, it operates briskly: but it generally requires some adjunct to ensure a decided evacuation of the intestines.

As I have already stated, Sulphate of Magnesia forms the active ingredient in many mineral waters. At *Aix*, in Savoy, it is conjoined with sulphates of soda and of lime, and a large proportion of carbonate of lime and Magnesia; in the *Barege* waters, with carbonate and sulphate of lime; in the *Kilburn*, *Moffat*, and several other waters, with sulphate of soda and

sulphate of lime. Sulphate of soda, however, is a more common ingredient in mineral waters than Sulphate of Magnesia. Mineral waters of this description are, therefore, merely combinations of various purgative salts, in conjunction with some gases and other substances, with which they cannot be united in an artificial state. Much of the beneficial effects of purging mineral waters arises evidently from the continuance of their use for a longer time than patients are generally willing to take artificial purgatives; from their daily employment being accompanied with exercise in the open air; from the great degree of dilution in which the salts are administered; and, not least, the freedom from business, care, and anxiety, which those who visit mineral springs generally enjoy. It has been the fashion of late to order mineral waters, in private practice, to patients residing in large towns, especially in the metropolis; but, the fact of situation and circumstances seem to have been forgotten; and also that the dilution, which is so useful at the springs, tends only to oppress the stomach and weaken the digestive organs in town, where the exercise, after the dose is taken, cannot be easily resorted to, and the habits of life are altogether different from those at watering places. Dilution aids greatly the purgative properties of the Sulphate of Magnesia in every situation: but it is preferable to drink the water or bland fluid, in a tepid state, half an hour after swallowing the dose of the salt, dissolved in a small portion of water, than to combine the two together. The purgative, in this case, is left to stimulate the excretory ducts of the liver and the pancreas, and to cause a copious discharge of the important secretion of the glands into the duodenum, where the fluid taken dilutes them, and aids in carrying them forward into the other intestines. It is by the augmented discharge from the biliary ducts, and the duct of the pancreas that the principal benefit is derived which accrues from the administration of this purgative. If the surface be freely exposed to cold air, the salt does not operate as a purgative, but as a diuretic; and, in some instances, it seems to pass off by the surface. Under every form, whether prepared by the hand of Nature or of art, Sulphate of Magnesia is a very valuable purgative.

2. SULPHATE OF SODA. *Sodæ Sulphas.* L. E. D.—Sulphate of Soda is generally prepared on a large scale, and at so low a price, that the process of the Pharmacopœias is seldom employed. In the officinal process, the excess of sulphuric acid in the residue of the distillation of muriatic acid from sea-salt, is ordered to be saturated with subcarbonate of Soda, and crystallized; the salt thus formed, however, is not worth the price of the Soda employed. When well prepared and carefully crystallized, it forms in six-sided prisms, terminated by dihedral summits; these are usually channelled, and always

exceedingly irregular. It effloresces in the air; and, when exposed to heat, undergoes the watery fusion, losing the whole of the water of crystallization: and the salt becomes opaque and white. The taste of Sulphate of Soda is saline, bitter, and nauseous. It dissolves in three parts of water at 60°; in an equal weight of water at 77°; and in one-third part at 91.5°; but it is a singular fact, that beyond this temperature it is less soluble: boiling water takes up only an equal weight of the salt. It is insoluble in alcohol, which throws it down in its watery solution. According to the analysis of Berzelius, the crystallized salt consists of—sulphuric acid 24.76 + soda 19.24 + water 56, in 100 parts; or of 1 equiv. acid = 40; 1 equiv. soda 31.3; 10 equiv. water (9 × 10) = 90, making the equivalent 161.3. If a saturated solution at 91.5° be evaporated at a higher temperature, opaque, anhydrous crystals of the salt, the primary form of which is a rhombic octohedron, are deposited.

This salt is contained in many mineral waters; it is also found in the ashes of many vegetables; and effloresced on brick walls whitewashed with certain compounds, as on those in the lowest part of the London University. From a similar cause, it is found both crystallized and effloresced in some caves near the village of Muhligen, in the Canton of Argovie in Switzerland. The artificial salt was first prepared by Glauber, a German chemist, who named it *sal mirabile;* but it has been always more generally termed Glauber salts. Before the introduction of Epsom salts, the Sulphate of Soda was the most common purgative: it is now less generally employed. It is, nevertheless, a very certain purgative, and its nauseous taste is covered either by a little citric or tartaric acid. The muriates of lime and of magnesia, and the salts of lead and of baryta, decompose this salt; and are, therefore, incompatible with it in prescriptions. In the usual crystallized state, the dose is from ʒiv to ℥ii in any bland fluid.

3. Phosphate of Soda. *Sodæ Phosphas.* L.—Phosphate of Soda, according to the London Pharmacopœia, is prepared from the superphosphate of lime, obtained from calcined bones by the action of sulphuric acid, subcarbonate of Soda being afterwards added. A double exchange takes place, the sulphuric acid unites with the lime, forming an insoluble sulphate, whilst the soda of the subcarbonate attaches itself to the phosphoric acid, forming a soluble phosphate; which, after filtration, to separate the sulphate of lime, slowly crystallizes. It generally contains some traces of sulphuric acid, if it be not repeatedly dissolved in distilled water and recrystallized. It forms in oblique, rhomboidal prisms, large, regular, and transparent, which effloresce when exposed to the air, and fall into an opaque, white powder. The taste of the salt is cooling, somewhat like that of common salt; a little more urinous, but

not unpleasant; it dissolves in four parts of water at 60°, and in two parts at 212°. When heated, it undergoes the watery fusion; and, in a red heat, melts into a white enamel. Muriate of magnesia and muriate of lime, acetate of baryta, and nitrate of silver, decompose it: all of these substances are therefore incompatible with it in prescriptions. It is often adulterated with sulphate of soda when it is in an efflorescent state. This may be discovered by dissolving 100 grains of the suspected salt in water, and adding to the solution acetate of baryta, as long as any precipitate falls. The deposite is then to be well washed and treated with nitric acid, which dissolves the whole if the phosphate be pure, but leaves an insoluble sulphate if it be adulterated with sulphate of soda. The weight of the Sulphate of Baryta indicates the extent of the adulteration.

According to the analysis of Berzelius, it consists of—phosphoric acid 20.33, + soda 27.67, + water 62.00, in 100 parts; and, according to Mitcherlich, it may be inferred to consist of—1 prop. phosphoric acid = 71.4, + 2 soda = 62.6, + 15 water (9 × 15) = 135, equiv. 269*.

Before this salt was artificially formed, it had been detected in urine and described by Hillot in 1737. Haught afterwards described it under the name of *sal mirabile perlatum:* but its real chemical nature was first pointed out by the younger Rouelle in 1776, and his opinions were confirmed by Klaproth and Scheele. Dr. Pearson introduced it into use as a purgative. From the similarity of its taste to that of common salt, it is a purgative well calculated for children, as it may be given in broth without being detected. It operates in doses of from ʒvi to ʒii.

4. TARTRATE OF SODA. This salt is not ordered in any of the British Pharmacopœias; yet my experience authorizes me to recommend it strongly in dyspeptic habits, when extemporaneously prepared by adding gr. xv of the tartaric acid in solution to a solution of ʒi of the bicarbonate of soda. The carbonic acid which is extricated acts as a gentle stimulus to the nerves of the stomach, whilst the Tartrate formed gently moves the bowels. When it is saturated with the soda, the Tartrate crystallizes in fine needle-form crystals, soluble in their own weight of water. In this state it is a mild purgative; and may be united with any of the aromatic bitters.

5. TARTARIZED SODA. *Sodæ Tartarizata.* L. *Sodæ Tartras et Potassæ.* E. D.—Soda Tartarizata of the London Pharmacopœia is a double salt, a *Tartrate of Soda* and of *Potassa*, as it is correctly termed by the Edinburgh and Dublin Colleges. It is produced by saturating the excess of acid of the bitartrate of potassa with subcarbonate of soda, which is decomposed, and

* Turner's Elements of Chemistry, 4th edit. p. 675.

its soda combined with the tartaric acid; so that the acid in this case is united with two bases; or is a double salt. Its crystals are large, beautiful modifications of right rhombic prisms: they are generally produced in halves in the direction of their axis. Their taste is bitter and saline, but not disagreeably so; their solubility is considerable, five parts of water only, at 60°, being required for this purpose. They slightly effloresce when exposed to the air. According to Vauquelin, the anhydrous salt consists of—tartrate of potassa 54, + tartrate of soda 46, in 100 parts; or the constituents may be thus stated—1 eq. tartrate of potassa = 113.63, + 1 of tartrate of soda = 97.78, + 8 water (9 × 8), = 72, equiv. 283.41.

This salt was first prepared, and introduced as a purgative by M. Seignette, an apothecary of Rochelle, in 1672: thence the names Salt of Seignette and Rochelle Salt. The discoverer made a large fortune by keeping the preparation a secret; and it was not made public until 1731, when Boulduc and M. Geoffroy discovered its components, and read a paper on the subject to the Academy of Sciences of Paris. It was long a fashionable purgative, and supposed to be fitted for all complaints; thence the name, *Sal Polychrest*, salt of many virtues. It was thrown out of favour, but was again restored in the form of Seidletz powders, of which it forms the active basis*. The dose is ʒss. It may be administered in any vehicle that does not contain acids or acidulous salts. If any of the mineral acids be added in quantities sufficient to acidulate the solution of this salt, the Tartrate of Potassa is converted into the insoluble bitartrate. It is also necessary to avoid combining it with the acetates of lead, or the soluble salts of baryta, or of lime.

All of these salts of soda operate moderately upon the whole length of the intestinal canal, stimulating the orifices of the exhalant vessels, and consequently producing serous or thin watery stools: they are therefore well calculated for all cases of febrile excitement, and those in which a plethoric state of the system requires to be reduced. Their influence on the exhalant vessels also promotes absorption; for these two systems sympathize so closely, that the action of the exhalants cannot be augmented without a corresponding increase of that of the absorbents. They are rarely given alone, unless as domestic medicines; but it is of great importance to attend to the incompatibles, and also to the nature of the vehicles in which they are administered, to understand how far they tend to quicken or to retard their action. Thus the addition of sulphate of magnesia quickens the opera-

* Dr. Paris informs us that the patent Seidletz powders consist of two drachms of Tartarized Soda and two scruples of carbonate of soda in the white paper, and gr xxxv of tartaric acid in the blue paper. The union of these form a bitartrate of soda, which, in conjunction with Tartrate of Soda and potassa, operates mildly and effectually on most persons; and is an agreeable medicine.

tion of infusion of senna; whilst, in weak habits that can scarcely bear the operation of purgatives, its combination with bitters and sulphuric acid sustains the strength, without impairing the purgative power of the salt; and, with the same view, sulphate of iron may be combined with this salt.

6. BISULPHATE OF POTASSA. *Potassæ Bisulphas* is formed during the decomposition of nitrate of potassa by sulphuric acid in manufacturing nitric acid; the Bisulphate being the result of the combination of the sulphuric acid with the potassa of the nitrate. It remains in the retort, and requires to be dissolved in water and crystallized. If the solution be not sufficiently evaporated, the acid is separated from the salt, remains in the water, and neutral sulphate of Potassa is formed. If too little sulphuric acid have been used to decompose the nitrate, the salt, instead of being a Bisulphate, is a mixed salt, a sulphate of Potassa and a nitrate of Potassa. The Dublin College orders it to be prepared by the direct combination of its constituents; but this is an unnecessary and expensive process. It differs both in its appearance and in its properties from the sulphate. It crystallizes irregularly, sometimes in slender, hexangular prisms, at other times in right rhombic prisms flattened so as to be tabular. It is extremely sour and slightly bitter; it reddens vegetable blues, is soluble in two parts of water at 60°, and less than an equal weight at 212°. It effervesces with alkaline carbonates. When exposed to a red heat, the water of crystallization and the superabundant acid are both driven off. When exposed to a moderate heat, it melts and assumes the appearance of oil, but again becomes white on cooling. Its constituents are sulphuric acid 54.80, potassa 32.87, water 12.33, in 100.00 parts, or 2 eq. sulphuric acid (40 × 2) = 80, + 1 potassa = 47.15, + 2 water (9 × 2) = 18, making the equivalent 145.15.

In prescribing this salt, it ought not to be united with any of the alkaline carbonates, nor with lime water. The carbonate of Potassa converts it into the neutral sulphate, that of soda or of ammonia form new salts with the excess of acid, whilst lime water forms an insoluble salt, and decomposes the bisulphate. It may, however, be combined with sulphates of iron and of zinc, and with most of the vegetable purgatives, particularly with rhubarb, which, although it contain a salt of lime, yet, this being an oxalate, is not affected by the excess of sulphuric acid in the bisulphate. It may also be advantageously prescribed with the sulphate of quinia, or that of morphia, if a purgative be required to be given in conjunction with these salts. In combination with rhubarb, it has been found useful in dyspeptic states of the habit, accompanied, as is usually the case, with torpid bowels. It is also a useful addition to aromatics and bitters. The dose is from gr. x to ʒii, three or four times a day.

7. Sulphate of Potassa. *Potassæ Sulphas.* L. E. D. —When Bisulphate of Potassa is dissolved in a large quantity of boiling water and subcarbonate of Potassa added, sufficient to saturate the superabundant acid, the result is a solution of Sulphate of Potassa, which, on evaporation, yields the crystallized salt. Mr. Phillips suggests that it is preferable to saturate the excess of acid with lime, as the sulphate is less valuable than the subcarbonate ordered to be employed by the London College. The Edinburgh College orders the carbonate of lime to saturate the superfluous acid, and the sulphate of lime which is formed to be separated by the filter previous to the crystallization of the Sulphate of Potassa which is held in solution. Besides these direct processes, it is formed also in several other processes, as, for example, in the preparation of the subcarbonate of magnesia. In the supernatant fluid, after the precipitation of the magnesia, Sulphate of Potassa is held in solution, and can be obtained by evaporation. It is usually in small, grouped, transparent crystals, the form of which varies according to the manner in which the crystallization is conducted; but one of the most common forms is a short hexædral, or six-sided prism, terminated with hexædral pyramids, forming a bipyramidal crystal. The primary form of the salt is a right rhombic prism. It has a bitter taste, is permanent in the air; and, as it contains no water of crystallization, decrepitates when thrown upon burning coals: in a red heat it melts. It dissolves in sixteen times its weight of water at 60°, and in five parts at 212°. Its composition is differently stated by different chemists; that of Berzelius is—sulphuric acid 47.1, potassa 52.9, in 100.0 parts, or 1 eq. of sulphuric acid = 40, + 1 of potassa = 47.15, making the equivalent 87.15.

Sulphate of Potassa, in solution, is decomposed by tartaric acid, which forms crystals of bitartrate of Potassa; by muriate of baryta, and muriate of lime; by solutions of acetate and subacetate of lead, bichlorde of mercury, and nitrate of silver; all of which might be ordered with it.

This salt has never, as far as my knowledge extends, been found in a state of nature, that is, as a mineral. I am aware that it is mentioned as a component in the water of Enghein, as analysed by M. Longchamp; but, in the analysis of the same water by M. Fremy and the junior M. Henry, no mention is made of the Sulphate of Potassa. It has been procured from the ashes of plants by lixiviation, and is contained in urine and some other animal juices*. It is a useful purgative; but, from its little solubility, it is seldom given alone, and scarcely ever in solution. It is supposed to extend its action beyond the bowels, and there-

* It was known at a very early period under a great variety of names, as, for instance, *Specificum purgans*, *nitrum fixum*, *arcanum duplicatum*, *panacea holsatica*, *sal Polychrest*, &c.: the present name, Sulphate of Potassa, was imposed by the French in 1787.

fore is generally preferred as a purgative in cases of visceral obstructions; but I am inclined to believe that any effect of this nature is confined to the liver and the pancreas, and that it acts upon them by stimulating the orifices of their excretory ducts, in its passage through the duodenum. The dose for an adult is from a drachm to three drachms. It is generally given in combination with jalap, rhubarb, aloes, or some resinous cathartic. In combination with aloes, as it acts on the duodenum, and the bitter of the aloes supplies the deficiency of bile, it is useful in jaundice, dyspeptic affections, and habitual costiveness in persons of sedentary habits*.

8. BITARTRATE OF POTASSA. *Potassæ Bitartras.* L. E. D.—In wine casks, during the slow fermentation which goes on in wine, a thick crust is deposited on the sides of the casks, tinged of a brown or reddish colour, according to the nature of the wine. This is familiarly termed argol, or crude tartar. It contains, besides the colouring matter of the wine, some extractive and tartrate of lime, and a large proportion of Bitartrate of Potassa. This bitartrate is also contained in the pulp of some fruits. The usual process for purifying this impure salt is operose†; but it may be equally well effected by simply boiling it with recent powdered charcoal, according to the directions of Schaub.

The crystals of this purified salt are small, irregular, right rhombic prisms, with one of the sides striated. They have an acid taste, a nauseous arriere-gout, feel gritty between the teeth, and are easily pulverized. The specific gravity is 1.953. They require sixty times their weight of water at 60°, and fourteen times their weight at 212°, for their solution. The salt is not altered by exposure to the air; but its solution, when long kept, is decomposed, a mucous matter is deposited, and carbonate of Potassa, coloured with a little oil, remains in solution. This is owing to the decomposition of the acid, which consists of oxygen, hydrogen, and carbon; and of the water, the oxygen of which goes to form the carbonic acid that unites with Potassa, whilst the abstraction of part of the carbon, and the addition of hydrogen to the original quantity, form the mucus.

The Bitartrate of Potassa of commerce is seldom pure, containing always more or less tartrate of lime. The constituents of the pure salt, according to Berzelius, are—tartaric acid

* The Duke of Holstein, as we are informed in Shaw's Life of Boyle, some time before 1663, purchased the secret of preparing this salt for 500 dollars, as a remedy in fever, stone, and scurvy. The term *Sal Polychrest*, which was applied to it as well as to the Tartrate of Potassa and soda, demonstrates the estimation in which these salts were held by the elder physicians. It is a good mechanical agent in assisting the pulverization of opium and some of the tough gum resins, which are apt to become soft under the action of the pestle.

† London Dispensatory, art. Potassæ Bitartras.

70.45, potassa 24.80, water 4.75, in 100.00 parts, or 2 eq. of tartaric acid (66 × 2) = 132, 1 potassa = 47.15, × 1 water = 9, making the equivalent 188.15.

From the manner in which this salt crystallizes when prepared in the large way, it has acquired the name of Crystals of Tartar*. It is a cooling purgative, operating on the whole length of the intestinal canal, stimulating the exhalants, producing watery stools, causing flatulence, and often griping. Owing to its property of evacuating watery stools, it is a useful purgative in ascites, and other dropsical accumulations. Its continued use is productive of emaciation; consequently, it is employed in cases of plethora and obesity. As it is little soluble, it is generally given in the form of electuary, combined with jalap, or sulphur, or the electuary of senna. The addition of one-fifth of borax, or one-ninth of boracic acid, to the Bitartrate of Potassa increases greatly its solubility. It is incompatible with muriates of baryta and of lime. The dose is from gr. xv to 3iii, twice or three times in the day.

9. Tartrate of Potassa. *Potassæ Tartras.* L. E. D. —By adding as much of the Subcarbonate of Potassa to the solution of the Bitartrate of Potassa as will saturate the excess of Tartaric Acid, this neutral Tartrate is formed. It is also a product in preparing Tartaric Acid from the Bitartrate of Potassa. It has a bitter, nauseous taste. Its specific gravity is 1.5567. It is generally in the form of powder; but it should always be crystallized; the form of its crystal is an irregular six-sided prism, with dihedral summits. It is soluble in its own weight of water, at 50° Faht. and still more soluble in hot water, whence its name *soluble Tartar*. But in its usual granular form it requires four times its weight of water for its solution; it also attracts water from the air. Like the Bitartrate, it is decomposed when kept in solution. When imperfectly prepared, it may contain Bitartrate of Potassa, which is easily detected by litmus; or Subcarbonate of Potassa, which is made evident by turmeric paper. If any sulphate be combined with it, the muriate of baryta will throw down a precipitate insoluble in muriatic acid; whilst muriatic salts are detected by nitrate of silver throwing down a precipitate insoluble in nitric acid; but such adulterations rarely occur. It contains exactly half the proportion of acid which the Bitartrate contains. According to the analysis of Berzelius, it consists of—tartaric acid 58.69, potassa 41.31, in 100.00 parts, or 1 eq. of tartaric acid = 66, + 1 potassa = 47.15, + 2 of water = 18, making the equivalent 131.15.

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* Paracelsus, the Prince of Empirics, says Van Helmont, in his Historia Vini Tartratis, asserted that the name *Tartar* is derived from its producing the oil, water, tincture, and salt, which burns the patient as hell does: he also affirmed that it is the principle of every disease and of every remedy.

Tartrate of Potassa is decomposed by all the acids and acidulous fruits, which throw down insoluble crystals of the bitartrate. It is also decomposed by lime-water, muriate of lime and of magnesia, nitrate of silver, and the acetate and subacetate of Lead, which are consequently incompatible with it in prescriptions. It is a mild, efficient purgative, operating without griping: it has also the power of rendering other purgatives—as, for example, senna and scammony—less griping. Its influence is exerted on the whole of the intestinal canal; and it operates very quickly. It is one of the most common purgatives given to carry off full doses of calomel through the bowels. Five or six grains of calomel are given at bed time; and next morning a draught, containing from ʒi to ʒii of Tartrate of Potassa in fʒiss of infusion of senna, is administered. This operates rapidly, and sweeps away the bile which the calomel brings down from the gall ducts. The usual dose of the Tartrate is from ʒi to ʒiv, mixed with infusion of senna or infusion of rhubarb.

10. ACETATE OF POTASSA. *Potassæ Acetas.* L. E. D.—Potassa has a powerful affinity for acetic acid; thence, when subcarbonate of potassa is added to diluted acetic acid, and its union aided by heat, the carbonic acid is driven off in the state of gas, and the solution being evaporated until a pellicle is formed, the Acetate of Potassa is procured. By the employment of acetic acid, instead of distilled vinegar, which was formerly used, the salt is now obtained of a pure white colour. In the large way, Acetate of Potassa is formed with the unpurified pyrolignous acid; it is therefore requisite to blanch the foliaceous crystals by melting them in a gentle heat; adding animal charcoal; pouring over the cooled mass distilled water; adding some purified acetic acid; and again evaporating the fluid to obtain the foliaceous crystals.

Acetate of Potassa, when properly prepared, is in masses, having a foliated texture, white or colourless; with a peculiar faint odour and a pungent, saline taste. It is extremely deliquescent in the atmosphere, and, consequently, very soluble in water. It is also very soluble in alcohol. It is decomposed by the strong mineral acids, which expel the acetic acid; the sulphates also decompose it. When the acetic acid which is employed in its formation contains lead or copper, it gives precipitates with sulphuretted hydrogen, ferrocyanate of potassa, and tincture of galls; but none of these are formed with pure acetate of potassa. When exposed to a strong heat, Acetate of Potassa is decomposed and converted into subcarbonate of potassa; the hydrogen of the acid is expelled, and the carbon and oxygen uniting to form carbonic acid, this combines with the potassa and forms the subcarbonate. It consists of—51 acetic acid + 49 potassa in 100 parts; or 1 eq. acet. acid = 51, + 1 potassa = 47.15, making the equivalent 92.15.

In small doses this salt operates as a diuretic; in larger doses, that is, from ʒii to ʒiv, as a purgative. In administering it for purgative purposes, the surface of the body should be kept warm. It is, however, an indifferent purgative. It is incompatible in prescriptions with sulphate of soda and of magnesia, corrosive sublimate, and nitrate of silver, besides the other substances already stated.

The salts of potassa, like those of soda, operate by producing large serous evacuations; and, therefore, they form powerful agents in the antiphlogistic or depleting plan of treatment, as it is termed. In cases which require the habit to be brought down rapidly, the tartrates are preferable to the sulphates or to the acetates; but, regarding the salts of potassa as general purgative agents in the cases for which salts of soda are peculiarly indicated, I have no hesitation in adjudging the superiority to those of soda.

d. DRASTIC CATHARTICS.

Drastic Cathartics are medicines which operate by powerfully stimulating the intestinal canal, affecting both the nerves of sensation and of motion. They consist chiefly of organic products, containing some very active principle, generally involved in substances that, from their inertness, seem intended rather to obtund its energy than to aid its cathartic properties. Their operation is usually attended with griping; and, in many instances, the effects are so violent, that, unless their operation be closely watched, much mischief may result from their employment. They exert a very powerful influence on the exhalants and the absorbents, and merit the term *Hydragogues* more than any other set of purgatives: indeed, when the powers of the system are capable of bearing up against the debility which they produce, there is no set of remedies so much to be relied upon in the treatment of dropsical affections, unconnected with organic disease.

ORGANIC PRODUCTS OPERATING AS A DRASTIC CATHARTIC.

a. COLOCYNTH. *Pulpa Colocynthidis.* L. E. D.—Colocynth is brought to this country from the Levant. It is the fruit of the Cucumis *Colocynthis*, an annual plant which grows in great abundance in Turkey and Nubia, and is cultivated in Europe, although it never attains to perfection there. The Colocynth, or Bitter Cucumber, as it is termed, belongs to the natural order Cucurbitaceæ*. The fruit of this plant is a globular berry or pepo, about the size of a small orange, smooth on the outside, trilocular, each cell containing many ovate, compressed,

* Woodville's Med. Bot. 3rd edition, p. 189, pl. 71. London Dispensatory, art. Cucumis. Richard, Hist.Nat. Med. t. ii, p. 644.

whitish seeds, enclosed in a white, spongy, membranous substance. It is seldom imported into this country with the outer coat on, but it is brought in the peeled state, having been dried in a stove, which converts the pulp into a white, easily torn, papery-looking matter. In this state, it is commonly called the *Coloquintida Apple.*

The dried Colocynth is inodorous; the white spongy part is intensely bitter and nauseous. When this spongy body is macerated in alcohol, it yields its bitterness and communicates a yellow colour to the spirit: and, when this is evaporated, it leaves a resinous substance, which Vauquelin, who first obtained it, regards as the active principle of the drug, and named it *Colocyntine**. It differs from resin in being partially soluble in water, so that the alcoholic tincture is not decomposed when poured into water. It resembles the bitter principle obtained from other plants; but differs from it in some respects. It is not affected by the reagents which usually affect vegetable bodies: the sulphates of iron coagulate the aqueous infusion, as do also the acetate and subacetate of lead; but nitrate of silver produces no effect upon it. The spongy mass swells and becomes diaphanous, resembling the appearance, in some degree, of tragacanth, when soaked in water; but it is not soluble in either water or alcohol: I am inclined to consider it a modification of Cerasin. Ether, when digested on the pulp, takes up both the resin and the bitter extractive: when evaporated on water, it leaves a pellicle of the former, white and opaque, whilst it communicates an intense bitterness to the fluid. The results obtained from the chemical examinations of Colocynth hitherto made, are by no means satisfactory, and cannot be regarded as elucidating the nature of its purgative principle.

Colocynth was well known to the ancients as a Drastic Cathartic, which required to be cautiously administered: they employed it chiefly in dropsical and lethargic affections. The watery decoction or infusion is much less violent in its effects than the alcoholic. On account of its extreme bitterness, however, it is usually given in the form of extract, made into pills. Its drastic qualities are much mitigated by combining it with camphor and hyoscyamus. From the experiments of Orfila, Colocynth appears to exert its influence chiefly on the rectum, which, in dogs killed by taking it, was always found inflamed; and this occurred even when the Colocynth was applied to a wound on the thigh, instead of being taken into the stomach. When swallowed, even in moderate doses, it gripes violently whilst it purges; in large doses it occasions bloody stools and inflammation of the colon. Several instances of fatal effects from its use are recorded by Continental practitioners;

* Journ. de Pharm. tome x, p. 416.

and Dr. Christison quotes a case from the Courier newspaper, in 1823, of an inquest held on the body of a woman who died in twenty-four hours, with incessant vomiting and purging, in consequence of having swallowed, by mistake, a tea-spoonful and a half of powdered Colocynth. Dr. Fordyce mentions the case of a woman who was subject to colics for thirty years, in consequence of only once taking an infusion of the pulp of Colocynth prepared with beer. Notwithstanding its violence, it is a Cathartic in daily use. When given in substance, the dose is from four to ten grains; but it is necessary to obtund its operation by triturating it with gum, or some other farinaceous matter. The difficulty of reducing it to powder is a sufficient reason for seldom giving it in substance. The aqueous decoction is milder in its effects than either the powder or the extract, and has been occasionally given in worm cases.

b. SCAMMONY. *Scammonii Gummi resina.* L. E. D.—Scammony is the product of the Convolvulus *Scammonia**, a plant belonging to the natural order Convolvulaceæ. It is a native of Syria, growing in abundance on the mountains between Aleppo and Latachea.

Scammony is the concreted juice of the root of this Convolvulus. In the month of June, the roots which have attained to the diameter of three or four inches are cut across in a sloping direction, the earth having been first cleared away from them. The incision is made about two inches below the place where the stalks spring; and a shell being placed at the lowest part of the incision, the milky juice which issues is collected in it. Each root yields a few drachms only; the different collections from a vast number of roots are put indiscriminately together, so that every kind of Scammony is found in the same package. The Jews of Aleppo, who are agents between the collectors of the Scammony and the exporters, mix the soft Scammony with sand, ashes, and various impurities, to give it weight; on which account the drums or packages of the drug, that generally weigh from 75 to 125 pounds each, do not contain more than from 50 to 65 pounds of pure Scammony. Scammony is often adulterated with jalap, senna, camboge, ivory-black, and sometimes with the juice of the Cynanchum *Monspeliacum.*

Good Aleppo Scammony is light, friable, and breaks with a regular, smooth, faintly shining fracture. Its odour is peculiar, not unlike that of old ewe-milk cheese; and the stronger this odour is, the better is the Scammony: its taste is bitterish and slightly acrid. The colour is a dark-grey, and, if good, it lathers or turns to a dirty white when it is rubbed with a moist finger.

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* Woodville's Med. Bot. third edition, p. 213 pl. 86, London Dispensatory, art. Convolvulus. Richard, Hist. Nat. Med. t. ii, p. 122.

When Scammony is triturated with water, it forms a milky or emulsive solution, which lets fall, on standing, a portion of insoluble resin. This solution of Scammony is altered by alcohol, and by some of the solutions of the metallic salts, especially subacetate of lead: when liq. potassæ is dropped into it, a yellow precipitate is formed, which is quickly dissolved on the addition of an acid: it is probably a compound of extractive and potassa, which is insoluble in water. The gum remains in solution with the alkali; and if the solution be strong, it is precipitated by alcohol. Alcohol takes up six-tenths of the Scammony; this is pure resin, and may be precipitated from the alcoholic solution by means of water. According to the analysis of Vogel and Bouillon La Grange, Scammony is composed of—

	Aleppo.	Smyrna.
Resin	60	29
Gum	03	8
Extractive . . .	02	5
Waste	35	50
	100	100

It is said that the root of the plant, after it has been drained of the milky juice, is still Cathartic; which, however, probably arises from some of the juice being left, concreted in the vessels of the root.

Scammony is a powerful Drastic Cathartic, very apt to gripe when given alone. Its activity resides in the resin, which is too drastic when separated from the gum and extractive. The ancients employed Scammony as an external application to tumours, itch, scurf, and fixed pains; which is rather surprising, as it purges almost as freely when rubbed upon the skin as when taken into the stomach. Its acrimony, also, as a purgative, was so constantly kept in view by the ancients, that they invented a variety of methods for correcting it; and they termed the compounds Diagrydia. It is usually given in combination with calomel; and it is one of those substances that sulphate of potassa aids greatly in its effects, at the same time modifying its griping quality. It is an excellent occasional Cathartic in leucophlegmatic and hypochondriacal cases; and for removing the scybala that frequently lodge in the colon in maniacal cases. In dropsical diseases, in which there is often torpid bowels, Scammony, in combination with bitartrate of potassa, aids greatly in removing accumulations of serous fluids from internal cavities when the dropsy is not of an encysted kind. It is also one of the best Cathartics, combined with calomel and sulphate of potassa, in worm cases. Its dose in substance is from gr. v to gr. xv. When administered, either alone or in combination, it should be conjoined with a drop or two of some volatile oil. The watery infusion is sufficiently active, and does not gripe

so violently as the medicine in substance, owing to the precipitation of the resinous part. When given in an overdose, the case must be treated as one of common inflammation of the bowels.

c. CAMBOGE. *Cambogia.* L. E. D.—There are various plants, both trees and herbs, which secrete a yellow juice, that thickens in the air, and has something of the appearance of Camboge; but it remains soft and tenacious, whilst true Camboge is hard and friable*. The name of this drug is derived from Kamboja, a river in Siam, on the banks of which the tree, the Staligmitis *Cambogioides*, the proper juice of which it is, grows in great abundance: it belongs to the natural order *Guttiferæ*†. This tree, which is also found in the island of Ceylon, and in China, is of a moderate height, with a tufted head, from the foliage appearing only at the summits of the branches. The leaves are on short petioles, ovate, opposite, entire, even, rigid, of a deep green colour, and exuding, when they are bruised or in any manner lacerated, a bright yellow juice, which also exudes in drops that concrete upon the bark. In Siam, the Camboge is procured from the leaves by merely breaking them, and allowing the proper juice to distil into cocoa-nut-shells, in which it is left to harden; and, when sufficiently firm, is formed into rolls and wrapt up in leaves. In Ceylon, it is collected by wounding the tree and striking the trunk as the juice flows. The juice, after hardening, is transferred into cases and boxes, in which state it is brought to Europe. It is in solid masses, of a deep orange colour, breaking with a vitreous fracture, brittle, easily pulverized; melting when heated, and burning in a strong heat with a white flame, leaving a light, spongy charcoal, which contains carbonate, phosphate, and hydrochlorate of potassa, and carbonate and phosphate of lime. Camboge has no odour, and scarcely any taste; but, after being masticated, it imparts a sensation of acrimony and dryness to the mouth. When triturated with water, it forms a turbid, bright yellow solution, which reddens slightly the tincture of litmus; is rendered transparent by the addition of alcohol; and is not affected by the solutions of any of the metallic salts; but is rendered nearly white when agitated in a bottle of chlorine. Alcohol dissolves nine parts in ten of Camboge, forming a deep orange tincture, which, when diluted with water, does not throw down the resin, but produces a uniform milky fluid, and, when evaporated, yields it perfectly free from gum. Ether dissolves it more freely, and, when evaporated on

* Some species of Hyperiium, Chelcdonium *majus* and *minor*, and some exotics, as I have already stated, yield yellow, proper juices; but these juices differ in their chemical properties from Camboge, and are not employed in medicine.

† Woodville' Med. Bot. 3rd edit. p. 78, pl. 23. London Dispensatory, art. Cambogia. Richard, Hist. Nat. Med. t. ii, p. 672.

water, leaves a pellicle of very pure, semi-transparent resin. The proportion of resin exceeds three-fourths of the Camboge submitted to the action of these agents. It is of a red colour, insipid, and possessing an idio-electric property. In the entire state, it is inodorous; but when pulverized, exhales a peculiar odour. When it is acted upon by Liquor Potassæ, a deep red oily solution is formed, which crystallizes when it is evaporated; and, when acids are poured into the solution, yields a coagulum of a beautiful yellow colour. What remains, after the action of alcohol or ether, is nearly altogether soluble in water, and, when evaporated, yields a semi-transparent gummy substance, which Braconot regarded as Cerasin, but which differs from it in being completely soluble in water. Lime water, added to the savonule of the resin, deposites a beautiful orange-coloured precipitate: sulphate of iron is precipitated brown, and nitrate of copper green. When Camboge is carefully analysed, it is found to consist of 80 parts of this resin and 20 of the gummy matter in 100 parts. With alkalies, it yields a deep brown solution, which is precipitated by acids. The resin, when acted upon by nitric acid, is converted into a yellow bitter principle. These experiments explain the chemical properties of Camboge, demonstrating it to be a simple gum-resin; but they throw no light on its purgative principle.

As a medicine, it is a powerful, drastic Cathartic, exciting vomiting when given alone, even in moderate doses. It is usually combined with calomel, soap, or rhubarb, for purgative, and with squills, Bitartrate of Potassa, Sulphate of Potassa, and nitre, for hydragogue purposes. The alkaline solution, in doses of from thirty to fifty minims in a sufficient quantity of water, given twice or thrice a day, is employed in dropsical affections. It operates both on the bowels and the kidneys, through the latter of which it passes unaltered, and may be detected in the urine. It was long regarded as a powerful vermifuge in cases of tape worm; but, since the introduction of oil of turpentine for the expulsion of tænia, the use of Camboge for this purpose has been discontinued. It is more employed as a pigment than as an article of the Materia Medica.

5. BUCKTHORN. *Rhamnus Catharticus. Baccæ succus.* L. E. D.—The Rhamnus *catharticus* belongs to the natural order Rhamneæ, of which it forms the type*. The fruit, which is the part used, is a globular fleshy berry, with from two to four fibrous, indihescent seeds. The recent juice, when combined with alumina and lime, forms the pigment called sap green. The juice of the berries is naturally of a green colour, but it is reddened by acids and again restored by alkalies, so that it is

* Woodville's Med. Bot. 3rd. edit. pl. 210, p. 595. London Dispensatory, art. Rhamnus. Richard, Hist. Nat. Med. tome ii, page 563.

sometimes employed as a reagent to detect the presence of these substances. The aqueous infusion is blackened by the persulphate of iron.

When employed as a Cathartic, the berries operate violently, causing griping and a sensation of dryness in the throat. It was formerly much used as a hydragogue purgative; but the violence of the griping which it causes has produced an almost entire ejectment of Buckthorn from the Materia Medica. The interior bark of the young branches is said to purge as violently as the berries. A syrup made with the juice of the berries, fermented and clarified, is much used on the Continent. Twenty of the recent berries purge briskly, and the peasantry employ them for this purpose: but the most common form of the medicine is the syrup. Whatever form it may be administered in, it is a medicine of too drastic a nature to be much employed; yet it was the favourite purgative of Sydenham; and it is alleged that much of his success in the early part of his career is attributable to his frequent employment of this Cathartic. It requires free dilution with some bland mucilaginous fluid. The dose of the syrup is from ʃʒi to ʃʒiii.

Hedge Hyssop, *Gratiola Officinalis*, L. E. D. is not an indigenous plant, although cultivated in this country. It is a native of the south of Europe; and belongs to the natural order Labiatæ*. It is a perennial, rising with a straight herbaceous stem, a little branched, and furnished with opposite semi-amplexicaule ovato-lanceolate, smooth, slightly-toothed leaves. The flowers are solitary, pedunculated, each accompanied with two lanceolate bractes, larger than the calyx, which is divided into five unequal segments. The corolla is a tube, terminated by four segments, which form two lips, the uppermost broad and reflected, the inferior consisting of three divisions. It has four filaments, but there are two anthers only; the germen is ovate, surmounted by a style supporting a hollow stigma. The seed-vessel is a smooth, two-celled capsule. The plant delights in a moist situation, and flowers in June and July, at which time it should be gathered for medical use, being then in its best condition.

Gratiola is nearly inodorous; the taste is bitter and nauseous; it yields its sensible properties both to alcohol and water, but chiefly to the latter. The colour of the infusion resembles that of Sherry or Madeira wine: it is erroneously said to be slightly acidulous; it strikes an olive colour with sulphate of iron, without any precipation. Vauquelin analysed it, and obtained a gummy matter of a brown colour; a very bitter resinous matter, soluble in alcohol and in water; malate and phosphate of lime;

* Woodville's Med. Bot. third edition, pl. 131, page 360. London Dispensatory, art. Gratiola. Richard, Hist. Nat. Med. tome ii, page 70.

and another calcareous salt combined with a vegetable acid, not yet known; silex, and woody matter. Vauquelin supposes that the active principle resides in the resinous extract.

Gratiola is a powerful drastic Cathartic, and is much employed by the peasantry; thence, it is commonly called, in France, Herbe à pauvre homme; and its name, derived from Gratia Dei, may have a similar origin. The root is seldom used, as it excites violent vomiting; and indeed the whole plant is poisonous in large doses, operating exactly in the same manner as other acrid, irritating poisons. From the experiments of Orfila, it appears to produce inflammation in the stomach, and throughout the whole intestinal canal, but chiefly in the rectum. He conceives that it is not absorbed, but acts directly on the nervous system. The German physician Hufeland thinks that it is extremely efficacious in visceral obstructions—jaundice, for example—and in ascarides: a circumstance that is likely to be the case, from its operating on the rectum. From its griping qualities, it is usually combined with aromatics. When given in the form of powder, the dose is fifteen grains; and in that of the infusion, made with ʒii of the herb in oss of boiling water, from ſʒiv to fʒi.

Gratiola is not contained in the list of the Materia Medica of the London College; and, if we consider that its drastic and poisonous properties are not counterbalanced by other useful qualities, we must admit that it should be altogether banished from the Materia Medica.

b. OLEO-RESINS.

The Resin in these compounds is combined with volatile oil; and it is doubtful whether the activity of the substances depends on the resin or the oil. We find both of these components so modified in different plants, as to operate with considerable energy upon the intestinal canal; and perhaps, in every instance, in which a resin can be demonstrated to be the active ingredient in a vegetable purgative, we might be able to detect a volatile, or an acrid fixed oil in combination with it. The only drastic Cathartic containing it is the root of a plant which has been long known in our gardens as one of the earliest harbingers of spring.

HELLEBORE. *Hellebori Nigri Radix.* L. E. D.—Black Hellebore, a plant belonging to the natural order Ranunculaceæ*. The root of the plant is composed of thick, fleshy fibres, of a dark colour. The plant is familiarly called Christmas Rose, owing to its flowering occasionally at Christmas; but more

* Woodville's Med. Bot. third edition, page 463, plate 169. London Dispensatory, art. Helleborus. Richard, Hist. Nat. Med. tome ii, page 536.

generally it does not flower until the end of January, or even until the commencement of February.

Authors, both ancient and modern, have differed greatly with respect to the actual plant which was employed by the ancients under the name *Helleborus*, and, consequently, it is still doubted whether the Black Hellebore is the real Hellebore of the ancients. Theophrastus and Dioscorides mention both white and black Hellebore, *Elleboros leucos* and *Elleboros melas*. Botanists have agreed that the former is the Veratrum *album* of Linnæus, a plant which I have already described, and which is very different indeed from the modern Hellebores, the family to which our present plant belongs; and there is a dark species of this genus. Tournefort, in a voyage to the Levant and into Greece, and Lamarck, have regarded the Black Hellebore of the ancients to be the Helleborus *orientalis* of Linnæus; and, if the writings of those ancient poets who have described the place of growth of the plant be credited, these opinions of the French naturalists have some foundation. But although our Black Hellebore is certainly not the celebrated plant of Anticyra, where it does not grow, yet it possesses similar medicinal properties. In the dry state, the root of Black Hellebore is exteriorly of a deep brown, sprinkled with grey; its interior is fleshy, not fibrous; its lateral fibres are fragile. Its infusion made with water at 60° has a yellow vinous colour, and is precipitated by tincture of galls; subacetate of lead also throws down a slight precipitate, demonstrating the presence of gum; and sulphate of iron striking a black colour with it, indicates the presence of gallic acid or a gallate, as no tannin can be detected by gelatine.

The taste of the roots of Hellebore is bitter and acrid, leaving an impression of burning upon the tongue. This acrimony is in a certain degree volatile; at least, the acrimony of the plant is impaired by keeping; and when the root is distilled with water, the fluid which comes over is acrid. The virtues of Hellebore, however, seem to depend upon a concrete fixed oil, which is taken up by boiling alcohol: and which may be separated by digesting the root in alcohol, and distilling off the spirit from the tincture: the oil gradually separates and concretes on cooling. When dissolved in weak alcohol, it precipitates the sulphate of iron. Monsieur Feneulle and M. Capron have analysed Black Hellebore, and state its constituents to be —1, a volatile oil; 2, a concrete oil; 3, a resinous matter; 4, wax; 5, a volatile acid; 6, a bitter principle; 7, mucus; 8, alumina; 9, gallate of potassa and of lime; and 10, ammoniacal salt.

As a purgative, Hellebore was one of the chief resources of the ancients: Hippocrates extols its virtues, and Galen regards it as the most valuable of all purgatives; but, even at that early period, the violence of Hellebore was so well known as to re-

quire the greatest caution in its administration. Perseus attacks the physicians of his time for not knowing the method of moderating the action of Hellebore. The ancients employed their Hellebore in many diseases; but it was chiefly celebrated for its effects in insanity; so much so, that the proverb "send him to Anticyra," the place where the plant was collected, was equivalent to a declaration of his madness*.

The importance of the employment of active purgation in insanity cannot be doubted; and, as the chief object is to dislodge irritating *scybala*, the advantage desired must undoubtedly depend greatly on the activity of the Cathartic. Whether Black Hellebore be the best purgative in such a case, my experience does not enable me to determine; but there can be only one opinion regarding the employment of any purgative capable of effectually clearing out the bowels. So long as the fæces consist of dark, broken-down matters, accompanied with scybala, the use of active Cathartics is indicated. I may, however, take this opportunity of pointing out the necessity of not carrying the purging too far, and the practical importance of knowing when to desist. If the fæces change in aspect and appearance, become moderately consistent, are more natural in colour and well tinged with florid bile; if, at the same time, there be a remission of symptoms, and a freedom from pain on compressing the liver; and, particularly if there be some reason to suspect the approach of debility; then it is time to discontinue the purging and support the strength of the constitution by nourishment.

With regard to the ancient use of Hellebore as a hydragogue, there can be no doubt that Black Hellebore, in common with some other drastic Cathartics, produce copious evacuations both by stool and urine; and hence it is well fitted to carry off dropsical accumulations. The pills of Bacher, that at one time held a high reputation for the cure of dropsy, contain an extract of Black Hellebore. They are now rarely employed; and indeed, except with the view of exciting the uterine organs, this Hellebore is scarcely ever prescribed. The dose of the Hellebore root, in substance, is from gr. x to ℈i, or of the decoction f℥i may be given once in four or five hours, which is a safer method of administering it than giving a full dose at once. When it is overdosed, the usual effects are vomiting, delirium, and violent convulsions; and the morbid appearances after death display signs of inflammation in the alimentary canal, particularly in the large intestines, the colon, and rectum. A gorged

* "Littus ad Euxinum, si quis mihi diceret, ibis,
Et metues, arcu ne feriare Getæ;
I, bibe, dixissem purgantes pectora succos
Quidquid et in tota nascitur Anticyra."—Ovid.

state of the lungs, and a brownish-black, or gangrenous appearance of the stomach, have also been observed. I know of no particular antidote for Black Hellebore; and, therefore, when it poisons, the case must be treated as one of simple inflammation of the mucous membrane of the intestines.

c. FIXED ACRID OIL.

In the substances arranged under this head, the fixed oil is the mere vehicle of some acrid principle, which is the cathartic agent: but the real nature of this is unknown to us, except as respects its influence on the habit.

1. OIL OF CROTON. *Tiglii Oleum.* L. D.—The Croton *Tiglium* is a native of Ceylon, the Molucca islands, Cochin China, and the greater part of the East: it furnishes one of the most violent of the Drastic Cathartics. It belongs to the natural order *Euphorbiaceæ**. The fruit, the part of this tree which yields the oil, like the rest of the natural order to which it belongs, is tricoccus, with thin, almost membranous partitions between the cells, each of which contains one seed.

The drastic properties of this plant are found in the roots, the wood, the leaves, and particularly in the seeds. The root is employed in Amboyna and Batavia as a hydragogue Cathartic in dropsy. In the same places, the wood, which is light, spongy, pale, covered with an ash-coloured bark, and has a caustic, pungent taste, and an unpleasant odour, is regarded as a *panacea*†. It is more active in the recent than in the dried state, exciting sweating in small and purging in large doses. Murray states that the leaves are so acrid that they inflame the lips, mouth, and fauces, and the heat induced by tasting them extends to the anus. The seeds were employed in medicine, in Europe, at a very early period, under the name of *Molucca grains*, and *Grana Tiglia:* but the imprudent use of them‡, in some cases, caused them to be neglected, until, a few years since, Mr. Conway, a surgeon in the Madras establishment, brought the oil into notice. In India the seeds are still employed; but their acrimony is diminished by roasting, which is done with the view of rendering them more easily pulverized.

The expressed oil of these seeds is of a bright straw or citrine-yellow colour; has a faint odour, and a hot, extremely acrid taste, which remains long upon the palate and fauces, producing a burning sensation, and a feeling of constriction in these parts.

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* Woodville's Med. Bot. 3rd edition, vol. v, p. 71. Richard, Hist. Nat. Med. tome i, p. 584.

† Rhumphius recommends an infusion of the shavings as an infallible remedy in dropsy.

‡ Geoffrey limits the use of the oil to one drachm!

Dr. Nimmo of Glasgow has chemically examined both the seeds and the oil. He found that the active principle resides in the kernels; for although the husks or shells impart a dark colour to alcohol, yet the tincture is devoid of acrimony. The kernels beaten to a paste, and digested for several days in alcohol, with a moderate heat, and this digestion repeated with fresh alcohol, eleven parts in forty were taken up by the spirit, and the residuum was tasteless, although it evidently contained a fixed oil, which greased the paper in which it was dried. To ascertain the quantity of the acrid principle, Dr. Nimmo purified some oil of turpentine by means of alcohol, agitating the two together, in the proportion of eight parts of the oil to one of the strongest alcohol, and decanting off the impurities with the alcohol, which dissolves them; and repeating this operation three or four times. This purified oil of turpentine was poured upon the residue of the Tiglium seeds after they had been acted upon by the alcohol; and after digesting for a considerable time, it was found that thirteen of the twenty-nine parts were by these means dissolved: and this being the fixed oil, it appeared that 100 parts of the decorticated seeds contained 27.5 of acrid matter, soluble in alcohol; 32.5 fixed oil, soluble in oi of turpentine; and 40 of farinaceous matter. The expressed oil consists of 45 of this acrid principle and 55 of fixed oil in 100 parts. The alcoholic solution reddened tincture of litmus when dropped into a solution of this colouring matter: it rendered water nebulous when dropped into it; and, when filtered, the clear water which passed the filter was found to be perfectly inert. From these experiments, Dr. Nimmo justly concludes that the acrid principle of these seeds, and consequently of the oil procured by expression, resides in a resinous principle, which is soluble in alcohol, sulphuric ether, and volatile and fixed oils. When strong alcohol is digested on the oil of Tiglium, and the operation repeated several times, about a third part of the oil is taken up, and the solution has all the properties of the unsophisticated oil; whilst the undissolved oil which remains is perfectly inert.

The Oil of Tiglium, from its high price, is frequently adulterated with olive or castor oil; to detect this, Dr. Nimmo recommends the following simple process. Put into a phial, the weight of which has been previously ascertained, fifty grains of the oil, add alcohol which has been digested upon olive oil, agitate well, and pour off the solution, and add more oil, repeatedly in the same manner. On placing the phial near the fire, to evaporate any remaining alcohol after the alcoholic solution has been decanted off, and weighing the phial with the residue; if we find that it is in the proportion to that which has been abstracted by the alcohol, as fifty-five to forty-five, the oil is genuine; but if the residue be greater, it implies that the

oil has been adulterated with olive oil; if smaller, then we may conjecture that it is mixed with castor oil. Dr. Paris has suggested the idea that the alcoholic solution which Dr. Nimmo obtained, contains a principle, sui generis, which he proposes to call Tiglin; but perhaps this proposition is rather premature.

Croton or Tiglium Oil operates exactly in the same manner as other drastic purgatives, except that the quantity requisite is extremely small: it operates even by the application of it to the tongue. Notwithstanding its violent action, it seldom excites nausea or vomiting; scarcely ever griping: and this is particularly the case when the alcoholic solution is employed. It may be administered in all cases where a quick and full purging is required; in maniacal cases, and in cases of visceral obstructions, and dropsical accumulations. Dr. Nimmo remarks that he has found this oil, or its alcoholic solution, in combination with opium, extremely beneficial in delirium tremens, a disease which arises generally from intemperance in the use of ardent spirits. In apoplexy I have been enabled to prove the utility of this oil; and have produced free evacuations by merely touching the tongue with the oil, after the faculty of deglutition was altogether suspended; for the same reason, it is extremely useful in maniacal cases, when there is a difficulty of getting the patient to swallow more bulky medicines.

Experience has amply justified the propriety of again introducing the use of the Oil of Tiglium into practice; and, with due caution, it is both a safe and not unmanageable medicine. The most common form of giving the oil is that of pill, formed by dropping the oil on crumb of bread; one or two drops proving a sufficient dose. It may be given with rhubarb, which readily absorbs it, and can be easily formed into pills. This mode, however, of administering the oil has one disadvantage; namely, it is applied in too concentrated a state to the portion of the stomach on which it rests. I have found that the taste and acrimony of the medicine are well covered by triturating the oil with mucilage and syrup of tolu, and diffusing it through the common almond emulsion. A tincture of the seeds, made by digesting gr. 170 of the decorticated kernels powdered in one pound of proof spirit for fourteen days, and then filtering, may be substituted for the oil. The dose of this tincture is from m. 40 to m. 100.

Mr. Morson, of Southampton Row, Russel Square, has manufactured this oil into soap, for internal use, to be given in the form of pills. He asserts that the combination of oil with the alkali diminishes its acrimony, but does not lessen its cathartic powers. The dose of this soap is from one to three grains: but no form of administering this powerful Cathartic is so good as that of solution in alcohol, as proposed by Dr. Nimmo.

2. OIL OF SPURGE. *Euphorbiæ lathyris Oleum.* — The species of Euphorbium which yields this oil is a herbaceous plant, a biennial, common to many parts of Europe, belonging to the natural order Euphorbiaceæ. It is a powerful excitant, and when taken into the stomach operates as a powerful Drastic Cathartic. In France, the fresh fruit of this species of spurge is in common use with the peasantry as a purgative; but at the same time it operates also as an emetic, and the vomiting is maintained for several days. If the dried seeds, decorticated, be swallowed, however, their purgative influence only is exerted in a mild manner.

In 1823, M. Barbier suggested the propriety of trying the influence of the expressed oil of these seeds as a purgative. This oil is white, transparent, having scarcely any odour, and a mild taste: like castor oil, it is soluble in alcohol. When kept, it becomes rancid and loses its transparency. The oil may be procured by expression; or the active principle may be separated by digestion in alcohol at 30° Beaumè, or in ether. Many experiments have been made with it in France, and these have fully demonstrated its purgative properties. From twenty to thirty minims of the expressed oil purge freely, without exciting griping; it does not heat the habit, nor cause thirst, nor affect the appetite: it operates briskly, but it does not produce that impression on the mucous membrane of the intestinal canal which plays the part of a counter-irritant; it is, therefore, inferior in many respects to oil of Tiglium, and many others of this division of Cathartics. It is, consequently, well adapted for clearing the alimentary canal in weak and nervous subjects, and in those in whom visceral irritation becomes a strong source of general discomfort, and who cannot sustain the influence of ordinary Drastic Cathartics, whilst at the same time they need the aid of an active one. The Oil of Spurge may be administered in combination with any of the other purgatives, especially rhubarb, which, from its tonic influence, is well adapted to supply tone to those habits for which it is especially indicated.

d. NICOTINA.

The existence of this principle in the leaves of Tobacco has been several times mentioned. It operates powerfully upon the intestinal canal, whether it be administered internally or merely applied to the surface. The infusion of Tobacco, which contains it, has been employed in dropsical complaints, internally; but it operates as a diuretic: it is not administered by the mouth as a purgative, although it be exhibited as a glyster in those cases which require the spasm to be resolved at the same time that the bowels are to be opened. With this view, it is frequently ordered as a glyster; but the remarks which may be offered re-

specting its effects in this form must be reserved until the subject of Enemas come to be discussed.

e. VERATRIA.

The chemical nature of this principle has been already explained. As a Cathartic, its chief influence is exerted upon the orifices of the common gall duct in the duodenum; thence a copious discharge of bile takes place, and the action of the intestinal canal is greatly augmented. It is the active principle of two Drastic Cathartics, Veratrum *album* and Colchicum *officinale*.

1. ROOT OF WHITE HELLEBORE. *Veratri albi Radix.* L. E. D.—This root is a native of the Alps, Auvergne, Provence, and Dauphiny. Although perennial, it gives origin to an annual plant, which belongs to the natural order Melanthaceæ*. The root is spindle-shaped, tuberculous, fleshy, and about an inch in thickness at the summit, and gives out, laterally, a great number of greyish fibrils. In the dry state, and reduced to powder, the root of Veratrum operates as a powerful Drastic Cathartic. According to the analysis of Pelletier and Caventou, it contains —1. a fatty matter; 2. an acidulous gallate of Veratria; 3. a yellow colouring principle; 4. starch; 5. gum; and 6. lignine†.

If we compare the quantity of the salt of Veratria contained in the root of this plant with that of the bulb of colchicum, it is surprising that it has not been substituted for the colchicum on every occasion. The other components are fewer and less likely to be taken up with the salt of Veratria, whether wine or alcohol be used as the menstruum, than when the bulb of the colchicum is employed: it is also less likely to spoil, owing to its containing less water than the colchicum bulb. In the root of Veratrum the only active principle is the gallate of Veratria; and the only question is, how can this be most advantageously separated, so as to procure a preparation of a known and specific strength? One difficulty stands in the way; the gallate of Veratria cannot be obtained in a crystalline form, consequently it must vary in strength according to the quantity of water combined with it. As one of the salts of Veratria, however—the sulphate, for instance—is crystallizable, it might be tried as a purgative; and, if its powers be equal to those of the gallate, we should thus be enabled to procure a preparation of a specific strength. In mentioning the poisonous properties of Veratria, when treating of colchicum, I stated that no antidote had yet been discovered; but on reflecting on the insoluble nature of pure Veratria, and the possibility of decomposing it, I am of opinion that an anti-

* Woodville's Med. Bot. third edition, p. 753, pl. 257. Richard, Hist. Nat. Med. t. i, p. 359.

† Ann. de Chim. tome xiv, p. 81.

dote may be readily found. Two salts at first present themselves to our attention as capable of effecting such a change—the acetate of lead and sulphate of iron; in both cases, however, a double exchange takes place, and the acetate and sulphate of Veratria are produced, both of which are poisonous. We know that magnesia precipitates pure Veratria from the gallic acid with which it is combined; but too high a heat is required to effect this, to render it useful as an antidote; and it is a daily custom to prescribe magnesia in conjunction with the various preparations of Veratria without rendering them inert. M. E. St. Maire, of Lyons, has proposed tincture of iodine as an antidote. Dogs, to which two grains of Veratria were administered, were saved on giving the tincture of iodine immediately afterwards. Too little attention has been given to this subject, which is one of great practical importance. The root of Veratrum *album* is seldom employed as a purgative.

2. COLCHICUM. *Colchici bulbus.* L. E. D.—This bulb, and the plant which bears it, has been already fully described. As a Cathartic, is operates chiefly upon the duodenum.

f. ELATIN.

This is the active principle of Elaterium, and constitutes one-twelfth of its weight. It is separated by digesting the Elaterium in strong alcohol, in a moderate heat, for twenty-four hours, filtering and washing the residuum with successive portions of fresh alcohol. By evaporating these alcoholic tinctures to dryness, a solid green substance is obtained, which is next to be boiled in distilled water; what remains undissolved is Elatin. It is nearly insipid, of a green colour, insoluble in water, soluble in alcohol and the alkalies; inflammable, burning with smoke and an aromatic odour. It is precipitated by water from its alcoholic and alkaline solutions, unaltered.* I have found that Elatin may be procured by digesting Elaterium in ether: a clear green solution is produced; and this, evaporated on pure distilled water, leaves an insoluble pellicle, which is Elatin, purer than that obtained by any other process. Elatin procured by Dr. Paris' process is not a simple principle. When it is acted on by ether, a substance is left which is soluble in alcohol; and which, on leaving the tincture at rest to spontaneous evaporation, crystallizes in acicular tufts. These crystals are nearly colourless; they are scarcely soluble in water and in diluted acids; they are fusible in a heat between 300° and 400° of Faht.; burn in the flame of a spirit lamp, and leave much charcoal. They do not form neutral salts with the acids. They consist of 17 parts of

* Paris, Pharmacologia, 5th edition, vol. ii, page 205.

carbon, 18 of oxygen, and 11 of hydrogen. Mr. Hennell, who discovered this principle, has named it Elateria*.

The activity of Elatin as a Cathartic is almost incredible; it operates violently when only one minim of an alcoholic tincture, consisting of one grain, dissolved in ninety-six minims of strong alcohol, is administered; thence it operates in doses of less than the ninety-sixth part of a grain. Elatin has not, however, been employed in its pure state, even in the alcoholic solution, as a Cathartic.

ELATERIUM, *Elaterii Extractum*, L. D.—is the dried juice of the fruit of the Momordica *Elaterium*, a plant which is a native of the South of Europe, but which is cultivated in England for medicinal use, although it is annually destroyed by the severity of our winters. The plant belongs to the natural order Cucurbitaceæ†.

The fruit of the Momordica *Elaterium* resembles a small oval cucumber, about an inch in thickness, an inch and a half in length, and is covered with thick, rough hairs. When it is fully ripe, the fruit suddenly leaves the footstalk with great force, scattering the seeds behind it like the sparks from a rocket, as it flies forward‡. The seeds, when fully ripe, are black, and are lodged in a light green pulp, the cells or interstices of which contain from half a drachm to a drachm of limpid fluid; and it is from this only that the Elaterium is precipitated.

The fruit is gathered before it is ripe, and being cut longitudinally, the juice of the pulp surrounding the seeds runs out; and this throws down the fecula, which, after the evaporation of the aqueous portion, forms the Elaterium of the Pharmacopœias. When it first flows out it is perfectly limpid and colourless, but it soon becomes turbid; and, after some hours, deposites a sediment, from which the clear liquor is to be poured off, and the residue left to dry upon fine linen stretched upon a frame. It is most active when it is dried without exposure to the light. When genuine, it is in thin flakes or light cakes, of a very light-green colour, with a bitter, slightly acrid taste, which remains long upon the palate. It is nearly inodorous, although the plant, even in its dried state, has a peculiar aromatic odour.

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* Journal of Royal Institution, N. S. 1, page 532.

† Woodville's Med. Bot. 3rd edit. plate 72, page 192. London Dispensatory, art. Momordica. Professor Richard has constituted it a peculiar genus, characterized by the separation of its fruit, and the scattering of the seeds from the orifice which is formed at the base of the fruit, when it leaves the peduncle, at the instant of its detachment: he has named it *Ecballium*.

‡ The cause of the fruit spontaneously leaving the footstalk in the forcible manner which has been mentioned, and the scattering of the seeds often to the distance of several yards, has not been discovered. When the fruit is nearly ripe, a gentle touch of the hand will cause its instantaneous separation; and from this circumstance the common appellation of the plant, *Squirting Cucumber*, originated: and also its specific name, Elaterium.

It is often adulterated with starch, which is not easily detected, as there is a large proportion of fecula in Elaterium; but when thus adulterated, it has almost a white colour instead of a pale green; and when this is the case, there is reason for suspecting its purity.

Much of the value of Elaterium depends on the manner in which it is prepared. The juice of the fruit should be allowed to run out; for when the fruit is pressed, more of the inactive parts of the natural juice of the fruit is mixed with the Elaterium, which is consequently weaker in its effects. The insolubility of Elatin in water suggests a query—what keeps it in solution in the juice of the fruit? Were I to suggest an opinion, it would be that Elatin does not exist completely formed in the fruit; the fecula which subsides when the juice runs out of the fruit is in part the consequence of an oxidizement of it; for it becomes turbid soon after it is exposed to the air; and it loses much of its activity, or rather it does not become so active, when it is dried in a bright sunshine as when it is dried in the shade. Now, we know that light abstracts oxygen from substances containing it; as, for instance, from metallic oxides, which are partially reduced by exposure to light; and we may thence infer that substances which would attract and combine with oxygen in the shade may be prevented from doing so in a bright light; and, therefore, in this case, owing to the superior attraction of light for oxygen, the fecula may be prevented from attracting its due share of oxygen; and, consequently, from acquiring the peculiar state of its constituents requisite for exerting its energy on the system. The lighter, the more spongy, the paler the green, and the thinner the cakes, the more genuine is the drug; but when the cakes are of a dark green or grey colour, or approaching to black, or when it is compact, heavy, and breaking with a shining, resinous fracture, they are not to be depended upon. The experiments of Dr. Paris, in which he was assisted by Dr. Farraday, authorized him to state that the chemical components of Elaterium are—Water 0.4, Extractive 2.6, Fecula 2.8, Gluten 0.5, Woody matter 2.5, Elatin 1.2, in 10.0 grains. The Elaterium found in the shops is generally imported from Malta. It seldom acts well under doses of a grain; and the black kind, which is prepared from the expressed juice of the whole fruit, requires from two to four grains to act.

Although the term Elaterium is frequently found in the writings of the ancients, yet it is very difficult to determine what was exactly implied by it. Hippocrates applied the term to any violent purgative; but it is evident that he also knew and prescribed the plant which we have before us; for he mentions the Σικυς αγριος, under which name Dioscorides describes the Momordica *Elaterium* of our Pharmacopœias, and the method of preparing the juice of the fruit. The ancients used every part

of the plant, both as an external application and an internal medicine, in dropsical affections; but the experiments of Dr. Clutterbuck ascertained that "no adequate substitute for the Elaterium could be found in the plant, exclusive of the fruit." Like many other medicines, Elaterium seems to have suffered in the estimation of the old physicians from the indiscretion with which it was prescribed. Simon Pauli speaks strongly of its violent effects; and, in addition to his opinion, Lister and Hoffman accused it of causing great heat and pulsation even to the ends of the fingers. Notwithstanding the opinions of the ancients, Elaterium has again been brought into general use; and, when properly managed, it is the best drastic Cathartic, not only for completely unloading the intestines, but for promoting greatly the excretion of water from the bowels; and consequently emptying those cavities of the body in which serous fluid is apt to collect. Sydenham employed it in dropsy with success; Dr. Ferriar, of Manchester, restored it to practice. He employed it very successfully in hydrothorax, in combination with colchicum, squill, and spirit of nitrous ether. In my own practice, I have given Elaterium, in doses of one-sixth of a grain, repeated every four hours, and have seen it evacuate two gallons of fluid, by stool, in the course of twenty-four hours. In such cases, it is necessary to support the strength of the patient during its operation with ammonia and camphor, Its administration, however, under every circumstance, requires great caution, and the closest attention of the physician in watching its effects. It has occasionally been exhibited in the form of suppository; that is, it has been introduced within the rectum and left there. In this case, the dose may be one or two grains combined with hard soap.

The Dublin College have placed the leaves of Momordica Elaterium in the list of the Materia Medica. From what has been said, it is evident that no confidence can be reposed upon the use of any part of the plant.

** INORGANIC SUBSTANCES OPERATING AS DRASTIC CATHARTICS.

1. PRECIPITATED SULPHURET OF ANTIMONY. *Antimonii Sulphuretum Precipitatum.* L. E.—This precipitate is produced by boiling together two parts of Sulphuret of Antimony with four parts of liquor potassæ and three of distilled water. This solution is strained through a double linen cloth whilst it is hot, and diluted sulphuric acid dropped into it as long as any precipitate is thrown down. This precipitate, after being washed with hot water and dried, is of a bright orange colour. In this process, the Sulphuret of Antimony, which is composed of one proportional of metallic antimony and one of sulphur, decom-

poses a portion of the water of the solution of potassa with which it is boiled, the hydrogen of which unites with the sulphur and the oxygen with the antimony of the Sulphuret, producing in the solution sulphur combined with hydrogen or sulphuretted hydrogen, oxide of antimony, and potassa. When the diluted acid is dropped into this solution, the potassa combines with it, forming sulphate of potassa, the sulphur and sulphuretted hydrogen being thus set free, the latter is partly evolved; and a compound of the sulphur and the protoxide of antimony is thrown down. According to the analysis of Thenard and that of Mr. Phillips, this precipitate consists of—

Thenard.		Phillips.	
Sulphur	12.00	Protoxide . .	12.0
Sulphuretted Hydrogen .	17.87	Sulphuret . .	76.5
Protoxide of Antimony .	68.30	Water . . .	11.5
Loss	1.83		100.0
	100.00		

Some chemists do not accord with the theory of the process which I have just described; but imagine that the precipitate is a simple Sulphuret of Antimony combined with water, the sulphuretted hydrogen and oxide of antimony reacting on one another when the potassa is withdrawn, the hydrogen of the one combining with the oxygen of the other to form the water, whilst the sulphur attaches itself to the freed Antimony, forming a sulphuret. There is some plausibility in this theory; as the precipitate closely resembles that which is thrown down by transmitting a stream of sulphuretted hydrogen through a solution of tartar-emetic. Regarding it as a hydrated oxysulphuret, its composition, independent of the water, will be 1 equiv. of Protoxide of Antimony = 76.6 + 2 sesqui-sulphuret of Antimony (88.6 × 2) = 176.12—making the equivalent 252.18.

This preparation is of a bright orange colour, inodorous, with a slight styptic taste. It readily catches fire, and burns with a blue, greenish flame; and when the Antimony is left in the form of a grey oxide, it is a proof that no oxide of iron is present. To render this more certain, throw the residue into hydrochloric acid, and precipitate the solution by ferrocyanate of potassa: if no iron be present, the precipitate will be white; but blue, if iron be present. If the Precipitated Sulphuret be pure, it will not effervesce with weak acids; but effervescence will occur if it be adulterated with chalk. The pure Precipitated Sulphuret is completely soluble in liquor potassæ.

This preparation is a component of the Pilula Hydrargyri Submuriatis composita of the London Pharmacopœia, which, in doses of from gr. viii to gr. xvi, operates briskly on the bowels, when it does not produce vomiting. It is, however, a very uncertain preparation.

D. CLYSTERS.—ENEMATA.

These consist of cathartic substances largely diluted and injected into the rectum.

The intimate relation between every part of the alimentary canal, and between it and the system in general, enables medicines to operate nearly in a similar manner, whether they be taken into the stomach, or injected into the intestinal canal, or applied to any part of the surface. In many instances the stomach is in such an irritable state that it rejects all kinds of medicines; in other instances, large quantities of medicines are occasionally taken by the mouth without producing any effect; in others, again, deglutition is impeded by lock-jaw, apoplexy, or similar causes. In all these cases, injections or Clysters, *Enemata*, may be resorted to; and they greatly aid the operation of Cathartics, by exciting the larger intestines.

In habitual costiveness, arising from a torpid state of the bowels, a pint of cold water, thrown daily into the rectum, not only excites the natural peristaltic movement, but imparts tone and activity to the entire gut. A table-spoonful of common salt, or of castor oil, augments the cathartic effects of this Clyster; but if the constipation be obstinate, or attended with flatulent colic, and an effective operation be required, what is termed the terebinthinate glyster is generally employed. This is made by triturating about an ounce of turpentine with yolk of egg or mucilage of gum and adding a pint of milk; or half that quantity of infusion of senna, if it be necessary to stimulate more briskly the lower bowels. All the purgatives and drastic Cathartics, combined with any bland fluid, may be employed as Clysters; infusion or decoction of senna, combined with any of the saline purgatives, are the usual kinds of Enemata in ordinary cases. Even hot water, in sufficient quantity to stimulate by distension, often answers every purpose which can be desired from the use of Clysters. Infusion of tobacco is frequently employed. Tobacco, when applied to any mucous membrane, stimulates powerfully; but, when thrown into the rectum, either in infusion in water or in the form of smoke, it operates chiefly on the nervous system, relaxing spasm, and diminishing, almost instantaneously, all the powers of life; and not unfrequently its sedative effect has been followed by death. The strong aqueous infusion paralyzes the heart and quickly destroys life: the essential oil contained in the smoke excites convulsions and coma without affecting the heart; but it proves equally fatal. Both act on the nervous system. Dr. Macartney, of Dublin, has confirmed the observation of M. Orfila, that, like other violent poisons, they are inert when applied directly to the denuded brain or nerves. But this affords no argument against the opinion that they operate through the medium of the nerves; since

there is a very great difference in the effect of an impression made upon a nerve in any part of its course, or at its origin in the brain, and its sentient extremities.

The quantity of the tobacco ordered by the Pharmacopœia for making the infusion is one drachm to one pint of water; but its effects depend very much upon the quality of the tobacco; and something upon the habit of the patient. I have seen cold sweats, the most alarming sinking of pulse, and syncope, caused by one-half the quantity which I have mentioned. Indeed, such is the risk attending the employment of the tobacco Clyster, that nothing but the failure of every other means of relief can authorize its employment. Besides the infusion, the smoke of tobacco is thrown into the rectum, with the view of overcoming obstructions similar to those which require the employment of the infusion; and certainly much less risk is likely to result than from the infusion: its efficacy, however, is less certain. A particular apparatus has been invented for exhibiting tobacco fumes as a Clyster; but every practitioner should, if possible, be independent of these *useful* inventions, which are not always at hand, and the absence of which ought not to prevent the employment of a useful remedy. The machine alluded to is a double bellows with a box interposed between its body and the nosle, for putting the lighted tobacco in, so that the stream of air passing through it carries the smoke of the ignited herb into the rectum: when this machine is not at hand, its place may be supplied by a common clay tobacco pipe, the small end of which being oiled and introduced into the rectum, and a piece of cloth spread over the mouth of the bulb holding the ignited tobacco, the smoke may be blown by the breath of an attendant into the bowels of the patient. It might be supposed that the breath, being chiefly carbonic acid gas, would extinguish the tobacco; but this is not the case, the quantity of nitre in the herb being sufficient to maintain its combustion, independent of the atmospheric air or any gaseous supply of oxygen.

Much of the inefficacy of Clysters, in many instances, arises from their not reaching the obstructed part of the canal, even when forcibly urged by the usual apparatus for exhibiting them; indeed, they seldom pass far beyond the sigmoid flexure of the colon: they operate, therefore, by exciting the lower portion of the bowels, and produce merely partial discharges; for although there is a general sympathy of action in the whole intestinal canal, in its healthy state, yet this has not much influence in those diseases which are accompanied with obstinate obstructions of the bowels. Clysters are more effectually administered by means of the stomach pump; by apportioning the force of which, the fluid may be conveyed to any part of the intestinal canal.

With regard to the proper bulk of Enemas for different ages—the usual quantity for an adult is a pint of fluid; that for an infant, not more than three fluid ounces; so that, between these points, taking into consideration the size of the individual, the quantity proper at different ages may be readily determined. If too much fluid be employed, the Clyster acts by its bulk, rather than the stimulus of the material; the reaction of the gut upon its foreign contents is too quick, and the object of the prescriber is defeated. But it is equally necessary that the quantity should not be too small; as, in that case, it remains too long in the bowels, and often fails altogether to excite their action.

Besides Cathartics and Enemas, the peristaltic motion of the bowels may be increased by various external means. Thus, in simple torpor of the gut, the electrical aura is highly useful; and, in obstinate costiveness, when all other means have failed, dashing cold water on the lower extremities has succeeded in procuring the immediate evacuation of the intestines.

THERAPEUTICAL EMPLOYMENT OF CATHARTICS.

Having completed our examination of the substances usually employed as Cathartics, it now only remains to advert to their practical employment in the treatment of diseases.

The symptoms, independent of the existence of specific disease, and exclusive of a confined state of the bowels, which indicate the administration of Cathartics, are—a whitish, yellowish, or blackish tongue: dryness of that organ, and any unusual taste in the mouth; fulness of the lower belly, with or without tenderness on pressure; the urine saffron-coloured or loaded with bile; and fluid dejections, with borborygmi.

The *first* general intention of administering purgatives is to clear the intestinal canal; for which purpose they must be given in full doses, and those selected that will act on the whole course of the canal; namely, castor oil, or a combination of tartrate of potassa and infusion of senna. The *second* is to correct unhealthy secretions; and this is to be effected by calomel or the blue pill given at bed-time, followed by a purgative in the morning. The symptoms indicating this practice are a whitish slimy-coated tongue, the white of the eye suffused with yellow, and the skin dry, harsh, dingy, and sallow. The *third* is to augment the discharge from the intestinal exhalants, so as to lessen the bulk of the circulating mass and to lower excitement, which are best accomplished by small repeated doses of neutral salts: for instance, from ʒss to ʒi of sulphate of magnesia, repeated at the distance of three or four hours, for several successive days. And it is important to recollect that, in many instances, purgatives debilitate as much as blood-letting. The

fourth and last intention is to lessen the determination of blood to particular parts, by employing a purgative to produce the effect of a counter-irritant.

In reference to disease, Cathartics are advantageously prescribed in every form of fever; and in the commencement they often arrest its progress. The intentions which have led to their employment in this class of diseases have been founded upon the theory which at the time has swayed the opinions of medical men. Thus, when fevers were supposed to depend on a morbific matter, which it was essential to expel from the habit, they were given to effect this in every stage and every form of fever; and their administration was thus dictated by opinions which have been long since forgotten. To examine these would be a sacrifice of time. Let us therefore enquire into the circumstances by which their administration is to be regulated in each description of fever.

In intermittents, the influence of tonics is greatly aided by the employment of brisk Cathartics, in the first instance, to clear out the intestinal canal: their subsequent employment, however, must depend very much upon circumstances. Thus, in warm climates, there is generally a greater derangement of the biliary organs than in cold climates; and therefore Cathartics are more required in agues. In cold climates, season makes a difference: autumnal agues require more purging than those of spring, owing to the derangement of the biliary organs which then occur. With respect to the period of the disease—they certainly ought not to be given so that their operation shall occur in the cold stage of the paroxysm, which they always protract by weakening the powers of reaction; and they are equally inadmissible in the sweating stage, as they tend to cut this short and to change the intermittent to the remittent type. In the hot stage, they are indicated when there is much oppression at the præcordia, and a determination to the head: but the time to administer them with least hazard is during the apyrexia or intermission. The symptoms indicating their use in intermittents, are, much arterial excitement, great derangement of the abdominal viscera, headache, and dyspeptic feeling. The division of the Cathartics best suited for intermittents, is that of Purgatives—for example, Calomel and Rhubarb; but if they are required merely to regulate the bowels, nothing answers better than Aloetics. In prescribing Cathartics, however, in intermittents, it should be recollected that, as agues are diseases of depression of strength, much purging is always injurious; for, when the disease is yielding to tonics, the exhibition of a brisk Cathartic will often renew the paroxysm in all its original violence, and render the subsequent treatment more difficult, and the disease more protracted than it would have otherwise proved. This is an observation which was made by Sydenham and De Haen; and has

been confirmed by the experience of every subsequent attentive observer.

The opinions regarding the efficacy of Cathartics in continued fever have been very opposite. It had been observed that spontaneous diarrhœa sometimes proved critical in continued fever; therefore Cathartics were supposed to be capable of cutting short the attack; and, undoubtedly, when there are vitiated biliary and intestinal secretions, they have proved useful in preventing the formation of both remittent and continued fevers: but it is doubtful whether a fever, fairly formed, was ever cut short by Cathartics. The bile may be vitiated by any morbid state of habit affecting its secretion; and we know nothing that will correct this state of bile; thence the importance of carrying it quickly out of the habit; which can only be effected by purgatives that stimulate the duodenum and unload the liver. They have been used to cure continued fevers, even typhus; and the custom of prescribing them in modern times may be ascribed, in a great degree, to the work of Dr. Hamilton on Purgatives. That experienced physician regards their utility to depend on "their acting through the whole extent of the intestines, and their carrying off feculent matter, rendered offensive and irritating by constipation." He recommends a purgative of an active nature to be given daily; and repeated more than once in that period, if full purging be not effected by it. But, notwithstanding the success of Dr. Hamilton, and his high authority, it cannot be denied that a course of purgatives, even the most judicious, will often fail to cure continued fevers. After the formation of these fevers, all that the physician can do is to watch their progress, to alleviate symptoms, and to obviate, as the late Dr. James Gregory used to express himself, "the tendency to death." Cathartics are, therefore, useful as auxiliaries; but they cannot be regarded as the remedy for the cure of fevers. When they are indicated in continued fever, they cannot be administered with propriety in every form and stage of the disease. When the fever is accompanied with great arterial excitement, they are well adapted to diminish this state; particularly the saline purgatives, administered in moderate and frequently repeated doses. In synochus, they may be freely used in the early period of the disease; but much caution is requisite in their after administration. In pure typhus, when there is much morbid irritability of the stomach and the intestinal canal, the use of Cathartics requires great caution; nevertheless, symptoms frequently occur in the progress of the disease that demand their employment; and we are not to be deterred from prescribing them by the name of the fever. Whenever the secretion of the liver is so much augmented as to tinge the skin and white of the eye yellow, Cathartics are indicated, and must be administered.

It was the practice of the physicians of former times to delay the administration of Cathartics until the decline of continued fevers; in order, as they imagined, that the morbific matter should be concocted and rendered proper to be expelled. The experience of modern times has demonstrated both the fallacious reasoning and the impropriety of the practice of our ancestors in this respect. The employment of Cathartics, as I have already stated, is contraindicated, at the conclusion of these fevers, by the debility which always accompanies their decline; but much of this may be obviated by the judicious administration of purgatives in the early stage of continued fever. Their early administration prevents also the occurrence of diarrhœa in the decline of the disease; this being often the consequence of accumulation of feculent matters, rendered more irritating by the previous derangement of the system. On this account, also, the administration of Cathartics is useful in convalescence from fever, to prevent the accumulation of crude and undigested matter in that period when the appetite exceeds in keenness the digestive powers of the stomach. Upon the whole, we may conclude, that Cathartics may be advantageously employed in every stage of continued fever, when the symptoms indicate a phlogistic diathesis, known by a hard, full pulse, thirst, a dry, hot skin, and high-coloured urine. There are states, however, where these symptoms are present, in which Cathartics are of little avail without the aid of blood-letting, either general or by leeches or cupping—thus, when there is a determination of blood to some particular organ, as the head, the chest, or the stomach. When the functions of the intestinal canal are deranged, marked by obstinate constipation, dark-coloured, fœtid fæces, Cathartics are particularly indicated; and, until this state is changed, require to be daily repeated. If, however, with these symptoms, the debility be great, the Cathartics must not be given in full doses: but, as debility arises from very opposite causes, it consequently requires to be removed by very opposite means. If it be kept up by irritating matters in the intestines, augmenting the fever, it is obvious that, by removing these, Cathartics will diminish instead of increase the debility; but when it is the result of long-continued febrile action, independent of such local irritation, then purging becomes injurious. As it is, nevertheless, requisite to regulate the bowels, clysters may be employed instead of Cathartics; and they are often of great advantage in effecting daily, regular discharges from the intestines.

With regard to the selection of Cathartics in continued fever, much will depend on the nature of the attack, its period, and the constitution of the patient. If the bowels be easily moved, no purgative is so well adapted for fevers of a typhoid character as the bitartrate of potassa; but often the bowels are so torpid, that the more powerful are requisite, even when the debility is

considerable. Those which require much time to produce their cathartic effects should not be employed; as the quicker the operation is produced, the better: calomel combined with an antimonial and rhubarb, or followed by a saline purgative, is the best Cathartic in such cases. On every view of the subject, we should remember these remarks of Dr. Hamilton—"that while purgative medicines preserve a regular state of the body, they do not aggravate the debilitating effects of fever. The complete and regular evacuation of the bowels, in the course of fever, is the object to be attained. Within this limit," says this experienced physician, "I have had much satisfaction in prosecuting the practice; nor have I, in a single instance, had occasion to regret any injury proceeding from it; for I am not an advocate for exciting unusual secretion into the cavity of the intestines, and for procuring copious watery stools: these, while they are not necessary, might increase the debility so much dreaded*." In taking this advice as our guide, we must be certain of the condition of our patient; for it occasionally occurs that accumulations take place when both the patient and the nurse report that the bowels are freely opened: not to purge in this case might be injurious; but, in satisfying ourselves of its necessity, the purgative must be such as will act fully, and will fairly clear the intestinal canal. On the contrary, when unhealthy secretions, pain, tenderness, and flatulence, do not soon yield to purgatives, their employment should be discontinued; as these symptoms, instead of being removed, are sometimes kept up by the use of the Cathartics. The physician who purges indiscriminately in continued fever, and expects that the patient can profit by this practice, relies on a vain delusion.

In fevers accompanied with topical inflammation and pains, however useful Cathartics may be in removing feculent irritating matters from the intestinal canal, they can be employed only for that purpose; their effects, as evacuants acting on the general circulating mass, are too slowly produced to be essentially useful in this description of fevers; and they never can supersede the employment of the lancet. In some cases, even their stimulant operation, if abdominal inflammation exist, may produce much harm, and counterbalance any benefit derived from their cathartic influence. Rheumatism and gout, however, are exceptions to this rule. In the commencement of the former, purging is not only useful, but essentially necessary, particularly in the acute form of the disease: indeed, nature has pointed out its advantage by the beneficial effects that follow the occurrence of diarrhœa in rheumatic attacks. During the free action of the bowels the pains are suspended; and if the diarrhœa be

* Hamilton on the Utility and Administration of Purgative Medicines in several Diseases.

not suddenly checked, it generally carries off the rheumatism. The alliance between gout and rheumatism is so close, that the treatment beneficial in one is applicable to the other. This was a very ancient practice: the Hermodactylus of the ancients, our Colchicum, was the remedy employed to effect this intention; and its chief benefit arose from its purgative properties, rather than from its sedative quality. It operates chiefly on the duodenum, powerfully stimulating the gall ducts, and emptying the liver of its contents. Indeed, in scarcely any instance have I observed gout relieved by Colchicum until the evacuations, which are chiefly bile, fresh supplied from the gall ducts, flow freely.

The student who is informed that gout was formerly cured solely by purgatives, will naturally enquire, why was the practice set aside? The only reply is, that the authority of Sydenham enslaved the minds of his followers; and, for nearly a century, physicians, misled by a name, abandoned the disease to itself. This great physician conceived the idea that it was an inviolable law of Nature that diseases should be thrown off by the extremities; thence, in gout, he forbade the use of cathartics—"nisi ut materia peccans," says he, "quam Natura in corporis extremitates protruserat, in sanguinis massam denuo revocetur:" an opinion purely hypothetical, and now happily exploded. Gout is a disease of depraved digestion: to relieve it, the most complete evacuations of the whole alimentary organs are essential. Colchicum, in effecting this, produces the well-known benefit derived from its employment, and not by any occult quality.

In thoracic inflammation Cathartics are not of great use; although, after free blood-letting, it is of importance to maintain the regular action of the bowels. In Enteritis, notwithstanding the dread of our Continental brethren, purging, after blood-letting, is necessary; and, instead of increasing the inflammatory action which constitutes the disease, it is the most effectual means of maintaining and extending the benefit derived from the use of the lancet: besides removing hardened fæces, or other causes of inflammation, purging, by increasing the exhalation of fluids into the intestines, unloads the vessels and relieves the diseased parts by the same process which Nature adopts. In strangulated hernia, after reduction of the gut, much of the danger of the case is lessened by freely unloading the bowels. In diseases of the other abdominal viscera, their administration requires much consideration: thus, when the liver is oppressed with an excess of bile, purgatives are productive of the most salutary effects; but when it is suffering under inflammation, they augment the excitement and produce mischief. In indurations of its tissue, also, purgatives, in small and frequently repeated doses, prove beneficial and permanently useful; while,

in hypertrophy of the organ, even when they evacuate much bile, only trivial and momentary relief follows their employment.

The close sympathy between the skin and the intestinal canal readily suggests the advantages to be derived from purging in contagious febrile affections, accompanied with cutaneous eruptions that run a particular course. In small-pox, next to cool air, nothing so much moderates the violence of the symptoms as the judicious administration of purgatives: they allay heat, reduce the general excitement, and, consequently, lessen the crop of pustules: the same advantages follow the use of the milder laxatives in measles. Much prejudice has existed against the employment of Cathartics in scarlatina. It is remarkable that this dread was even felt by so judicious a physician as Dr. Willan; and, although it is gradually subsiding, yet it still continues to haunt the imaginations and modify the practice of many excellent practitioners. My own experience in the treatment of this disease authorizes me to say that Cathartics benefit not only by diminishing the fever, but also by preventing those dropsical swellings and visceral derangements that follow it; and when they have taken place, Cathartics are the best means of removing them.

Cathartics are useful in erysipelas, when it assumes what has been termed the phlegmonous character; but when it is accompanied with symptoms of low fever, delirium, or coma, when the colour of the affected part is dark red, and the vesications assume a livid hue, they must be given with the greatest circumspection: on the contrary, along with the employment of bark, the mineral acids, opium, and wine, the mildest aperients only are admissible in this state of the disease. If it be necessary, however, to open the bowels more freely, even in this form of the disease, terebinthinate enemata may be exhibited with advantage.

In the hæmorrhagic affections, the employment of Cathartics will depend on the nature and kind of the hæmorrhage. In passive hæmorrhages, when the flow of blood is the consequence of a weakened condition of the coats of the vessels, connected with general debility, purgatives, except merely to obviate constipation, are contraindicated: but, in active hæmorrhages, they are advantageously given during the intervals of the bleeding, both to reduce the general phlogistic diathesis and to promote the balance of the circulation. In hæmatemesis, Hoffmann, Frank, and other excellent Continental physicians, reprobate the use of purgatives; but, in many cases of this disease, British practitioners place much confidence on them, particularly when this form of hæmorrhage is connected with uterine torpor and sluggish bowels; and the benefit has been found to extend even to chlorotic and leucophlegmatic habits. It must, however, be

admitted, that their inconsiderate employment in exhausted constitutions, especially when this arises from organic disease, may prove highly pernicious. In hæmoptysis, purgatives of the saline kind are useful, by the determination which they effect to the mucous membrane of the intestinal canal, and the reduction of the mass of the circulating fluid which follows their action. In hæmorrhoids, whether depending on a dilated state of the veins, or a varicose state of the hæmorrhoidal veins, or on fungous and polypous growths of that part of the intestinal tube, the accumulation of fæces, by pressing upon these irritable tumors, augments the disease and induces severe pain ; thence, the aid of purgatives is required. In this disease, however, the kind of purgative is of importance : in the majority of cases, those which operate mildly and promote the regular excretion of the fæces, namely, castor oil, sulphur, and the saline purgatives, are the best adapted for this disease : but although many of the resinous Cathartics are too violent in their operation—and we are particularly warned, in most works on the treatment of diseases, against the use of aloës—yet even aloës may be employed in doses sufficient merely to keep up a regular discharge. The local effect of resinous purgatives on the rectum even proves useful in this affection ; as may be observed in the effect of copaiba, and of Ward's paste, the chief ingredient of which is long pepper, a substance which stimulates the whole of the canal from the duodenum to the rectum.

Cathartics are generally administered in dysentery. When the intestinal inflammation is not preceded by diarrhœa, the contents of the bowels acquire an acrid character, and require to be removed : in effecting this, we must recollect the inflammatory state of the colon and rectum, and employ castor oil, or even milder purgatives, as soon as a little respite from pain has been obtained by bleeding. Drastic Cathartics augment the tendency to tenesmus, the most distressing of its symptoms.

In apoplexy, Cathartics of the most active description are often requisite. I have hinted the great advantage of employing the oil of Croton *tiglium* in this disease, when deglutition is completely impeded. The merely placing a drop of this oil upon the tongue is often sufficient to excite the evacuation of the intestines. In stating, however, the importance of this class of medicines in apoplexy, it is obvious that little can be expected from the administration of purgatives, except in aid of the lancet. When they prove beneficial, the result must be ascribed as much to their counter-irritant as to their evacuant influence. In many other affections of the head, they are the remedies to be relied upon. In the commencement of hydrocephalus, for example, the disordered state of the stomach and the comatose tendency are often readily removed by active purging. Indeed, in families in which there is a strong predis-

position to this disease, I have succeeded in warding it off, until after the age in which its attacks are most frequent and most to be dreaded has passed, by a constant attention to the state of the bowels. In maniacal cases the ancients rested their chief reliance on Cathartics, and black hellebore was the medicine they employed. But although this faith in the virtues of hellebore kept its ground for upwards of two thousand years, yet it lost ground ; and hellebore is now altogether neglected in these diseases : but the general utility of purging in maniacal cases is undoubted. In the commencement of the disease and during its active stage, purging is not only useful, but absolutely necessary ; the secretions are then always of a vitiated kind ; and when the torpidity of the bowels is great, large quantities of vitiated bile and feculent matters collect in the cells of the colon ; thence, the irritation excited by these greatly increase the cerebral excitement ; and as ordinary purgatives will not remove them, the more drastic are indicated. For this purpose it is sometimes necessary to employ elaterium and oleum tiglii, in conjunction with calomel. In general, however, such active measures are not required in the treatment of insanity ; after they are once cleared, it is sufficient to keep the bowels regular by the use of simple laxatives, if diet and exercise be insufficient for this purpose. Their torpid state in maniacal cases often admits extraordinary accumulations to take place without the suspicion of the practitioner being directed to this circumstance. The bowels are daily opened, but fluid stools only are passed ; and even when purgatives are administered, and ample evacuations apparently obtained, yet no sufficient relief results ; there is still a sensation of uneasiness ; and, as the patient expresses himself, a load remains. In such circumstances, if an examination be made per anum, the rectum is found to be extended by an accumulation of fæces immediately within the sphincter muscle. In one case, which came under my care, it was necessary to dilate the anus and to take away the hardened fæces by means of a spoon. The quantity filled a bladder of considerable size ; and, from the induration of some parts of it, must have been accumulating for a considerable time. In general, the excretions in mania are dark-coloured and extremely fœtid : this state demands the use of purgatives ; and their employment continued, if the constitution of the patient permit, as long as it remains. When debility, in mania, has been induced by long-continued violence, or by want of due assimilation of the food, clysters are more requisite for regulating the bowels than purgatives administered by the mouth. But the young practitioner should be aware that maniacs often resist the natural tendency of the bowels to relieve themselves ; and, yet, that the difficulty of getting medicines introduced into the stomach is such as to render the evacuation of the intestines a

matter of the greatest uncertainty. In such cases, elaterium or the oil of tiglium must be resorted to, as they may be given in small bulk, and we can almost always depend upon getting the bowels evacuated by their means. Upon the whole, although the ancient opinion of strong purging in maniacal cases be founded on an untenable hypothesis, yet, as far as it can be accomplished, a daily evacuation of the intestines is essentially necessary; and, as far as this is deficient, or when the secretions are unhealthy, Cathartics are important auxiliaries in this class of diseases.

In all spasmodic complaints, as every source of irritation in the intestinal canal tends to increase the irregular actions which characterize these affections, Cathartics prove highly beneficial. In noticing their effect, however, in spasmodic affections, it is requisite that we should be aware that, owing to peculiar idiosyncracies, some Cathartics induce the very diseases which they are intended to remove: a dose of rhubarb has produced every symptom of epilepsy; and, in an instance within my own observation, the smallest dose of calomel has caused the most alarming syncope. Hysteria is undoubtedly a disease intimately associated with a morbid condition of the alimentary canal. The preceding symptoms are pains in different parts of the abdomen, sour eructations, hiccup, flatulence, constipation, vomiting sometimes, and purging, indeed the usual symptoms of dyspepsia; and after these have continued for some time, a sudden alarm, or any circumstance which can powerfully affect the nervous system, will bring on all the convulsive efforts that characterize this disease. Dr. Hamilton regards hysteria in this point of view; and considerable improvements in its management have resulted from the purgative practice which he introduced; nevertheless, purgatives alone will not cure hysteria; although its recovery is much promoted by the free employment of purgatives. When the phlogistic diathesis is present, it is removed speedily by Cathartics; when debility exists, the alimentary canal being relieved, the tone and vigour of the system is more easily restored than it otherwise would be were purgatives not employed.

It is highly probable that in both varieties of tetanus the exciting cause is a morbid irritation; which, if it cannot be traced to a wound, must be looked for elsewhere, and in no place is it so likely to be found as in the alimentary canal. This view of idiopathic tetanus is confirmed by the frequent occurrence of this variety of the disease in countries where the food is of a crude and indigestible kind. In Sir George Mackenzie's Travels in Iceland, we are informed that, in the group of islands called Westmann-Eyar, situated on the southern coast of Iceland, many of the children are cut off by lock-jaw. These islands are formed of lava; the inhabitants are remarkably

indolent; their food consists chiefly of salted fulmars and puffins—very fat, oily sea birds. They have no vegetable food. The disease, therefore, appears to arise from the effect of bad food on the constitution of the mother, and the practice of giving to the infant a strong and oily animal diet almost immediately after birth. Whatever may be the nature of the irritation which produces tetanus, it acts on the nerves of the spinal marrow that supply the muscles of respiration. In idiopathic tetanus, if the bowels be cleared out, much of the difficulty attending the cure of the disease is set aside*. But, if the utility of purgatives in tetanus were all problematical for adults, there is no difference of opinion respecting their employment in the lock-jaw of infants: indeed, when we consider that in every instance the disease in infancy can be traced to some irritation of the abdominal viscera, we cannot for a moment withhold our concurrence in the propriety of the active employment of Cathartics for its relief. In such cases, the importance of those Cathartics, such as oil of tiglium, which operate when merely applied upon the tongue, becomes obvious.

No disease admits of so much benefit from the use of purgatives as Chorea, St. Vitus' dance. In the commencement of this disease, gentle purgatives, repeated at moderate intervals, are more useful than drastic cathartics; and when the irritability and mobility of the habit is lessened by the administration of nitrate of silver as a tonic, a cure is often speedily effected. When the disease has long held possession of the habit, and custom has some share in maintaining its influence over the nervous system, the Cathartics must be of the most active description, and given in such succession that the effect of one dose shall be still felt at the time of administering the next. Unless such an impression be perpetuated on the intestinal canal, I have seldom seen much benefit derived from this method of treating Chorea. It was the custom of Sydenham and the older physicians to purge freely in Chorea; and, at the same time, to bleed both generally and topically. I have never seen any advantage from this practice: on the contrary, after the due evacuation of the intestines, as soon as the stools assume a healthy aspect, tonics of the most powerful kind can

* I cannot avoid taking this opportunity of making public my experience of the powerful influence of cupping along the spine, in relieving the spasmodic rigidity of the muscles in tetanus, in conjunction with the exhibition of cathartic glysters, as long as the jaw remains fixed; and purgatives, combined with opium, on the first moment that any relaxation of the spasm permits their introduction into the stomach. I had an opportunity of witnessing the successful effects of this plan of treatment in two cases; one of which was a case of traumatic tetanus. Blood was drawn from the cervical portion only of the spine; but dry cupping was employed throughout the whole length of the spine three times a day. The patient informed me that, each time the cups were applied, the acute pain under the apex of the sternum was relieved, and did not return for some time afterwards.

alone be depended upon for the establishment of the cure. Indeed, however important purgatives are in the treatment of Chorea, as long as the bowels exhibit appearances that demand their administration, beyond that point they are productive of mischief. An interesting case is detailed by Dr. Bostock (Medical Gazette, vol. vii) of a boy having been cured of stammering by purgatives. Dr. Bostock thinks that stammering often depends on a state of certain muscles, resembling that of all the muscles in Chorea, and which may be termed local Chorea. The alvine discharges were offensive and dark-coloured.

In some forms of dropsical effusions, practitioners have long and justly relied upon the efficacy of Cathartics. Sydenham recommends their daily employment, provided the strength of the patient admit of continued purging. No practice can be more sound than this in those cases of dropsy that are connected with an inflammatory state of the system; and Cathartics are still more beneficial when they are employed in conjunction with blood-letting. I have already stated, that, from the property of the drastic Cathartics to produce watery discharges from the bowels, they were termed *hydragogues* by the ancients, and were conceived to be peculiarly well adapted for the cure of dropsy. In many respects this opinion is correct; and when dropsy is attended with a torpid state of the bowels and great fulness and activity of the pulse, drastic Cathartics are highly beneficial. But, in adopting this opinion, we must recollect that dropsy is also occasionally a disease of debility, the result of a weakened and exhausted state of the system. In such cases Cathartics are not admissible; indeed, I might almost say that *anasarca* and *ascites* are the only forms of dropsy in which they are absolutely indicated. In hydrothorax, on the contrary, they are wholly inadmissible: they do not sufficiently stimulate the capillaries in these cases; but, by increasing the debility, they augment the difficulty of breathing, not only by allowing the fluid to accumulate and narrow the capacity of the chest, but by generally weakening the habit, and increasing the difficulty of expanding the thorax and enlarging the breathing portion of the lungs to an extent requisite for effectually carrying on the function of respiration. When drastic Cathartics are admissible in hydropic complaints, they should always be administered on successive days; but, if their proper curative effect be not obvious in a short time, their continuance is injurious, by increasing the debility of the general system. During the intervals of their administration, tonics and moderate stimulants are indicated, to support the strength. When drastic purgatives prove beneficial, the effect is probably the result of the excitement of the exhalant arteries of the intestines, which, by pouring out their contents, abstract a great quantity of serum

from the circulating mass; so that the blood is thereby deprived of much of its fluid matter.

In Jaundice, Cathartics have been employed to remove local obstructions to the flow of the bile into the duodenum; and to stimulate the liver to increased action, as far as regards the secretion of bile, when this is deficient. By stimulating the orifice of the common duct, and at the same time augmenting the natural movements of the intestines, they convey a new excitement to the duct, which enables it to force forwards any calculus or inspissated bile in it, and thus to aid its expulsion. With respect to the Cathartics proper for this purpose, calomel is almost invariably selected. It has a powerful influence on the duodenum; and, in conjunction with aloetics, is perhaps the best that can be employed in jaundice. But the bile is often prevented from passing into the intestines by the condition of the intestines themselves, independent of calculi. This is particularly the case in young patients, in whom the obstructing cause is not unfrequently a viscid state of the secretion of the duodenum, arising from a deficient secretion of pancreatic fluid to stimulate its glands. In some cases, even foreign substances, passing undigested from the stomach, act as the obstructing causes. In all of these instances, Cathartics are the best remedies; and, even when scirrhus exists, or the common duct is obliterated by cohesive inflammation, Cathartics are still indicated for relieving the obstinate constipation which always accompanies a deficiency of bile in the intestinal canal. In this state, the best Cathartic is aloës; not because it is bitter, and may supply the defect of bile, but because its cathartic operation is always followed by a lax state of the bowels. It is a curious effect of the repetition of calomel in some habits, that it causes white stools. It has been supposed that, in such cases, gall-stones previously exist in the gall-bladder, and that the stimulant influence of the calomel on the orifice of the common duct brings them down from the bladder into the duct: but were this the case, other purgatives, which also stimulate the gall-ducts in their passage through the duodenum, should produce the same effect; which, however, is not the case. I am, therefore, inclined to think that this effect of calomel depends upon some other cause not yet ascertained.

The whole genus of Cathartics has been employed for the expulsion of worms from the intestinal canal. They are well adapted for removing these parasites when they are destroyed or detached from the coats of the bowels by other means: but the continued use of Cathartics is more likely to foster worms than to destroy them, by weakening the intestines and increasing the quantity of morbid mucus, the nidus in which they are formed.

In all chronic diseases, Cathartics are useful. It is almost

unnecessary to speak of their utility for regulating those natural and diurnal discharges from the intestines requisite for preserving the ordinary state of health: for there is great diversity in the frequency of the evacuation required for maintaining health in different individuals. We read of persons who have continued to enjoy health, although they have passed weeks, months, and even years, without an alvine discharge. Some of these cases are recorded in Haller's Physiology. In Heberden's Commentaries, mention is made of a person who had a motion once a month only; and of another who had twelve motions daily for thirty years; and then seven every day for seven years —"neque," adds the distinguished narrator, "vir hic interea macuerat, quin potius aliquanto habitior factus erat*." But the most remarkable case on record, is one of abstinence in a young lady, mentioned by Ponteau, who had no stool for upwards of eight years; yet, during the last year, she ate abundantly of fruit, and drank broth, with yolks of eggs, coffee, milk, and tea. But these are rare cases. The daily evacuation of the bowels is generally requisite for the preservation of health; and, when this is interrupted, head-ache, vertigo, a sense of weight at the epigastrium, nausea, fœtid breath, and other symptoms indicating derangement of the digestive organs and abdominal viscera occur; and, when long-continued, are followed by emaciations. In such cases, courses of mild purgatives, upon the plan pointed out by Mr. Abernethy, are proper: besides relieving the bowels daily, the secretions are improved, particularly those of the liver; and all the functions of the stomach and intestines are gradually brought into a healthy state. In the instances of irregular bowels of this kind, which have come under my notice, I have found the Rochelle Salts, in combination with carbonate of soda, taken in a state of effervescence with lemon juice, to answer better, and to clear the loaded tongue more rapidly, than the draught with infusion of senna usually prescribed by Mr. Abernethy. When costiveness is accompanied with griping, arising from spasmodic constrictions, the disease is *Colic;* when with twisting about the umbilical region, with acute pain, it is *Ileus*. In both, Cathartics, combined with opiates, are the remedies to be relied on. In some modifications of this state, particularly that which is termed painters' colic and dry belly-ache, castor oil is regarded almost as a specific. In violent cases of ileus, all the ordinary Cathartics fail; in this extremity, injections of turpentine and of infusion of tobacco have been employed; administering, at the same time, mild purgatives combined with narcotics, especially henbane, by the mouth; and, when these fail, the patient has been relieved by being taken out of bed and cold water suddenly dashed upon his extremities.

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* Commentarii de Morb. Hist. cap. v.

In the event of intusception, or the strangulation of the gut, from one portion of it slipping within another, I have already mentioned that injections, forcibly thrown into the intestines from the rectum, are the only rational means of relief. Dr. Haen practised this plan successfully. He employed water, and invented a machine, which may be regarded as the original of the stomach pump, for effecting this purpose. I have employed the stomach pump successfully in two instances. In order to secure success, however, the injections must be administered before inflammation of the strangulated portion of gut has continued long enough for coagulable lymph to be thrown out, and cohesion to take place. When this occurs, no human means are effectual for the removal of the obstruction; gangrene supervenes, and death ensues.

In concluding the consideration of this part of my subject, I need not advert to its importance, and the great value of the tribe of medicines which produce a Cathartic effect on the body. In all diseases, they form useful auxiliaries to other medicines. Their number retained in the British Pharmacopœias is greatly less than formerly; but the list is still too extensive: the pruning knife, however, must be applied with caution; and it is only when the facilities for extensive clinical observation are within our power that we can determine the absolute worth of any medicine.

SECTION XV.

DIURETICS—MEDICAMENTA DIURETICA*.

DIURETICS are usually defined, "medicines which augment the urinary discharge." This definition is correct in the general terms in which it states the effect of *Diuretics* on the body; but it conveys no idea of the manner in which they operate, nor describes nor points out any organ upon which their influence is exerted to produce their effects. It might thus be considered defective, as being too general; but it is the only one that can be admitted: for the excretion of urine, under the influence of Diuretics, does not always arise from a direct application of the diuretic substances to the kidneys; but from circumstances connected with the state of the stomach and other organs, under which the kidneys act only a secondary part.

Diuretics are supposed to operate in four distinct ways: 1.

* From διὰ and οὖρεω.

By passing into the circulation, and reaching the kidneys without undergoing any decomposition in *transitu*, acting directly as stimulants to the urinary organs. 2. By suffering decomposition in *transitu*, and aiding, by one or more of their constituents, the secretion of the urine. 3. By acting primarily on the stomach and primæ viæ, communicating their action by sympathy to the kidneys. 4. By stimulating the torpid capillaries to more healthy action, thereby preventing the undue effusion of fluids into the serous cavities, and enabling the absorbents to convey back those already effused into the circulation, to be discharged by the kidneys. To understand these methods of action, it is requisite that we should have a correct knowledge of the structure and functions of the kidney.

In the longitudinally divided kidney, the organ displays two parts: one exterior, or, as it is termed, *Cortical;* the other interior, or *Medullary*. The secreting part of the organ is situated in the cortical portion, and consists of small vessels arising from the sides of the capillary arteries and running into vascular glomerules, hanging from them like berries from stalks: from these arterial glomerules spring minute, colourless, secreting vessels, and also the radicles of veins for conveying back into the venous trunks the blood, after it has been deprived of the secreted fluid. The secreting ducts terminate in the excreting tubes; which, pursuing a straight course through the medullary substance, coalesce into a few trunks, the open mouths of which perforate the papillæ in the pelvis of the organ. Each of these papillæ corresponds to an original lobe of the kidney, and conveys the urine secreted in that lobe into its infundibulum: the union of the infundibula forms one large membranous cavity or pelvis, which terminates in the ureter.

1. Now, the blood sent to the kidney passes through the glomerule in innumerable streams, and supplies the pabulum from which the urine is secreted. The blood, therefore, is the natural stimulus of the kidneys; and whatever it can convey to these organs must more or less affect this natural function, so as to increase or diminish the discharge of urine. Hence the inquiry, in what manner is this effected?

If we analyse the urine, we find that it consists chiefly of water and urea, a peculiar substance, which is a compound of 2 eq. of nitrogen = 28, + 2 of oxygen = 16, + 2 of carbon = 12, + 4 of hydrogen = 4, making the equivalent = 60; and thence the kidneys have been regarded as the great outlet for nitrogen from the system. The urea, the largest component, if we except the water, is separated from urine by evaporating it and acting upon it by alcohol, which dissolves the urea; and then evaporating till it crystallizes; or, it may be detected by evaporating urine to the consistence of a syrup, and pouring into it concentrated nitric acid, which, combining with the urea, forms shining crystals, closely

resembling that of boracic acid. There are two free acids supposed to be present in healthy urine: one, which is the cause of fresh urine reddening litmus, the *Lactic;* the other, which appears sometimes in red crystals, the *Uric:* but, instead of free acid, Dr. Prout regards the former of these effects to be produced by the superurate of ammonia. It is astonishing how small a quantity of animal mucus and albumen can be detected in healthy urine. Infusion of gall-nuts precipitates albumen: and, in some diseases—in sthenic dropsy, for example—the quantity is so great, that it may be detected by merely heating the urine, which coagulates both by heat and acids when it contains much albumen: in some instances it has spontaneously coagulated within the bladder. But, besides these principal components, urine contains sulphates of soda and potassa; phosphates of soda and ammonia; muriates of soda and ammonia; lactate of ammonia, with a trace of fluate of lime and siliceous earth. Knowing that these are the components of urine, it is not difficult to ascertain what substances have passed through the kidneys, and whether these have undergone decomposition. Thus, if free potassa or soda, or nitrate of potassa, be taken into the stomach, so as not to act upon the bowels, and be afterwards found in the urine, we are authorized in concluding that they pass through the blood, and are directly applied to the kidneys, from which they are excreted in solution with the watery part of the urine. The excretion, however, of these salts does not take place until they have stimulated the viscus to an increase of its natural function, and consequently to the formation of more urine than is secreted in the usual state of the organ. It is a curious fact that, although these substances can be detected in the urine, they cannot easily be discovered in the blood, which must carry them to the kidney. Thus, nitre can be readily detected in urine by deflagrating a piece of paper soaked in the urine and drying it; which only occurs if nitre be present in the urine. Owing to this circumstance, and the facility with which some substances taken into the stomach are conveyed into the kidney, Sir Everard Home was led to suppose that they pass through the spleen: but he afterwards abandoned the idea; for, on removing the spleen and tying the thoracic duct, the colouring matter of rhubarb, injected into the stomach of a dog, could be detected in the urine, while no trace of rhubarb was discovered in the lacteals. There is no difficulty in detecting some substances in the urine: if rhubarb be present, and any of the mineral alkalies be added, a deep orange colour is produced; if iodine be present, a deep blue colour is evolved when chlorine gas is poured on the surface of urine and the fluid is shaken and tested when cold with starch In jaundice, the bile passes again into the blood, and is separated from it in the kidneys, and can be detected in the urine by muriatic acid causing

a green tint. From what has been said, it is evident that some substances are conveyed by the blood to the kidneys; and if these are of a nature to stimulate the viscera, provided the excitement be short of inflammatory action, a greater discharge of urine is the consequence. It is this class of substances which occupy the first section of the table. I may here remark, that the excretion of urea by the kidneys seems to be essential to the health of the system. When both kidneys are taken away in a dog, the animal dies before the ninth day: and the serosity of the different secreting organs gives traces of the presence of urine in it. It must however be recollected, that, in health, when the kidneys are entire, some of the principles of urine—for instance, *Urea*—is found in the perspiration. There are instances also of persons who have passed no urine for many years together; and Dr. Richardson, in a paper published in the Philosophical Transactions of 1713, mentions the case of a lad of seventeen, who had never made any urine, and, nevertheless, suffered no inconvenience. Besides the evidence of several saline matters passing through the circulation, and being excreted by the kidneys unaltered, some vegetable substances follow the same course—for example, the volatile oils, namely, turpentine, juniper, cajuputi, and cubebs. The odorous principles of garlic and asparagus may be detected in the urine an hour or two after these substances have been swallowed. Water also passes off in this way; and, therefore, the quantity of urine is generally in proportion to the quantity of fluid drank.

With regard to the manner in which the kidney is stimulated to increased action when the blood sent to it contains saline and other substances, which, having been taken into the stomach, are found in the urine, it is obvious that their action must be within a certain limit; for, were the excitement of the kidney sufficient to induce inflammatory action, the urine, instead of being augmented in quantity, would be scanty and high coloured —a fact of great practical importance. Much of the fluid ingesta passes off by the kidneys, and the quantity of urine excreted is generally proportionate to the quantity of fluid taken into the stomach; thence the necessity of dilution to promote the operation of Diuretics. None of the substances possessing diuretic properties require the addition of dilution so much as those which pass undecomposed into the blood. Without this they would scarcely be conveyed to the kidneys; and if they were, the over-excitement which would be induced, would check rather than promote the increase of the urinary discharge.

The action of diuretics is much modified by the function of the skin. When a diuretic is administered, the surface should be kept cool; for if the cutaneous exhalants be stimulated by heat, the action of the medicine is determined to the surface by that law of the system which regulates the balance between the

skin and the kidneys as excretories; and sweating supervenes with a diminished discharge of urine: just as, in the healthy state, in cold weather when the surface is chilled, the quantity of urine is abundant and pale; whilst, in hot weather, when perspiration flows freely, the urine is scanty and high coloured. On this account, the season of the year, clothing, and all circumstances influencing the function of the skin, modify the operation of direct Diuretics.

2. Many vegetable and also some saline bodies suffer digestion to a certain extent, and only one or more of their constituents reach the kidneys: and it is a curious fact, that the salts which undergo decomposition in transitu are those into which the vegetable acids enter as components. These acids, in their free state, are extremely prone to decomposition; and it would seem that the power by which this is effected, in the stomach and intestines, is also sufficient to separate them from the alkalies with which they are united. The acid thus separated is decomposed, whilst the alkali is taken into the circulation, conveyed undecomposed to the kidneys, and excites that action which promotes the secretion and excretion of the urine. This remark, however, does not generally apply: for some salts, compounds of vegetable acids with alkalies—bitartrate of potassa, for instance—operate in a manner which cannot be explained upon the supposition that its alkali only is conveyed to the kidneys. The mineral acids also, being less prone to decomposition, are not separated; and, owing to this circumstance, their neutral salts act as direct diuretics. Dr. Paris seems inclined to believe that the *bitter principle* is the active ingredient of the vegetable diuretics which are decomposed by the digestive organs*. I am not prepared to deny the accuracy of this opinion; but, if we may reason from analogy, I should be disposed to ascribe the effect to some alkaline principle, which it is probable all vegetable diuretics contain. That other principles of vegetable bodies are separated during digestion and determined to the kidneys, is evident from the odour which asparagus and garlic impart to the urine; and, as these substances are in some degree diuretic, it is not improbable that they possess this quality from the principle, whatever it is, which affords the odorous matter. Salts containing vegetable acids, which undergo decomposition in the digestive process, are more diuretic, in proportion as they are more susceptible of decomposition, than those which contain the same acids in proportions only sufficient to neutralize the alkalies with which they are united. Thus the bitartrate of potassa is diuretic, whilst the neutral tartrate has no effect whatever upon the kidneys. Besides, as Dr. Paris very justly remarks, "the diuretic operation

* Pharmacologia.

of any body that acts by being absorbed, is at once suspended if Catharsis follow its administration;" owing to the law of the œconomy, "that the processes of assimilation and absorption are very imperfectly performed or altogether arrested during any alvine excitement." Something, however, is due to the extent of the dose of the substance employed; seeing that many substances, within certain limits, as regards the doses in which they are given, operate as diuretics, but, beyond these limits, as cathartics: thus, the bitartrate of potassa in large doses purges; in small, stimulates powerfully the kidneys: oil of turpentine, in doses of from ten or fifteen minims to a fluid drachm, stimulates the kidneys so powerfully as to cause bloody urine; yet, if a fluid ounce be administered, little effect is perceptible on the urinary organs; and in the same manner, when nitrate of potassa has been taken by mistake for sulphate of magnesia, to the extent of an ounce for a dose, the symptoms do not indicate any action upon the kidneys.

Those substances which increase the flow of urine, without acting directly upon the kidneys, are substances that diminish arterial action, and augment that of the capillaries. It is a well-known fact, that if digitalis be given while the habit is labouring under a state of inflammatory excitement, it produces little or no effect on the kidneys; but if this excitement be previously reduced, the influence of the remedy becomes quickly obvious by the increased flow of urine. Indeed, experience daily demonstrates the activity of this diuretic in weakened habits, if the debility have not proceeded too far; and, also, how imperfectly it operates when the system is under the influence of febrile excitement. Thence the necessity of watching, attentively, the state of the system during the employment of Diuretics, in order to obtain their full influence; and, if the excitement continue, to intermit the use of the Diuretic and have recurrence to venæsection and purging before again administering it.

3. The third description of Diuretics, those which operate without acting at all on the kidneys, are substances that augment the nervous energy, give an impulse to the general vigour of the habit, and produce tone. In a weakened condition of the body, the fluid in the serous cavities and cellular tissue accumulate; and when the cutaneous system shares in the general debility, asthenic anasarca is the consequence. In such conditions of the body, the employment of bitters produces a diuretic effect; for the tone of the body being increased, all its natural functions are augmented, and those of the urinary organs in particular, so that an increased flow of urine follows.

4. The last division of Diuretics is intended to demonstrate the manner in which mercury produces diuresis, by its primary action on the capillary system.

Besides these different modes in which diuresis is induced, it is necessary to advert briefly to the influence of mental affections on the urinary discharge. Whatever suddenly depresses the nervous energy, produces diuresis; thence all the depressing passions have this power. Fear has a considerable influence in this respect: various sounds* and even odours operate in the same manner through the medium of the nerves.

Diuretics, from the increased discharge of urine which they induce, operate as evacuants; but at the same time they also exert a stimulant influence. As *evacuants*, they remove the general plethoric state of the system, and diminish, also, the excitement of the habit without inducing much debility; for, as the abstraction of the fluid, which they chiefly separate from the circulating mass, is slowly effected, the vessels contract, and gradually adapt themselves to the diminished quantity of their contents. As evacuants, also, they are supposed to carry off acrimonious matters from the blood; but the existence of such matters in the blood is doubtful. As *stimulants*, Diuretics act on the general and the capillary systems, even when they exert a direct action on the kidneys. As far as their effects depend on their stimulant properties, they are contraindicated in all inflammatory and irritable states of the kidneys; in which, the simple dilution is to be preferred. Water is the best diluent: how far it acts a part in the operation of all Diuretics is not accurately known; but it has, undoubtedly, a considerable influence in modifying their effects.

On account of the necessity there is for keeping the surface cool during the operation of Diuretics, the day time is to be chosen for administering them; and during their action the patient should, if possible, be kept out of bed. Their effect is increased by exercise and friction on the surface of the body. Care ought also to be taken, in selecting the diuretic substances, to ascertain which description of those usually employed is best fitted for the case: to reduce the arterial action, by bleeding and other means, rather below the natural standard, before administering Diuretics; but never to bleed or purge during their actual operation; and, when full diuresis is desired, to administer freely diluent drinks.

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* Shakspeare, who allowed nothing to escape his notice, remarks, in the person of Shylock,—

> And others, when the bagpipe sings i' the nose,
> Cannot contain their urine: for affection,
> Masterless passion, sways us to the mood
> Of what it likes or loaths.—*Merchant of Venice.*

TABLE OF DIURETICS.

A.—DIRECT DIURETICS.

1.—not undergoing decomposition in transitu.

* *Organic Products.*

a.—VOLATILE OIL—uncombined, obtained from

Pinus *Larix.*	21.	6.	Coniferæ.
—— *Sylvestris.*	21.	6.	———
Juniperus *communis.*	22.	8.	———
Melaleuca *Cajuputi.*	12.	1.	Myrtaceæ.

** *Inorganic Substances.*

b.—IODINE—*Iodinum.*
c.—POTASSA—*Potassa.*
d.—DILUTED MINERAL ACIDS. *Acida Mineralia diluta.*
e.—SALTS.
Hydriodate of Potassa, *Potassæ Hydriodas.*
Muriate of Baryta, *Barytæ Murias.*
Nitrate of Potassa, *Potassæ Nitras.*
Chlorate of Potassa, *Potassæ Chloras.*

2.—undergoing decomposition in transitu.

* *Organic Products.*

Animal.

f.—CANTHARIDINE, procured from

Cantharis *vesicatoria.*	4.	5.	Insecta Coleoptera.
Mylabris *variabilis.*	—	—	——— ———

Vegetable.

g.—OLEO-RESINS—contained in
Copaiferæ *Balsamum.*
Piperis *Cubebæ* baccæ.
Juniperi *communis* baccæ.

Diosma *crenata.*	5.	1.	Diosmeæ.

h.—VERATRIA—obtained from
Colchicum *autumnale.*

i.—SCILLITINA—contained in
Scilla *Maritima.*

k.—UNKNOWN PRINCIPLES—contained in

Roots.—Smilax *Sarsaparilla.*	22.	6.	Smilaceæ.
Polygala *Senega.*	17.	3.	Polygaleæ.
Leaves.—Chimaphila *Corymbosa.*	10.	1.	Pyrolaceæ.
Twigs.—Spartium *Scoparium.*	10.	4.	Leguminosæ.

** *Inorganic Substances.*

l.—ACIDS.

Carbonic Acid.	*Carbonicum Acidum.*
Tartaric Acid.	*Tartaricum Acidum.*
Citric Acid.	*Citricum Acidum.*

m.—SALTS.

Carbonate of Potassa.	*Potassæ Carbonas.*
Bicarbonate of Potassa.	——— *Bicarbonas.*
Acetate of Potassa.	——— *Acetas.*
Citrate of Potassa.	——— *Citras.*
Bitartrate of Potassa.	——— *Bitartras.*
Carbonate of Soda.	*Sodæ Carbonas.*
Bicarbonate of Soda.	—— *Bicarbonas.*
Biborate of Soda.	—— *Biboras.*

B.—INDIRECT DIURETICS.

1.—operating through the Vascular System.

* *Organic Products.*

n.—NICOTINA, in

Leaves.—Nicotiana *Tabacum.*	5.	1.	Solaneæ.

o.—DIGITALIA, in

Leaves.—Digitalis *purpurea.*	15.	1.	Scrophularineæ.

p.—LACTUCARIUM, obtained from

Lactuca *Sativa.*	19.	2.	Compositæ.
——— *Virosa.*	19.	2.	———

** *Inorganic Substances.*

q.—MURIATE OF IRON. *Ferri Murias.*

r.—SPIRIT OF NITRIC ETHER. *Etheris Nitrici Spiritus.*

s.—ARDENT SPIRIT. *Alcohol dilutum.*

2.—augmenting the general tone of the habit.

t.—BITTER VEGETABLES. *Vegetabilia Amara.*

3.—acting primarily on the capillaries.

u.—MERCURIALS. *Hydrargyri preparationes.*

A. DIRECT DIURETICS.

ORGANIC PRODUCTS WHICH DO NOT UNDERGO DECOMPOSITION IN TRANSITU.

a. VOLATILE OIL.

1. OIL OF TURPENTINE, from whichever of the species of Pinus it is procured, or in whatever manner it be introduced into the habit, rapidly displays its presence in the urine, by the

odour of violets which it communicates to that secretion. It stimulates the kidneys locally: but its effects are greatly influenced by the extent of the dose;—in small doses, it passes to the kidneys; in larger, it operates upon the intestines and the nervous system. Owing to idiosyncracy, in some individuals it causes a cutaneous eruption, resembling eczema mercuriale. When such an eruption occurs during the use of Oil of Turpentine, the remedy should be instantly discontinued. During its employment, also, wine and spirits, and the ordinary quantity of food, should be diminished.

2. CAJUPUTI OIL, which has been already described, possesses the same diuretic properties as oil of turpentine, and sometimes produces the same eczematous rash.

3. OIL OF JUNIPER, *Oleum Juniperi*, L. E. D., has also a close affinity to the oil of turpentine. It is procured from the fruit of the Juniperus *communis**, the enclosed nut of which is surrounded at its base with three or four glandular vesicles, that secrete the oil. *a*, *a*, *a*, fig. 1, display these entire and largely magnified; *a*, *a*, fig. 2, shew them in a transverse section of the nut; *a*, *a*, fig. 3, in a longitudinal section. The plant,

1 2 3

which belongs to the natural order Coniferæ, is found in most parts of Europe, growing on heaths and hills. It is a thick evergreen shrub. The greater part of the Juniper berries is imported into this country from Italy, and preferred to those from Germany and Holland, on account of their superior succulence and plumpness. Both water and alcohol bring over, in distillation, the volatile Oil of Juniper; but not unless the fruit is well bruised, so as to open the vesicles that contain the volatile oil. When properly treated, the oil obtained by distillation is green, has the odour of turpentine, and a hot pungent taste.

Juniper has long been employed to excite the action of the kidneys in hydropic diseases. The oil is carried into the blood and conveyed undecomposed to the kidneys, where it is excreted with the increased flow of urine. As the whole of the plant yields this volatile oil, the extremities of the shoots, or Juniper tops, as they are termed, are as diuretic as the fruit; but the mucous and saccharine matter not being present, the

* Woodville's Med. Bot. third edition, p. 13, pl. 6. London Dispensatory, art. Juniperus. Richard, Hist. Nat. Med. t. i, p. 469.

decoction of the tops is more nauseous, and, therefore, less frequently employed than that of the fruit. The berries are sometimes given in substance, triturated with sugar or with bitartrate of potassa; but they are more diuretic in the form of decoction. A spirit flavoured with the oil, by being rectified with the fruit, *Hollands*, is frequently and advantageously added to the decoction. What is termed Gin, in this country, was originally an imitation of Hollands, and was also rectified from Juniper; but the gin now used is made from Scotch and Irish whiskey rectified on turpentine. If the spirit were good, the English gin is a better Diuretic than Hollands, inasmuch as the Oil of Turpentine is a superior Diuretic to the Oil of Juniper. The oil may be given combined with sugar, as an oleo-saccharum; and, when this is added to any bland fluid—for instance, emulsion of almonds—it is the best mode of administering this Diuretic.

All of these oils are employed to excite the action of the kidneys; but, in effecting this, they probably also influence generally the capillary system. The Oil of Turpentine is the most useful of the three.

* * INORGANIC DIURETICS WHICH DO NOT UNDERGO DECOMPOSITION IN TRANSITU.

b. IODINE, *Iodinum.*—The nature of this elementary substance has been already explained. I have only to add here, that it is sometimes adulterated with plumbago and other things. The quantity of the plumbago can be readily ascertained, by volatilizing a given portion of the suspected specimen and weighing the residue. Besides uniting with mercury, iron, lead, arsenic, zinc, and bismuth, to form the metallic iodides which have been described under the head of Excitants, it also forms an iodide with potassium. In combining with it, an explosion occurs during the union; owing to the heat which is developed volatilizing the compound: but when it is condensed, it assumes a crystalline form. It consists of 100 parts of potassium + 319 of iodine. When thrown into water, it forms hydriodate of potassa, owing to the decomposition of the water. It also readily and spontaneously combines with phosphorus, extricating much heat, but no visible light, unless the union be made in the open air.

As a Diuretic, Iodine is given in alcoholic solution, or tincture. When administered, internally, in doses of from ten to thirty drops in a glass of water, twice or thrice a day, this tincture stimulates very powerfully the whole of the glandular system, and, in a special manner, the kidneys. This renders it a most useful remedy in ascites, connected with diseased states of the liver and the mesenteric glands. Dr. Baron of Gloucester succeeded in curing that disease by its means; and I believe a

case has also proved successful in the hands of Dr. James Johnson. I have taken advantage of this decided effect upon the capillary system to render Iodine beneficial in the treatment of organic disease. In one case of ovarian dropsy, the Tincture was administered immediately after tapping, in conjunction with mercury, three times a day, in doses gradually extended to sixty minims: under its use the swelling disappeared, and health was restored. In this instance, it is probable that the great advantage arose from the rapidity with which the Iodine was thrown into the habit after the tapping, and whilst the flaccid sac remained as a kind of extraneous body in the abdomen. It has never proved equally beneficial in similar cases in my hands: but in some other cases, which have been treated in the same manner, although a cure has not been effected, yet the period for tapping has been greatly protracted: for instance, in one case from ten weeks to six months. Like foxglove, it does not act beneficially when the abdomen is tense; but, after tapping and reducing the excitement by blood-letting, it rapidly displays its influence on the kidneys. It is the only substance which seems to stimulate decidedly the absorbents; and their influence, when thus urged, extends even to healthy glands: both the mammæ and the testicles, free from disease, have, in several instances, nearly disappeared during its administration. The Tincture has also succeeded in reducing enlargements of the liver when all other means had failed. Its influence in bronchocele and other enlarged glands, whether of a scrofulous or an incipient scirrhous nature, has been well authenticated. Out of 109 cases of scrofula treated by M. Lugol at the Hôpital St. Louis, in seventeen months, 26 were completely cured, 30 greatly benefited, 4 not improved, and 39 under cure when the report was made. Iodine only was internally administered, and externally applied.

Some inconveniences arise from its employment in irritable habits. It causes a febrile state, often accompanied with nausea, vertigo, and headache; and, occasionally, with dysenteric symptoms. In some respects the symptoms resemble those of paralysis agitans, shaking palsy; sometimes it excites profuse perspirations; and griping pains of the stomach and bowels. When these occur, the use of the medicine must be suspended.

Iodine exerts a decided influence in softening and removing bronchoceles and scrofulous tumours; but when febrile symptoms, cough, and nervous irritability occur, such as I have already noticed as requiring the medicine to be discontinued, it is then productive of much danger. In its administration, therefore, the attention of the physician to the general state of the patient should be close and unremitting.

The dose of the Tincture of Iodine is from m. x, gradually carried to m. xl.

c. POTASSA. *Potassa.* L. E. D.—The only oxide which has

a diuretic influence is that of Potassium,—*Potassa*. This oxide is formed when Potassium is thrown into water, owing to the decomposition of the water by the metal. For medicinal purposes, however, Potassa is not produced by the immediate oxidizement of the metal: but, by the decomposition of the subcarbonate, by means of quick-lime, the lime attracting the carbonic acid, and leaving the potassa in a free state. When lime is employed to produce this effect, it must be in a state of admixture in water, and the alkali in a state of solution; so that, in order to procure the Potassa in the solid form, evaporation must be resorted to; and, when this is properly performed, the salt is obtained in a crystallized state. Pure Potassa is a brittle substance, of a white colour, with a peculiar odour, and an extremely acrid taste. In this state, it is pure enough for medicinal purposes: but to free it from every other salt, it must be dissolved in alcohol, which takes up the pure Potassa only, and leaves the other salts. It is still combined with a small proportion of water; and is, in truth, a hydrated protoxide of Potassium. According to Berzelius, pure Potassa consists of 20 parts of oxygen and 100 of Potassium; or of 1 eq. of Potassium = 39.15, + 1 eq. of Oxygen = 8, making the equivalent 47.15; but Potassa, as we employ it, is a hydrate, and thence, by the addition of 1 eq. of water, its equivalent is 56.15. When Potassium unites with its full proportion of oxygen, it acquires a yellow colour; and it is curious that, when this peroxide is put into water, it effervesces, gives out its oxygen, and is converted into Potassa.

Potassa is deliquescent, attracting rapidly the humidity of the atmosphere, and is wholly soluble in half its weight of water. When applied to any part of the animal body, it instantly extinguishes the vitality of the part, destroying its organization, and combines chemically with the dead matter, forming a slough; which, after a time, is thrown off by the living parts beneath and around it. The *Causticum acerimum* of the British Pharmacopœias is this salt. Pure Potassa fuses at a temperature of 360°, and at a red heat is volatilized: it displays all the properties of an alkali, changes tumeric paper and infusion of rhubarb to brown; restores the solution of litmus reddened by an acid; greens the vegetable reds; and, in combination with acids, forms neutral salts. When exposed to the atmosphere, besides deliquescing, it attracts carbonic acid, and is converted into the carbonate. It is distinguished from lime and baryta by not forming precipitates with carbonic, oxalic, and sulphuric acids; and from soda, by forming a precipitate with tartaric acid. This test is the simplest and the best; but it requires some attention to avoid fallacy. Thus, the precipitate is redissolved if the quantity of the alkali be increased, or if any strong acid be added: but if the precipitate be redissolved by an alkali, the addition of a small

quantity of a strong acid will reproduce it: but it is insoluble in an excess of either tartaric or acetic acid.

Such are the chemical properties of Potassa. As it acts as a powerful escharotic when applied to the body, it cannot be administered internally in a solid form; it must be largely diluted with water, or some bland, aqueous fluid. In the form of Liquor Potassæ, it may be given in very large doses, if the dose be gradually augmented and sufficiently diluted. This solution, when properly prepared, is limpid, colourless, and void of any odour: it is too acrid and caustic to be tasted alone; and, when rubbed between the fingers, it feels soapy, owing to a solution of the cuticle. Its specific gravity should be 1.056; and one pint of it should weigh sixteen ounces. It ought not to effervesce with acids, nor to render lime-water turbid; but it is seldom prepared for medicinal purposes so free from carbonic acid, nor is this perfection requisite. In its ordinary state, when given in doses of from ten minims to ʒss, in a large cupful of water, or of milk, or almond emulsion, or even beer if it be not sour, it passes unaltered to the kidney and acts as a Diuretic. When taken into the stomach, however, its primary effect is upon that viscus. If any acid be present, it neutralizes it; and when the dose is sufficiently large to allow the alkali to predominate, or if no acid be present, it then acts as a sedative upon the stomach, allaying its morbid irritability, and enabling it to secrete the gastric juice more slowly, and consequently in a more healthy state. Its secondary action is upon the kidney, to which it is carried undecomposed; and its passage through it can be detected by testing the urine with infusion of rhubarb or of tumeric. As a Diuretic, Potassa is not extensively employed, owing to a fallacious opinion that it is injurious, if given in doses sufficient to produce its full effect. I have given it to the extent of upwards of 100 drops, three times a day, in psoriasis, without any bad effect; but, on the contrary, with the greatest advantage. It must not, however, be given in large doses at first; but the dose should be gradually increased until the full dose be administered. As soon as it displays its diuretic effects, the influence of the remedy over the disease becomes obvious: its use must still be continued, and the dose as gradually diminished as it was increased, for some time after the disease has disappeared. It is salutary in several cutaneous diseases; but as a Diuretic in dropsies it is not much to be depended upon. Its properties as a solvent of urinary calculi shall be noticed in another part of this volume.

d. DILUTED MINERAL ACIDS.

Water acidulated with the mineral acids is a valuable Diuretic: but, although I have placed water in this state of com-

bination as a Diuretic which enters the circulation and directly stimulates the kidneys, by the aid of the acid which it contains, yet it is doubtful whether the mineral acids, undecomposed, pass to the kidneys. The acids aid the diuretic properties of the water, by their tonic influence promoting the action of the capillaries; and if we regard water as the basis of every fluid, there is no difficulty in conceiving the extent of its influence in promoting diuresis. The erroneous idea that drinking large quantities of watery fluids is likely to induce dropsy, is now discarded, since the pathology of that disease has been understood. Every one knows that when much fluid is taken into the stomach, many of the secretions are augmented, and, in a special manner, that of the kidneys. In dropsies, if we observe attentively the operation of Nature to effect a cure, we shall seldom fail to remark that, inasmuch as thirst is one of the symptoms of dropsy, the free use of fluids is indicated as the curative means in these affections. If the habit be not well supplied with fluid, the secreting vessels of the kidneys are apt to suffer a collapse, and the effused fluid in the cavities is augmented. The beneficial effects of dilution in dropsy was first pointed out by Sir George Baker; and, after him, Sir Francis Milman collected several cases demonstrating the accuracy of the opinions advanced by Sir George, and published them in his Treatise on Dropsy. Whatever may be the character of a Diuretic, it is doubtful whether it will act on the kidneys without the aid of a large quantity of water or watery fluid taken as drink: and this is especially the case with the saline Diuretics. In hydropic affections, it is of some importance to ascertain how diluents are likely to prove serviceable. If we find that the excretion of urine exceeds the quantity of the liquid ingesta, then we may presume that the fluid taken into the stomach is advantageous: but if the opposite effect takes place, and particularly if the dropsical swelling increases under the use of ample dilution, the quantity must be diminished, and other means taken to excite the urinary discharge. If the individual be of a languid habit, and if the inflammatory action connected with the dropsical effusion be subdued, then there can be no doubt of the advantageous combinations of the mineral acids with the water. Experience has fully demonstrated the efficacy of this combination; and, therefore, the rationale of their operation, however desirable it may be to know it, is a matter of secondary consequence.

e. SALTS.

1. HYDRIODATE OF POTASSA. *Potassæ Hydriodas.*—A formula for preparing this salt is now contained in the Dublin Pharmacopœia, and in the London Dispensatory. The simplest method is to add Potassa or its carbonate to the solution of hy-

driodate of iron: a protoxide or a carbonate of iron falls, and a Hydriodate of Potassa is held in solution.

Hydriodate of Potassa is in irregular cubes, not unlike those of common salt. It must be given in solution, being very deliquescent and soluble. The dose of the saturated solution is from ten drops to thirty: but it has hitherto been seldom given internally, although frequently employed externally, in conjunction with lard, as an ointment for the discussion of scrofulous tumours. It aids the solution of Iodine in water, and on this account it is given in combination with Iodine in aqueous fluids. M. Lugol's formula is of iodine gr. i$\frac{1}{4}$, Hydriodate of Potassa gr. iiss, and distilled water f$\frac{z}{3}$viii. One-fourth part of this solution is to be administered, in divided doses, in the course of the day. M. Lugol forms a bath also of iodine by similar means—three parts of iodine and six of Hydriodate of Potassa are dissolved in 3000 parts of water. M. Lugol has employed this bath successfully in scrofula. When the Hydriodate of Potassa is adulterated with bicarbonate of potassa, the fraud may be detected by adding lime-water, then muriate of baryta and sulphate of magnesia; a white precipitate is produced, soluble in muriatic acid, if the carbonate be present. If we suspect muriate of soda, add solution of nitrate of silver; and, tc the yellow precipitate produced, add excess of ammonia, and stir the mixture: after some time, filter, and add a little nitric acid; if a muriate is present, a white precipitate will fall. The rationale is this—the nitrate of silver precipitates the Hydriodate: the precipitate is insoluble in ammonia, being an iodide of silver; but the muriates are soluble in ammonia: the addition of the acid, taking away part of the ammonia, allows a chloride of silver to be precipitated. The Hydriodate of potassa is incompatible in prescriptions with salts of copper, of lead, of mercury, and nitrate of silver. It operates on the kidneys, passing undecomposed to these organs, and can readily be detected in the blood. Dr. Williams has lately used it in secondary syphilis; and it has been found beneficial in doses of gr. v, especially when the symptoms of periostitis are troublesome. It is less salutary in scrofula than iodine.

2. Baryta Murias. *Muriate of Baryta.* E. D.—Although the diuretic influence of this salt has been correctly ascertained, yet it is very seldom prescribed as a diuretic. It has been found serviceable in old worn-out asthmatic habits, in which the disease displays a tendency to terminate in hydrothorax. In such cases, the tonic influence of the muriate maintains the strength of the patient while he is under its diurectic action. The dose of the solution, made with one part of the muriate and three parts of water, is from three to nine minims. It is incompatible in prescriptions with sulphates, citrates, and astringent vegetable infusions and decoctions.

3. NITRATE OF POTASSA. L. E. D. *Nitre.*—This salt passes unchanged to the kidneys, which it stimulates to increased action, augmenting the flow of the urine: it may be detected in that secretion. The doses in which it is administered, to produce its diuretic effects, are from gr. xv to ʒss: it requires to be largely diluted.

4. CHLORATE OF POTASSA. *Potassæ Chloras.*—When a stream of Chlorine is passed through a saturated solution of carbonate of Potassa, a partial decomposition of the water takes place, the hydrogen attaches itself to one portion of the Chlorine, and forms hydrochloric acid, whilst the oxygen unites with the remainder and forms chloric acid. These acids combine separately with the Potassa, and form Hydrochlorate of Potassa, which remains in solution in the fluid; and Chlorate of Potassa, which is nearly insoluble, and falls down in the form of pearl-white rhomboidal plates or scales. It is readily decomposed by all the mineral acids, common salt, muriate of baryta, and nitrate of silver, all of which are incompatible with it in prescriptions. As a Diuretic, Chlorate of Potassa operates directly on the kidney, acting nearly in the same manner as nitrate of potassa. It was, at one time, largely employed under the idea of communicating its oxygen to the system, and curing syphilis: but this practice was soon found to be inefficient; and the salt is now seldom employed, even as a Diuretic, as which it has undoubted claims on our confidence. It may be given in doses of from gr. v to ʒi, in infusion of broom or juniper tops, or in any bland fluid.

2. DIRECT DIURETICS, UNDERGOING DECOMPOSITION IN TRANSITU.

* *Organic Products.*

a. Animal.

f. CANTHARIDINE.—This substance is procured by a very operose process from the Spanish fly, Cantharis *officinalis*, and the Mylabris *variabilis*. It is a white substance, in minute, micaceous scales, insoluble in water and in cold alcohol; but soluble in boiling alcohol, ether, and oil. The knowledge of its solubility in oil is a fact of much practical importance. The substance has not yet been employed in its free state as a Diuretic, probably from the difficulty of apportioning the dose.

The BLISTER BEETLE, Cantharis *officinalis*, from which Cantharidine is procured, is a Coleopterous insect. It is oblong, nearly parallel for two thirds of its length, and then tapering to the extremity. It is about two thirds of an inch long, a quarter of an inch broad, green, shining, and tinted with a golden hue; the wing sheaths are marked with three longitudinal raised

stripes; the wings are brown, membranous, and transparent. The body is terminated with two small, callous, sharp spines; and the head, which is gibbous, bears two black, jointed, thread-like feelers. It is of some importance to know the real character of the Blister Beetle, as the specimens of them are frequently mixed with the Melolontha and other beetles*. It is a curious fact that the circulating, respiratory, and nervous system of this insect, in conjunction with the generative organs, have a singular analogy with those of the vertebrated animals. This beetle is found in every part of Europe where the vine flourishes naturally in the open air, that is, from the equator to the 52nd degree of northern latitude. It feeds upon the ash, the privet, the lilac, and most of the plants of the natural order Jasmineæ. When it is very abundant, an odour resembling that of the mouse is exhaled; and it is probable that the cause of the ardor urinæ and ophthalmia, experienced by persons who sit under a tree containing many of these insects, during the time of their copulation†, is to be attributed to the Cantharidine being carried off with the volatile oil which causes this odour. Ophthalmia is severely felt by those who prepare Cantharidine, unless the eyes be protected by gauze shades.

For medicinal purposes, Cantharides are collected in May, the period of their copulation, by shaking them from the trees upon which they settle, and catching them on cloths; they are then killed by the vapour of boiling vinegar—a process as ancient as Dioscorides, who describes it. Sometimes they are killed by dipping the cloths on which they are collected into vinegar and water, after which they are dried by exposure to the sun. During the drying, the insects require to be frequently turned; and if the hands of those who perform this operation be not guarded with gloves, great pain is felt at the neck of the bladder, and strangury and ardor urinæ supervene. When properly dried, Cantharides preserve their active properties for more than thirty years. They are often attacked by a small mite or acarus, which, devouring the soft parts, leaves only the hard parts, or the shell of the insect, thus rendering it nearly inert. The only method to stop the depredations of this parasite is to put a little pyroligneous acid into the bottle containing the Cantharides.

Many experiments have been made to determine on what the active principle of the insect depends. Dr. Zeer ascertained that the ovaries, the external genitals, and the intestines, contain the most active matter for blistering; the muscular

* To those who have time and taste for pursuing inquiries in natural history, I would recommend the perusal of an admirable paper on the Anatomy and Organization of the Blister Beetle, in the *Annales des Sciences Naturelles*, for 1826, accompanied with excellent figures of the parts.

† The males die after this act, the penis being left in the vulva of the female.

parts, the thorax, and the exterior parts of the body, contain much less; the wing sheaths, the antennæ, and the feet, the smallest quantity, but still some. This accounts for blistering plaster thick with the bright green elytra proving almost inert. Thouvenel, in 1778, first endeavoured to ascertain the nature of the active principle of this insect by chemical analysis. He treated the entire insect with water, alcohol, and ether, submitting each infusion and tincture separately to the press. He obtained—1, one half of the weight of the insect of a parenchymatous matter, which he did not examine: 2, three-eighths of a reddish-yellow extract, very bitter, and affording, when distilled, an acid liquor; 3, a concrete yellow matter, which he compared to the pollen of flowers; 4, one-tenth of green, waxy, concrete oil, which smelt strongly of the insect, and yielded, when distilled, a sharp, acrid, thick oil, which he conceived to be the active principle of the insect.

In 1803, Beaupoil extended the analysis of Thouvenel: he found that the acid of the parenchymatous matter is the *phosphoric*. On submitting the precipitate, which falls, in an aqueous infusion of the insects exposed to the air, to the separate action of alcohol and ether, he obtained a black, gluey matter, insoluble in alcohol, which blistered without affecting the urinary organs, and a yellow matter soluble in alcohol, which did not blister unless united with the wax, but produced virulent poisonous effects when introduced into the circulation.

In 1810, a new analysis was undertaken by Robiquet. He boiled slightly-bruised Cantharides in distilled water, and obtained a brownish-red solution, which reddened litmus, and was highly vesicant. By repeated boilings, he obtained all the soluble matter of the insect: and having treated the dried residue with alcohol, he obtained a green tincture, which, by evaporation, left a green, inert oil, proving that Thouvenel was mistaken in attributing the active principle to this oil. On evaporating the aqueous decoction and treating the residue with alcohol, he obtained a black *insoluble* and a yellow *soluble* matter: the former not vesicant, the latter powerfully vesicant. On treating this yellow matter with ether, small micaceous crystalline plates formed, which were powerfully vesicant when dissolved in fixed oil. This principle he regarded justly as the active part of the insect. Robiquet found also that the insect in its recent state contains a little uric acid, acetic acid, phosphate of lime, and magnesia, forming the bases of the horny parts; and a concrete fixed oil, besides the volatile oil, which Orfila states is combined with and aids the medicinal powers of the active principle. Dr. Thomas Thomson named the active principle *Cantharidine*.

The diuretic properties of Spanish flies were known to Hippocrates, who prescribed them in dropsy and amenorrhœa. A very celebrated Diuretic, also, that of Tulpius, consisted of a

tincture of Spanish flies, tincture of Cardamoms, and sweet spirit of nitre. The effects of this insect upon the urinary organs were also very generally known in oriental countries, and in the south of Europe as an *aphrodisiac;* but, unless they were employed with the greatest caution, the voluptuary who swallowed the powder bought his momentary gratification by pains and suffering of a very acute description. It was probable that the violence of these results of the internal use of Cantharides tended to prevent it from being much employed as a Diuretic*.

When Cantharides are swallowed, they are partially digested, and the Cantharidine is the only part of the insect received into the circulation. But whether it be this principle, or the entire matter of the insect, in minute division, that is absorbed and conveyed to the kidneys, its influence upon these organs is stimulant; and may amount to acute inflammatory action, producing bloody urine, insupportable pains in the abdomen, strangury, vomitings, convulsions, delirium; and frequently the issue is fatal. When administered in proper doses, namely, one or two grains, Cantharides stimulate the kidneys and cause an increased flow of urine. Their effect is stimulant in the first instance; but this is transitory, and, whilst there is a copious increase of the urinary discharge, neither heat of the kidney nor strangury is experienced. They have been found extremely useful, when administered as a Diuretic, in scaly affections of the skin: but this is the result rather of the general stimulus given to the capillary system than of any diuretic power. They have been employed with success in the ascites of old worn-out constitutions. It is requisite during their employment to dilute freely with bland fluids. If strangury occur, the best mode of relieving it is to throw into the rectum a pint of warm water, containing from twenty to sixty minims of laudanum. Notwithstanding the safety and advantage with which they may be internally administered, they have not been much employed; and indeed when we consider that many individuals suffer considerably, even from the absorption of such minute portions as can be taken up from a blistering plaster, the danger of an incautious employment of them internally is sufficient to set aside their general administration.

When Cantharides have been accidentally taken in large doses, the best mode of counteracting the dangerous symptoms is to bleed, and to dilute copiously with bland, demulcent drinks. The use of oil must be carefully avoided; for, as oil is the best

* Cantharides, besides forming the celebrated lithontriptic of Tulpius which I have noticed, were also long prescribed for the cure of gleets by the Sicilians; yet, in 1693, Dr. Groenvelt was committed to Newgate by a warrant from the president of the College of Physicians, for prescribing them internally. Quincey, in relating this anecdote, adds, that this act, which ruined the unhappy doctor, taught the safety and the value of his practice.

solvent of Cantharidine, the poison is only the more widely diffused, and consequently it is rendered more extensively hurtful. Many of the cases of poisoning by Cantharides have arisen from the poison having been swallowed to excite the venereal appetite; for, in many cases, this effect having not followed the ordinary dose, large doses have been swallowed. The greater number of the cases detailed by toxicological writers have not terminated fatally, although the sufferings of the patients have been most severe. In some instances, the inflammation of the genital organs has run on to gangrene; which was the case in a fatal instance noticed by Ambrose Paré, which was caused by a young woman seasoning comfits for her lover with Cantharides. In some instances, phrenitic symptoms, with tetanic convulsions and hydrophobia, have been the consequence of overdoses of the tincture. No antidote is known for this poison; and the only method of relieving the patient is to empty the stomach with the stomach-pump, and to treat the case as one of inflammation.

Of late years, another insect has been introduced into practice, as a substitute for the Cantharides, which appears to possess all its vesicant and diuretic properties. This is a species of the genus *Mylabris*, one species of which, the M. *Chicorii*, a native of the south of France, Italy, and Greece, was employed by the ancients, and is described both by Dioscorides and Pliny. Pliny says it was used in the same manner as the blister beetle. The genus Mylabris consists of fifty-one species, of which twenty-eight are found in Africa. The species employed as a substitute for Cantharides is the Mylabris *variabilis*. It is brought from China, and is regarded rather as a variety of the M. *Chicorii* than a distinct species. M. Robiquet has analyzed it, and has found that it affords Cantharidine in as great abundance as the Cantharides. It acts with as much energy as a vesicant as the best Cantharides. Another species of Mylabris, the M. *pustulata* of Olivier, is also used as a vesicant in China. Some species of Meloe, the *Proscarabæus* and *Majalis* in particular, also contain Cantharidine; they may be used both as vesicants and diuretics. If an easy method of obtaining Cantharidine were discovered, its use might supersede that of the entire insect.

Vegetable Products.

g. OLEO-RESINS AND VOLATILE OILS.

It is doubtful whether the Oleo-resins pass entire through the kidneys, or whether the volatile oil only, which is undoubtedly the active principle, is separated from the resin by the digestive process, and alone passes into the circulation. The latter is the most probable opinion.

1. COPAIBA. *Copaiferæ Balsamum.* L. E. D.—The diuretic

properties of Copaiba closely resemble those of turpentine. In moderate doses, it excites the natural functions of the kidney and increases the secretion of urine: in overdoses, it causes inflammation of the kidneys: consequently its employment should be avoided when there is the least tendency to ulceration of these organs. It may be exhibited in either a fluid or a solid state. Its solidification may be effected by means of its combination with an alkali, into a soap, which does not diminish its powers, whilst it permits it to be formed into pills, which may be given in doses of from gr. xii to ℈i. The fluid Copaiba may be given in doses of from eight to twenty minims, in water, suspended by means of mucilage. The volatile oil, separated from the balsam by distillation, may be formed into an oleo-saccharum; and, in this form, its dose is from ten to twenty minims.

2. CUBEBA PIPERIS BACCÆ. *Cubebs.* D. JUNIPERI COMMUNIS BACCÆ. *Juniper Berries.* Both of these vegetable productions are partially digested when taken into the stomach; and the volatile oils which form their active principles are separated and pass into the blood. Both these oils closely resemble that of turpentine; it is, therefore, unnecessary to make any remarks on their chemical properties. The properties of oil of Juniper have been already noticed. The oil of Cubebs differs from most of the other volatile oils in the degree of its volatility; indeed, the escape of the oil, owing to its great volatility, is the cause why the powder of Cubebs so quickly loses its activity.

In moderate doses, Cubebs are diuretic; in larger, they are purgative. In the former case, the oil can be detected in the urine by the odour, in a manner similar to that of turpentine. The chief disease for the relief of which Cubebs have been employed in this country is gonorrhœa; but I have occasionally used them in other inflammations of the mucous membranes. In doses of from ten to twenty grains, I have found them useful in chronic inflammation of the mucous membrane of the bladder. Their beneficial effects evidently arise from the volatile oil entering the circulation, and stimulating not only the kidneys to increased action, producing an augmented secretion of urine, but also passing on to the bladder with the urine, so as to stimulate the mucous membrane of that organ and the urethra. To secure the effects of Cubebs, the pepper should be well preserved in close vessels, and ground or powdered a few hours only before it is administered, so as to retain as much of the oil as possible. For the same reason it is more beneficial to administer them in the form of powder than in that of tincture. To obtain their diuretic effects, the dose should exceed half a drachm, and be repeated at moderate intervals; at least four times in twenty-four hours. The distilled oil may be employed

in doses of from ten to twenty minims, in the form of an oleo-saccharum.

4. DIOSMÆ CRENATÆ FOLIA. *Buchu Leaves.* D.—The beautiful little plant* yielding these leaves is a native of the Cape of Good Hope, belonging to the natural order Diosmeæ. The leaves are ovate, acute, crenated, dark green on the upper disk, pale on the under side, and studded with small pellucid glands. By the inexperienced eye, they might be mistaken for leaflets of senna. They exhale a powerful but agreeable aromatic odour, and impart a taste not unlike that of peppermint, leaving a sweetness and pungency on the palate. By distillation, a volatile oil is obtained, which has the odour of a mixture of camphor and rue. According to the analysis of M. Felix Cadet de Gassicourt, Buchu Leaves contain 6.65 parts of volatile oil + 21.17 of extractive + 1.10 chlorophylle + 2.15 resin + lignine 63.63, in 100 parts. The active principles are the oil and resin, which are taken up both by boiling water and proof spirit.

Buchu Leaves have decided diuretic properties, combined with a tonic power. They are administered in the forms of infusion and tincture. The former is made with half an ounce of the leaves and half a pint of boiling water. Ten fluid drachms are given for a dose, which should be repeated every four hours.

h. VERATRIA.

COLCHICI BULBUS ET SEMINA. *Bulbs and Seeds of Colchicum.* L. E. D.—In the same manner as the stomach separates the volatile oil in cubebs and juniper, it separates the Veratria from the Colchicum, and the former passes into the circulation and stimulates the kidneys. But Colchicum also purges; which requires some explanation, the action of a Diuretic being at direct variance with that of a purgative: it is in full doses only that it acts powerfully on the duodenum, and brings down a large quantity of bile into the bowels and purges; in small doses, it is taken into the circulation and operates on the kidney. As a Diuretic, it was long employed in dropsical affections, after its use as a remedy in gout became obsolete. It must however be acknowledged, that, as a Diuretic, Colchicum is much less powerful in its influence upon the kidneys than the squill—a circumstance depending undoubtedly on its disposition to run off by the bowels. For producing diuresis, tincture is the best form of it. In this form it operates mildly; but, when it is combined with vinegar or white wine, the acetic acid renders the Veratria more soluble than in its natural com-

* Woodville's Med. Bot. third edit. vol. v, p. 52, pl. 13. London Dispensatory, art. Pyrola.

bination; thence it passes the pylorus and excites the peristaltic action of the intestines. The seeds and the petals of the flower also contain Veratria, and have been employed for the same diuretic purposes as the bulb. The dose of the bulb in substance, as a Diuretic, is from three grains to twelve; that of the tincture or the wine, from thirty to sixty minims.

The diuretic powers of Colchicum are not such as to enable the practitioner to rely, with confidence, on its influence in removing morbid accumulations of fluid by the kidneys; and where it has proved useful, it has had little influence on the intestinal canal.

i. SCILLITINA.

SCILLÆ MARITIMÆ BULBUS. *Squills.* L. E. D.—Squill has been employed as a Diuretic from the earliest antiquity. The Egyptians administered it in dropsies, under the name of the *Eye of Typhon;* and it is mentioned as an hydropic Diuretic both by Theophrastus and Dioscorides. It is generally given in substance, although seldom alone, being combined with calomel, or the blue pill, or the bitartrate of potassa. If a full dose be given at first, it is apt to excite nausea and vomiting; it is, therefore, preferable to begin with a small dose—one grain, for example—repeated every sixth or eighth hour, and gradually to increase the dose to six grains, or until some degree of nausea be induced. When it is combined with mercury, the excretion of urine is always more rapidly augmented; but whether this depends on the action of the mercury on the capillary system generally, or whether, by this combination, the Scillitina is more readily separated by the stomach, I will not venture to determine. Calomel is the best addition to Squill, to promote its full diuretic effect. Cullen recommends the bichloride of mercury; but every intention is answered by calomel, with much less chance of griping than the bichloride is apt to produce. The advantages of the combination of Squill with mercurials are still greater when the source of the deposition of the fluid in the serous cavities is the obstruction of the liver or any of the abdominal glands. If the Squill purge when combined with mercurials, these must be either altogether discontinued, or the mercurial applied in the form of friction; but this direction is not peculiarly applicable to Squill, as it is a law of the system that purging and diuresis cannot exist at the same time.

In some habits, owing to idiosyncracy, the use of Squill excites an eruption on the skin not unlike that caused by the stings of nettles, accompanied with severe gripings, cold sweats, and occasionally convulsions. When this is the case, the medicine must be discontinued, and cordials with opium exhibited. It is also probable that, as the alkaline carbonates, infusion of

galls, and sulphate of iron, throw down precipitates in mixtures containing the tincture of Squill, the sulphate of iron may prove an antidote when Squills are taken in an overdose; but this requires to be confirmed by experience. The dose of Squill, in substance, when well dried, should not exceed eight or ten grains. It is most useful in small doses frequently repeated.

k. PRINCIPLES NOT CORRECTLY ASCERTAINED.

Roots.

ROOT OF SARSAPARILLA. *Smilacis Sarsaparillæ Radix.* L. E. D.—This root has had a greater variety of fortune than any other substance contained in the list of the Materia Medica, having been sometimes in the highest degree of favour, at other times in the lowest state of degradation as a remedial agent. It is the root of the Smilax *Sarsaparilla*, a plant belonging to the natural order Smilaceæ. The plant is a native of the northern region of South America and of Virginia. It is said that the best Sarsaparilla grows on the borders of a lake on the north of the Cerra Unturan, not far from Esmeralda.

The Sarsaparilla imported into Britain is named from the places of export. 1. That which is termed *Lisbon* is the produce of Brazil. It is much esteemed, and brings a high price in the market. Its epidermis is of a dull red colour, marked with slight longitudinal striæ, and free from radicle fibres. The interior is very white, and seemingly formed entirely of fecula. Its taste is bitterish. 2. The *Jamaica*, which has been lately brought into notice, is a subvariety of the Lisbon*. It is characterized by a reddish-brown coat, and, when divided longitudinally, has a kind of spongy or farinaceous aspect. It is more bitter and aromatic, and less free from fibres, than the other variety. 3. The *Honduras* is the next in point of estimation. Its characteristics are a dirty brown, sometimes whitish cuticle; it usually displays more radicles, and has a more woody pith, than the two other varieties. 4. The *Vera Cruz* is less fibrous than either of the others; but it is less esteemed.

The roots of Sarsaparilla, whatever may be the variety, are inodorous, and have a bitterish, mucilaginous taste. The efficacious part is the bark, the axis or heart being mere ligneous matter, perfectly inert. The bark yields all its soluble matter to cold water, but more readily to boiling water: it is also said to yield it to lime-water and to water saturated with pure potassa.

* Mr. Pope, in a paper on Sarsaparilla, published in the 12th volume of the Medico-Chirurgical Transactions, regards it as the uncultivated root of this variety, whilst that which is called Lisbon is the cultivated root of the same variety. It grows on the Spanish Main of South America.

According to the experiments of Mr. Pope, equal quantities by weight of the different kinds of Sarsaparilla, when infused in distilled water, and the solutions filtered through paper, afford the following comparative proportion of hard extract. Each was successively treated with hot and cold water. The Jamaica afforded 64 parts; the finest Lisbon, 42; the Honduras (finest), 48.

When equal quantities of the cortical part and of the wood were separately submitted to infusion in boiling distilled water, the proportions were—

Of the bark of the Jamaica.....	100
the wood of the same.....	20
Of the bark of the Honduras....	48
the wood of the same.....	24

The watery infusion of Sarsaparilla has a brown colour, and is precipitated by infusion of galls; but this precipitate is redissolved when the infusion is heated: it is a tannate of fecula. This infusion is not affected by protosulphate of iron; but it is precipitated by acetate of lead and nitrate of mercury. Pfaff analyzed Sarsaparilla, and obtained—2 parts of a balsamic resin, 2.6 of extractive, 3.8 of a substance resembling cinchonia, 2.1 of albumen, 2.9 of water, and 75.7 of woody fibre, in 100 parts. Another chemist, Cannobio, obtained—2.8 of bitter acrid resin, 5.5 of gummy extract, 54.2 of starch, 27.8 only of woody fibre, and 9.7 of loss, in the same quantity of Sarsaparilla. Whilst a third, M. Battka, procured—1, a crystallized acid, which he has named *Parillinic;* 2, an essential oil; 3, gum; 4, bassorine; 5, a colouring crystallized matter; 6, starch; 7, albumen; 8, extractive; 9, gluten and glaïadine; 10, pectic acid; 11, acetic acid; 12, saline matter, consisting of muriates of lime, potassa, and magnesia; carbonate of lime, oxide of iron, and alumina; 13, lignine. He regards the parillinic acid as the active agent. He thus describes it:—it resembles the scales of fish, and, when fined, acquires the aspect of brownish resin; in a high temperature, it exhales a peculiar odour and is carbonized. It is soluble in alcohol; scarcely in cold water; and only sensibly in boiling water: it is precipitated in gelatinous masses by muriate of lime and the mineral acids. It differs from pectic acid in dissolving unchanged in nitric acid. It is not easy to reconcile these discrepancies. An Italian, M. Galileo Pallota, has separated, by a very operose process, an alkaloid substance from Sarsaparilla, which he supposes is the active principle of the root; and he has named it *parillina.* This substance is a white, pulverulent, light, saline body, of an austere, slightly astringent, nauseous taste, with a peculiar odour. It is soluble in hot water, slightly soluble in cold alcohol, but very soluble in hot alcohol: its solution reddens turmeric paper; it forms a sulphate when conjoined with diluted sulphuric acid; but the

strong acid decomposed it. It forms neutral salts with the other acids. Another Italian, M. Folchi, has also claimed the discovery of the active principle of Sarsaparilla, which he asserts resides in the woody or central part: he regards it as a vegetable alkali, and has named it *smilacine*. I am very sceptical as to the claims of any of these products.

Sarsaparilla affects the secretion of the kidneys: it is probably partially digested, and sends only the active principle, whatever this may be, to the kidneys; but nothing is known upon this subject. It was early introduced into notice for the cure of syphilis: and, in the sixteenth century, Fallopius extolled its powers as preferable to mercury. He denominates the cure by Sarsaparilla the royal road to health, the via regia, and condemns the mercurial treatment as harsh and severe: "omnium," says he, "curationum acerbissima." Fallopius did not stand alone in this opinion; but, nevertheless, the medicine fell into disrepute, and was not again brought into notice until the middle of the last century, when Dr. William Hunter and Dr. Fordyce again restored it to favour, but not as a remedy for primary syphilis. Its real utility in this disease has been fixed by Mr. Pearson, who regards it as useful after a course of mercury, to free the habit from what may be regarded as the sequelæ of such a course; and Mr. Bacot, an authority of considerable weight in every thing relating to syphilis, remarks that "there is no medicine in the whole materia medica comparable to the Sarsaparilla for the purpose of restoring the tone of the stomach and recruiting the broken-down constitution." It certainly possesses the power of improving the general state of the system, and restoring the vigour of the constitution when broken down either by long-protracted disease or by an extended course of mercury. What part of this benefit is to be attributed to the diuretic influence of the root I will not venture to determine. That beneficial effects result from the use of Sarsaparilla, experience has fully demonstrated; but perhaps no medicine that is so frequently ordered is prescribed so much on what are termed empirical principles; neither the active principle of the medicine nor the mode in which it operates being yet understood. The parillinic acid of Battka, the parillina of Pallota, or the smilacine of Folchi, may be the active principle of Sarsaparilla; but none of them has been yet examined in this country; nor have they attracted much attention even on the Continent. M. Planché stated, in 1824, that he had repeated the experiments of Pallota; but had not, at that time, verified all the properties said to belong to the parillina. In the ten years which have elapsed since that time, nothing has been done with respect either to Parillina or to Smilacine. In whatever form Sarsaparilla is administered, it is requisite to give it in large doses: a pint of the decoction, an ounce of the pow-

dered root, and from two scruples to three ounces of the extract, must be taken in the course of the day, and should be continued for many weeks.

In the preparation of the decoction, much unnecessary maceration and boiling are ordered in the Pharmacopœia. The experiments of Mr. Battley have demonstrated that the bruised root yields all its active and soluble matter to water at 180° Faht. and that much boiling is unnecessary.

The great expense of Sarsaparilla has induced substitutes to be proposed for it. For this purpose, the roots of the Aralia *nudicaulis*, a root indigenous in the United States of America, have been used. They resemble the Lisbon Sarsaparilla in their external characters; but may be distinguished by being marked with purplish dots, and having no ligneous, central part. I have occasionally seen this root mixed with the split Sarsaparilla of the shops: and the roots also of the Agave *Cubensis*, which resemble the red Sarsaparilla. The Smilax *aspera* has been lately introduced, and is a good substitute. I have for some years past employed Elm Bark, in dispensary practice, instead of Sarsaparilla: it produces a decided effect upon the kidneys; but it does not act in restoring the vigour of the habit so effectually as Sarsaparilla. Besides *ulmin*, a peculiar principle which is found in the bark of many trees, Elm Bark contains much carbonate of potassa in combination; and probably a great part of its diuretic effects may depend on the union of the ulmin and the potassa.

2. POLYGALÆ SENEGÆ RADIX. *Senega or Rattlesnake Root**. L. E. D.—The plant† which yields this root is a native of North America, belonging to the natural order Polygaleæ. It grows on the sides of hills and in dry woods, in Kentucky, Ohio, and Tennessee. The root is irregularly shaped, contorted, gibbous, and covered with a thick, dull-yellowish or greyish bark: it has scarcely any odour; its taste is bitter, pungent, and peculiar. The bark is the active part of the root: it yields its medicinal principle to boiling water, and still more completely to proof spirit. Water renders the tincture turbid; thence it might be suspected that the active principle is oleoresin. M. Peschier has procured from it an alkaline principle, which he has named *polygalina*, and which he asserts exists in the Senega Root, in combination with a new acid which he has named *polygalinic*; but these opinions require confirmation by additional experiments. It is a stimulating Diuretic; and its

* It receives its name from having been long employed by the Senagaroo Indians as a remedy for the bite of the rattlesnake. It was applied externally, and internally administered.

† Woodville's Med. Bot. third edition, pl. 162, pl. 452. London Dispensatory, art. Porygala. Barton's Vegetable Materia Medica of the United States, vol. ii, p. 111, pl. 36.

active principle, whatever it may be, is absorbed, and acts directly on the kidneys. On account of its influence on the vascular system, it cannot be administered in the first stages of inflammatory diseases.

Senega Root may be given either in substance, in the form of powder, or in decoction. The decoction is made with one ounce of the powdered root and a pint and a half of water, boiled down to a pint; of which from half a fluid ounce to a fluid ounce is a dose for an adult. The dose of the powder is from thirty grains to two scruples. It may be advantageously combined with mercurials.

Leaves.

3. CHIMAPHILÆ UMBELLATÆ FOLIA. *Leaves of Winter Green**. Syn. *Pyrola umbellata.* D.—This plant is a native of Europe, North America, and Northern Asia, belonging to the natural order Pyrolaceæ. The leaves, which are the part of the plant chiefly employed, are lanceolate, somewhat wedge-shaped or narrowed towards the base, deeply serrated, and of a coriaceous texture. According to the analysis of Dr. Wolf, they contain—18 parts of bitter extractive, + 20.4 of resin, + 1.38 of tannin, + 77.58 of woody fibre; but as this extractive burns with a white flame and resinous odour, I am inclined to regard it as an oleo-resin. Both water and alcohol extract the active principle of the leaves. The decoction strikes a deep colour with sulphate of iron. The tincture is rendered scarcely turbid by water.

The diuretic properties of the Chimaphila *umbellata* were known to the Hourons and other Indians long before Europeans employed the plant. It was first used as a remedy in dropsy by Mr. Carter, surgeon to the hospital at Fort William, in Canada; and its influence was fully determined by Dr. William Somerville, who gave it a fair trial in the case of Sir James Craig, Governor of Canada, who was labouring under ascites, with a cachectic habit. Besides its diuretic influence, it operates as a tonic, increasing the powers of the stomach; and so far it has a decided advantage over many other Diuretics. The bruised leaves, applied to the skin, induce vesication and desquamation: I am therefore disposed to think that its diuretic properties depend on some acrid principle, which is separated in the stomach and conveyed to the kidneys.

Chimaphila *umbellata* may be administered in the form of infusion, or decoction, or extract. The decoction is made by macerating an ounce of the dried plant, cut into small pieces, in two pints of cold water, and then boiling the strained fluid

* Barton's Vegetable Materia Medica of the United States, 4to. vol. i, p. 17, pl. 1. Richard, Hist. Nat. Med. t. ii, p. 169.

down to one pint: three fluid ounces may be given for a dose every six hours. The dose of the extract is from ten to fifteen grains; and this may be repeated every third hour.

SUMMITATES VEL CACUMINÆ SPARTII SCOPARII. *Tops of the common Broom.* L. E.—The Broom is an indigenous shrub, a frequent inhabitant of our dry commons, belonging to the natural order Leguminosæ*. The plant generally rises to the height of five or six feet, branching towards the summit. The lower leaves are ternate, small, and smooth; the upper, simple. The flowers are papilionaceous, with bell-shaped, bilabiate, gaping, purplish calyxes. The anthers are saffron-coloured, the germen villous, and the style bent almost to a circle. The legume is compressed, brown, ciliated, and contains several flat, shining seeds.

The tops of the twigs are the parts of the plant employed. When boiled in water, a clear-brown decoction is obtained, which strikes a blackish or deep-olive tint with the solution of the persulphate of iron, and throws down precipitates with acetate of lead and nitrate of mercury. When the Broom tops are burnt, carbonate of potassa is procured from the ashes. These processes throw no light on the active principle of Broom. As a Diuretic, its tops have been used by the peasantry from time immemorial. It is probable that they undergo partial decomposition in the stomach. In large doses they operate as a cathartic.

* * *Inorganic Substances.*

l. ACIDS.

1. CARBONIC ACID. *Acidum Carbonicum.*—This acid is usually employed in solution in water, in combination with soda, as soda water, in calculous affections and irritable states of the kidneys. It is not easy to determine its diuretic influence; but it probably operates by giving tone to the stomach, whilst the alkali is conveyed to the kidneys.

2. TARTARIC ACID. *Acidum Tartaricum.* L. E. D.—As a Diuretic, Tartaric Acid acts powerfully; but in what manner has not been determined. Its particular effects being the same as those of the bitartrate of potassa, they shall be noticed under the head of that salt.

3. CITRIC ACID. *Acidum Citricum.* L. E. D.—This acid exists ready formed, both in a free and a combined state, in many fruits and vegetable productions that display diuretic properties. It has been detected in the Squill and the Onion, in combination with lime, and in the fruit of the Cranberry,

* Woodville's Med. Bot. 3rd edition, p. 413, pl. 150. London Dispensatory, art. Spartium.

Whortleberry, Hep, and most abundantly in the Lemon, in a free state. It possesses little power as a Diuretic in its uncombined state. There is, nevertheless, sufficient reason for supposing that both it and Tartaric acid pass to the kidneys undecomposed; as they have been detected in the urine of those who have taken them freely. They augment the urinary secretion when they are administered to remove the tendency to the formation of the ammoniaco-phosphates: and when the kidneys are in such an irritable state as occasionally occurs in fevers and in the phlegmasiæ, they have been found useful. The ancients were well aware of their influence on the kidneys, and distinguished them from other Diuretics by the term *cold diuretics*, from an idea that their effects originated, not from any excitement on the kidneys, but, on the contrary, from a cooling or sedative influence on these organs.

m. SALTS.

1. CARBONATE OF POTASSA. *Potassæ Carbonas.* L. E. D. Carbonate of Potassa is procured by the combustion of land vegetables; and is prepared by merely dissolving the impure potash from these ashes in water, filtering, and evaporating the solution to dryness. It is obtained in the state of a white, granular salt, deliquescent on exposure to the air, and dissolving entirely in the water which it attracts. Its solubility in alcohol distinguishes it from Potassa. When pure, it consists of—potassa 61.57, + carbonic acid 31.43, in 100 parts; or, 1 eq. of potassa = 47.15, + 1 of carbonic acid = 22, making the equivalent 69.15: but it contains, also, an indefinite proportion of water.

2. BICARBONATE OF POTASSA. *Potassæ Bicarbonas.* L. E. D.—If a stream of carbonic acid, extricated from white marble by means of muriatic acid, be passed through a solution of carbonate of Potassa until it is saturated, a bicarbonate is produced: or it may be formed by evaporating a mixture of carbonate of ammonia and carbonate of potassa; the pure ammonia being dissipated by the heat. This salt is in large tetrahedral, rhomboidal prisms, with dihedral summits. It is colourless; permanent in the air; has little alkaline taste; and scarcely browns turmeric paper. It dissolves in four times its weight of water at 60°, and is decomposed when it dissolves in boiling water. It consists of—potassa 47.53, + carbonic acid 43.56, + water 8.91, = 100; or, 1 eq. of potassa = 47.15, + 2 of acid = 44, + 1 of water = 9, making the equivalent 99.15.

Both of these salts, particularly the last, afford an agreeable mode of exhibiting Potassa as a Diuretic. The acid is partially separated in the stomach, and probably decomposed, while the alkali is carried forward to the kidneys, and acts there nearly in the same manner as pure potassa. The dose of the carbonate

is from gr. x to ʒss, at first; but it may be augmented to ʒiii; that of the bicarbonate may be double the quantity of the carbonate. Both may be given in any bland liquid which does not contain lime or any substance capable of forming an insoluble compound with carbonic acid. The diuretic properties of these salts are not injured by administering them in a state of effervescence with lemon juice; the citric acid being separated by the digestive powers of the stomach in the same manner as the carbonic; and, if any febrile heat be present, this is the best mode of exhibiting them.

3. ACETATE OF POTASSA. *Potassæ Acetas.* L. E. D.—This salt is formed by the direct combination of its constituents: and, since the introduction of the pyrolignous acid, which contains no vegetable matter, it has been obtained perfectly free from colour. On this account, the London Pharmacopœia now orders the employment of strong acetic acid instead of distilled vinegar, which always contains some mucus. The salt is inodorous; has a foliated texture, and a pungent saline taste; is extremely deliquescent; very soluble in water, and also in alcohol. For medicinal purposes, it is fused so as to produce a white crystalline, foliated mass, which is nearly anhydrous. Its constituents are—1 eq. potassa = 47.15, + 1 acetic acid = 51, making the equivalent 98.15; or, 49 parts of potassa, + 51 of acetic acid, in 100 parts. In the crystalline state, not fused, it consists of 1 eq. of acetate = 98.15, + 2 of water = 18, making the equivalent 116.15. When it is properly prepared, its solution should not be precipitated by nitrate of silver, the salts of baryta, nor by sulphuretted hydrogen. It is decomposed by the mineral acids; the sulphates of soda and of magnesia; and bitartrate of potassa, the tartaric acid of which forms a neutral tartrate with the potassa of the Acetate. In doses of ℈i to ʒi, this Acetate operates as a Diuretic; but in doses of ʒii to ʒiii, it exerts a cathartic influence.

As a Diuretic, Acetate of Potassa is undoubtedly decomposed in the stomach; and probably in this case the alkali only reaches the kidney. It has been given advantageously in hydropic diseases; but, frequently, it disappoints the practitioner: this sometimes, however, arises from its being overdosed; as when it purges it necessarily loses its Diuretic powers. It may be administered in the infusion of gentian, or any light bitter, or in any bland demulcent fluid. It is better to give it in small doses, frequently repeated, than in a full dose. I have seen it ordered, in cases of ascites, in conjunction with the bitartrate of potassa; but, for the reasons already stated, this combination purges and counteracts the intention with which both salts are ordered.

4. CITRATE OF POTASSA. *Potassæ Citras.*—This salt is

generally prepared by adding a scruple of the carbonate of potassa to fifteen grains of citric acid in solution, or half a fluid ounce of recent lemon juice. It is seldom prescribed as a Diuretic; but it is a useful vehicle for the administration of more powerful agents belonging to this order of medicines.

5. Bitartrate of Potassa. *Potassæ Bitartras.* L. E. D. —This salt, in small doses, namely, from gr. x to ℈i, operates as a Diuretic. Its effects are explained by Dr. Paris on the probability of the decomposition of the salt in transitu; and consequently the conveyance of the alkaline base to the kidneys. It is possible that this explanation may be correct; but when we consider that the quantity of alkali contained in a scruple of the Bitartrate is equal only to five grains, and that seven grains of the alkali are taken when twenty minims of the liquor potassæ are administered, yet, that the effects of the Bitartrate are much more considerable in producing diuresis than the liquor potassæ, there is some difficulty in assenting to the accuracy of this explanation. The influence of the Bitartrate in dropsical effusions is well authenticated; and, indeed, every day's experience confirms our confidence in its powers as a Diuretic. The emaciation which its continued use produces, when taken as a beverage, demonstrates the powerful effect of this salt upon the capillaries. It is frequently and beneficially combined with squill, colchicum, and other diuretics; and, also, with infusion of gentian and other bitter infusions. If the Bitartrate have weakened the digestive organs, which it occasionally does, it may be combined with tartarized iron. In cases which depend on hepatic or other glandular obstructions, iodine, in the form of ointment, may be used at the same time; and in this form, the use of the iodine may be continued with much advantage, when the internal use of it would have been injurious. The Bitartrate, in these cases, is administered in the usual doses, as if the iodine were not employed. For diuretic purposes, the dose should never exceed ℥ss: but it should be frequently repeated, until the kidneys be affected, diluting very freely during its employment.

The soluble Bitartrate formed by the addition of subborate of soda is said to operate also powerfully as a Diuretic. It requires only seven parts of water at 60° for its solution. It is not acted upon by boiling alcohol. The mineral acids decompose it very imperfectly. I have had no experience of its powers.

6. Carbonate of Soda. *Sodæ Carbonas. Sodæ Subcarbonas.* L. E. D.—The remarks made on the Carbonates of Potassa apply to those of Soda.

The Carbonate is found ready formed in the Salsola Soda, a plant growing abundantly on the shores of the Mediterranean; in the ice plant, Mesembryanthemum *crystallinum;* and in all

the Fuci, from which it is obtained by simply burning the plants and lixiviating the ashes. It is also found native in the soil in India, Thibet, and several tropical countries; and in the Natron lakes of Hungary and of Egypt. It is this salt which formed the nitron of the ancients. The best crude carbonate is barilla, which is procured from the Salsola *Soda* and Salicornia *herbacia*. The Carbonate, for medicinal use, is formed by boiling the *barilla* in water, filtering, and evaporating to obtain crystals, which are Carbonate of Soda. The mother water retains the salts with which it is combined in the barilla. The French chemists properly remark, that when barilla is employed to yield Carbonate of Soda, it is preferable to lixiviate with cold water, as the boiling water takes up many of the other salts contained in the barilla. Much of the Carbonate of Soda now used in this country is prepared from the decomposition of Sulphate of Soda and muriate of Soda; and a purer salt is obtained by this method than can be usually procured from the barilla*.

Carbonate of Soda, when pure, is in large, beautiful, octohedral crystals, nearly transparent, with a rhombic base, the acute angles of which are generally truncated. The taste of this salt is acrid, urinous, and disagreeable: it is inodorous, and displays an alkaline reaction on the solution of rhubarb, and on turmeric paper. It is soluble in two parts of water at 60°, and in less than its own weight of water at 212°. It crystallizes on cooling. It effloresces on exposure to the air. The chemical constituents of Carbonate of Soda are—

Soda..... ...	20.92	1 prop.	=	31.3
Carbonic Acid.	14.38	1 —	=	22.0
Water.....	64.70	10 —	=	90.0
	100.00	Equivalent		143.3

It often contains Sulphate of Soda and common salt mixed with it: but by forming the salt into a nitrate and adding nitrate of silver, the common salt is detected; or nitrate of baryta, which detects the Sulphate of Soda. The dose of this salt is from gr. xv to ʒii, in any vehicle not containing acidulous salts, lime water, muriate of ammonia, or solutions of earthy and metallic salts.

7. BICARBONATE OF SODA. *Sodæ Bicarbonas.* L. E. D.—This salt is found in a state of nature in the province of Stikena, in Africa, where it is called trona: it is artificially prepared by passing through the solution of the carbonate a stream of carbonic acid gas. In its pure state it consists of—

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* To procure it from Sulphate of Soda, this salt, mixed with saw-dust and lime, is exposed to the heat of a reverberatory furnace. The sulphuric acid is decomposed and its sulphur partly united with the lime, partly dissipated in the form of sulphurous acid, while the carbonic acid generated in the process combines with the Soda. The Carbonate of Soda is then obtained by lixiviation and crystallization.

Soda.....	38	1 prop. =	31.3
Acid.....	39	2 — =	44.0
Water.....	23	1 — =	09.0
	100	Equivalent	84.3

The crystalline grains are opaque, white, minute, and irregular. Their taste is scarcely alkaline; and, therefore, it can be taken with less disgust than the carbonate; and it is more generally employed as a Diuretic. Both these alkaline salts are given as Diuretics in dropsical affections, in which deposites of lithic or rosasic acids are found in the urine. As the crystallized salts are apt to effloresce and fall into powder, they are frequently dried before being administered, which enables them to be made up in pills. They are decomposed in the stomach, and the soda only is conveyed to the kidneys: they possess, therefore, no advantage over the pure alkalies, except in point of taste and greater mildness of operation. The tonic power of the carbonic acid, which is extricated in the stomach, prevents any unpleasant effect from the alkalies, even in the most irritable habits*. The dose of the Bicarbonate is from gr. x to 3i. It is decomposed by the same substances as the Carbonate.

8. BIBORATE OF SODA. *Sodæ Biboras*, *Borax*, L. E. D., is seldom employed as a Diuretic in this country. It, nevertheless, possesses diuretic powers, and may be given in doses of 3ss dissolved in almond emulsion or any bland fluid.

B. INDIRECT DIURETICS.

This division of Diuretics contains substances which act primarily on the nervous system, and secondarily on the capillary system, particularly the kidneys. These agents are of two distinct kinds: the one set diminishing arterial action, and throwing a large supply of fluids upon the circulating mass; the other set increasing the general tone of the habit, in which case the kidneys share in the benefit.

1.—DIMINISHING ARTERIAL ACTION.

* *Organic Products.*

n. NICOTINA.—The influence of Tobacco in diminishing

* M. Robiquet (Journ. Pharm. 1826) states a case in which a large stone of uric acid was reduced by drinking daily a strong solution of Bicarbonate of Soda for three months. The remainder of the stone, reduced to the size of a pea, was passed by the urethra. The continued use of it has been thought to be injurious; but this is an erroneous opinion. M. D'Arcet remarks, that, in the French manufactories of Carbonate of Soda, the workmen who are pounding, sifting, and barrelling the salt, respire and receive also into the stomach a large quantity of the salt which is constantly floating in the air, and that their clothes are always impregnated with it: yet these workmen enjoy good health, have no complaint but that of hunger, and are slightly constipated. He calculates that each workman swallows at least ten grammes of the salt per day.—*Ann. de Chimie, et Phys.* v. xxxi, p. 66.

arterial action, whether taken into the stomach, applied to the surface, or injected into the rectum, would lead us to regard it as a remedy of great power as a Diuretic; and if it could be managed so as to controul the circulation, there is no doubt that, in the direct ratio of its influence in this respect, we should find it, by increasing diuresis, prove a most useful remedy in dropsical accumulations; but its unmanageable character has hitherto prevented it from being much employed as a Diuretic. No medicine requires so much caution in its administration under the most favourable circumstances; and, therefore, it has yielded place to other sedative Diuretics. For diuretic purposes, any of the kinds of Tobacco may be employed, as they all contain Nicotina. This substance is supposed to be the active principle of Tobacco; but whether it excites the same stimulant action on the mucous membrane of the intestines as on that of the nostrils, it is difficult to demonstrate, although there is every reason to suppose that it does so; and probably, therefore, we may consider that Nicotina is the purgative principle of tobacco; but the sedative and antispasmodic properties of tobacco are undoubtedly due to its volatile oil; and it is the influence of this on the nervous system which produces the powerful sedative effect of tobacco when it is applied to an external surface. It nevertheless is contended that this volatile oil is not a direct sedative, but operates in the first instance as an excitant. Thus we are informed by M. Nick, of Tubingen, that smoking a pipe of Tobacco in the morning, even by those accustomed to its use, accelerates the pulse from fifteen to twenty beats in the minute, and this continues for an hour afterwards. Too little is known of the therapeutical qualities of Nicotina to allow us to say how it operates. It is not an alkaloid, but resembles the essential oils in its properties. In small doses it causes vertigo in quadrupeds.

Tobacco was introduced to the profession as a Diuretic by Dr. Fowler; and when administered, either in the form of infusion or of wine, in doses so small as not to nauseate, it has proved useful in dropsy. Tobacco has been, perhaps, less prescribed as a Diuretic than it deserves to be.

o. DIGITALIA.—The diuretic powers of the leaves of Foxglove, Digitalis *purpurea*, are supposed to depend on this principle. Its efficacy, as a Diuretic, is modified by the period of the growth of the plant at which the leaves are collected, and the manner of drying and preserving them. They are in the best state in the months of July and August; at which time they should be gathered and dried between colourless bibulous paper, in a warm room, under moderate pressure. When the dried pulverized leaves lose their green colour, some chemical change takes place in them, which diminishes their activity;

and, consequently, they should never be employed in this state.

As far as respects the diuretic powers of the Foxglove, it should be recollected that they are not obtained in that condition of the habit which exceeds the limit of healthful tone; for no benefit can be expected from its employment as long as any tension of the vascular system exists. It is only after ample depletion, or at least such as reduces greatly the frequency of the pulse, that it affects the capillary system and augments the urinary discharge: or, after tapping and a reduction of arterial action, that decisive advantages are obtained from the employment of Foxglove in hydropic affections.

In looking into the history of Foxglove, we find it in the London Pharmacopœia, in the beginning of the eighteenth century, although it was omitted in 1746, and was not reinstated until 1788, ten years after its practical restitution as a Diuretic by Dr. Withering, who brought it before the profession in 1775. In consonance with the opinion which I mentioned, respecting the diuretic influence of Foxglove, Dr. Withering and those who have followed him, found it most useful in lax, pale, leucophlegmatic habits; and if the disease be anasarca, in those cases in which pitting is left on pressure of the affected parts: thence, when this state does not exist, the system must be lowered by blood-letting and purging, before any advantage can be expected from Foxglove as a Diuretic. It has been found most beneficial in hydrothorax, and, next to that, in anasarca. In cases of dropsy, also, following scarlatina, it has been found very useful, after purgatives have been freely employed; and in those instances of anasarca, and occasionally of ascites, which attack constitutions broken down by long and severe courses of mercury. The best adjuncts to Foxglove, in these cases, are calomel, bitartrate of potassa, acetate of ammonia, and colchicum; and, in broken-down constitutions, it is beneficially conjoined with nitric acid. It may be given either in the form of powder, or infusion, or tincture. If administered in the form of powder, it is frequently combined with calomel and squill; but these adjuncts are supposed by Dr. Blackhall not to be very admissible. He remarks, "the practice is unsafe and not very consistent:" indeed, he regards the depressing effect of Digitalis to be at variance with the stimulant effect of the calomel; and adds, "where the urine is coagulable, and Digitalis agrees, both calomel and squill are positively injurious. On the contrary, where the urine is foul and not coagulable, and squill with calomel render service, I have on that very account made less trial of Digitalis, and cannot therefore speak of it from experience." My experience does not accord with Dr. Blackhall's views: I have found that Foxglove acts as an excitant on the capillary system.

The dose of the powder should be gr. i, frequently repeated: but, when its effects display themselves, it should not be repeated oftener than once in twelve hours; then, once only in twenty-four hours; and, ultimately, in forty-eight hours, to prevent its accumulation in the system. The form of infusion obtained by pouring f℥vii of boiling water and one of cinnamon water over ℥i of the dried leaves, and macerating for four hours, speedily produces the diuretic effects of the plant: but much of the efficacy of both these forms depends on the manner in which the leaves have been preserved. The tincture is a very excellent preparation, as it can always be made when the leaves are in the best condition. The dose of the infusion is f℥i to f℥iss, repeated once in five hours; the dose of the powder, gr. i to gr. ii, repeated once in six hours; and that of the tincture, m. x at first, once in four hours; but this dose, in many cases, may be gradually augmented to m. lx, and even to lxx, three times a day.

When an overdose of Foxglove is taken—for I know of no instance in which it has been used as a poison, with the view of committing murder or suicide—the symptoms are nausea, vomiting, vertigo, pulsation in the temples, a sense of heat throughout the body; occasionally diarrhœa; sometimes, but rarely, salivation; and, for the most part, profuse sweating. In a few instances the result has been fatal. One symptom recorded in some of the cases is remarkable—a suppression of urine. Post-mortem examinations of the body have displayed the brain much injected with blood, and the villous coat of the stomach displaying redness in some parts. When poisoning by Foxglove has taken place, the best remedial agents are ammonia, brandy and water, and opium: and the stimulus of a blister to the region of the stomach, which rouses the nervous energy and gradually restores the functions of the sensorium. One circumstance connected with its poisonous influence should be more generally known than it is—I refer to the singular fact of the medicine accumulating in the habit like mercury, and bursting forth with violence when not expected. At all times, when nausea comes on, the dose should be diminished; and we must recollect that vomiting instantly arrests the diuretic influence of Foxglove.

p. LACTUCARIUM.—This is the inspissated juice of the Lactuca *sativa* and L. *virosa**, plants belonging to the natural order Compositæ. These plants contain a white, opaque, proper juice, contained in the vessels chiefly under the cuticle. It is most abundant when the plant is in flower; indeed, so much so at that time, that it exudes from the vessels in drops when

* Woodville's Med. Bot. 3rd. edition p. 75, pl. 31. London Dispensatory, art. Lactuca. Richard, Hist. Nat. Med. tome ii, page 351.

the stems of the panicle are touched; the juice, therefore, should be gathered at this time. The odour of these plants is narcotic, resembling that of opium; and the taste is bitter and slightly acrid. This inspissated juice of the garden lettuce was introduced into practice as a narcotic by the late Dr. Duncan. He imposed upon it the name of *Lactucarium*. It may be collected in various ways; the best method is to make transverse incisions in the shoots of the plants when they are in flower, and to scrape off the exuded juice. The relative quantity yielded by one plant of the garden lettuce and one of the Lactuca *virosa*, is in the proportion of seventeen grains of dry Lactucarium from the garden lettuce and fifty-six from the Lactuca *virosa*. Besides this method for procuring the juice, the following is also used:—the plant is to be broken into small lengths, without employing a knife, except in the tougher parts of the stem, which contain little proper juice; then the whole is to be submitted to the press, and the expressed juice inspissated with a moderate degree of heat. It is this preparation which is used as a Diuretic, in doses of from five grains to ʒi or more, gradually augmented. It is little used in England: but it has been found useful, in cases of hydrothorax, by the German physicians.

From the similarity of the taste and odour of the proper juice of the strong-scented lettuce to those of opium, the active principle has been supposed to be morphia; but this alkaloid, if present, cannot be separated from it, and there is, at least, no meconic acid present in Lactucarium.

* *Inorganic Substances.*

q. TINCTURE OF MURIATED IRON. *Tinctura Ferri Muriatis*. L. E. D.—This is an etherial solution of the Muriate of Iron. It is not, assuredly, a Diuretic, in the strict meaning of the term, as it does not operate on the urinary secretion, but merely on the bladder of urine, when that is affected by spasm. For this purpose, it must not be administered in any solution containing gum acacia, as this decomposes it. It may be administered in doses of m. x every five minutes, until the desired effect is produced.

Some excitants are also beneficially employed as Diuretics, when no inflammatory symptoms exist to contraindicate their employment. They are chiefly combinations of alcohol and volatile oil; such, for example, as are found in gin and whiskey. The following combination of nitric ether and alcohol is still more commonly employed:

r. SPIRIT OF NITRIC ETHER. *Sweet Spirit of Nitre. Spiritus Etheris Nitrici*. L. E. D.—This compound is formed by mixing together three ounces of nitric acid and two pints of alcohol, so gradually that the heat shall not exceed 120° Faht.

and then distilling off twenty-four ounces. A portion of each of these ingredients is decomposed, and Nitric Ether formed by the recombination of their elements in the following proportions:—4 equiv. carbon 24, + 5 hydrogen = 5, + 1 nitrogen = 14, + 4 oxygen = 32, making the equivalent 75. The Nitric Ether rises with the alcohol and is condensed with it, forming the Spirit of Nitric Ether. This spirit is colourless, has a fragrant, etherial odour, and a pungent, slightly acid taste. Its specific gravity is 0.834; but it is less inflammable and volatile than sulphuric ether. When recently made and mixed with tincture of guaiacum, it strikes a deep blue colour, owing to some uncombined nitrous acid contained in it. When it has been kept long enough to assimilate this acid, no such effect is produced. It is incompatible with solution of sulphate of iron. The dose is from ten to forty minims, in any bland vehicle; and in this form it is a very generally employed Diuretic.

Besides the Diuretics which are of a material nature, the urinary secretion is powerfully influenced by the passions of the mind. Fear is one of the passions which operate powerfully on the urinary organs: the secreting and excreting vessels lose their contractile force, and thence a great flow of urine occurs. Sweat-drops appear on the forehead, and a diabetes or a diarrhœa often follows. The urine voided under such circumstances is pale; the desire of passing it frequent; and the sphincter of the bladder is affected. But the physician cannot take advantage of this mental affection in the treatment of disease.

2. DIRECT DIURETICS WHICH OPERATE BY AUGMENTING THE TONE OF THE HABIT.

The Diuretics under this division consist of tonics and excitants; they operate by producing a secondary effect on the kidneys.

The influence of tonic substances, as Indirect Diuretics, is most felt in those diseases in which the powers of the system are greatly diminished, and there is a consequent accumulation of fluid in the serous cavities and the cellular tissue; as, for example, in asthenic ascites which sometimes follows acute diseases: but in these cases, although the bitter vegetable tonics will do much, yet even the tone which they produce is hurtful, unless the secreting organs be stimulated to more healthy action; purgatives, therefore, ought to precede their use, and mercurials be employed at the same time. In such cases, also, much benefit is derived from the ferrum tartarizatum, which, besides operating as a tonic, exerts a direct diuretic influence, and has been found peculiarly serviceable in anasarca connected

with affections of the heart; but, in these cases, its employment should be preceded by purgatives.

3. INDIRECT SUBSTANCES WHICH OPERATE PRIMARILY ON THE CAPILLARIES.

These are chiefly Mercurials. Much benefit is derived from their aid in promoting the operation of other Diuretics; for they are seldom used alone as Diuretics. Thus, the diuretic influence of Squill, Colchicum, and Digitalis, is rendered more certain by being combined with Calomel or the blue pill. The mercury stimulates the capillary system, and in this manner, independent of any increased action of absorbents, aids the active principles of other Diuretics on the kidneys.

THERAPEUTICAL EMPLOYMENT OF DIURETICS.

After the view which has been taken of the substances most commonly employed as Diuretics, their practical utility as remedial agents may be briefly stated. Their character of operating as stimulants on the kidneys points out the propriety of not employing them in cases of inflammation of these organs. With regard to their influence in febrile affections, much must be done before prescribing them; but, in long-protracted fever, whether intermittent or continued, if œdematous swellings occur, their use is indicated, and must not be delayed. If they be prescribed during fever, it must be recollected that one of the most distressing symptoms in that disease is retention of urine; and therefore, in prescribing Diuretics, it is highly requisite to examine daily the state of the bladder. Most fevers in their termination display critical changes either in the quantity or the quality of the urinary discharges; and therefore, under such circumstances, it becomes a question how far a Diuretic is likely to favour such a crisis. At the commencement of fevers, the urine is generally pale; it becomes afterwards high-coloured; and, at the termination of a paroxysm, if the fever be intermittent or remittent, or when it begins to decline, if it be of a continued type, a sediment, either of a brick-red colour, lateritious as it is termed, or of a pale pink colour, is deposited, and has been regarded as critical: but this sediment is to be viewed rather as the result of a certain catenation of actions than as the excretion of any thing injurious to the habit; and, were Diuretics able to promote it, they would be of no avail. Upon the whole, therefore, even as simple evacuants, Diuretics are of little value either in idiopathic fever or in acute diseases where fever is a symptom. They have been advantageously administered in some chronic febrile diseases, especially those accompanied with eruptions on the skin; but the chronic affections in which their influence is most beneficial are dropsies,

This class of diseases consists in such an atony of the capillary system, that, instead of the capillaries carrying forwards the fluids which they contain, they pour them out into the serous cavities and the cellular membrane*, whilst the balance between exhalation and absorption is broken, and the effused matter overpowers the absorbents. Diuretics are prescribed to cure dropsies in every form; and they do so by stimulating the capillaries, so that, no fresh effusion taking place, the absorbents are enabled to take up the already effused fluid, and to throw it upon the kidneys, its natural emunctory. When success attends the administration of Diuretics in dropsy, one advantage which results from their employment over drastic purgatives and some other remedies is the little debility which they occasion. If Diuretics, however, be given alone, they are uncertain in their effects, and seldom, in that case, do they deserve more than the title of palliatives; but, as adjuncts to other means, they aid materially the evacuation of the effused fluid, and they have thus frequently effected the removal of general dropsy. Their success, however, is very precarious; and so many circumstances interfere with their operation, that it is difficult to form a prognosis of their expected effects. Sometimes they operate freely, increasing greatly the discharge of urine, and yet the dropsical swellings continue. In this case, some organic mischief must be looked for; and, unless this can be discovered, no great advantage can be expected from the evacuation of the effused fluid. The kinds of dropsy in which the *direct* Diuretics have proved most successful are anasarca and ascites; whilst those which operate by diminishing arterial action and augmenting that of the capillaries are the best adapted for hydrothorax. But, even in any case, the influence of Diuretics hinges upon so many accidents, that all of them are precarious in their effects. In encysted dropsies they are utterly useless.

Diuretics have been prescribed in calculous diseases; and most of the substances called lithontriptics are Diuretics. We have ample proofs that none of them act chemically in dissolving calculi; nor indeed can they be said to effect any change on the kidneys sufficient to prevent the formation of calculous matter. It is probable that the benefit accruing from their employment is wholly due to their influence on the stomach and digestive organs; and, by their aiding in the formation of a better gastric juice, the digestive process being ren-

* In anasarca, it is generally stated that the fluid is deposited in the cellular membrane; but Dr. William Hunter contended that it is not in the same cells of this membrane as those which contain fat. The chief arguments he urged were—that those parts, such as the eye-lids, the penis and scrotum, in which the fluid in anasarca is most deposited, contains no fat. Dropsical parts pit on pressure; the fluid disperses and returns, which is not the case with parts distended by fat; although the same thing takes place when oil is poured into the common cellular membrane after death.—*Med. Obs. and Inquiries*, vol. ii, p. 33.

dered more complete, all the secretions as well as the excretions must necessarily become more healthy, and cease to deposite the uric and other acids in the pelvis of the kidneys.

In conclusion, we would say that the efficacy of this order of remedies depends greatly on the state of the nervous system* ; and more on the tact of the prescriber, and his intimate acquaintance with the changes, both structural and functional, which disease produces on the system, than on any other. The operation of no other order of medicines is so much modified by circumstances; and no other medicines require so much attention as these for ensuring their beneficial effects. The following rules ought always to be strictly observed during the administration of Diuretics:

1. The surface of the body must be kept cool.
2. They should be administered during the day, and whilst the patient is out of bed.
3. The use of diluents is essential, and ought to be urged more especially when the saline Diuretics are employed.
4. Little advantage can be anticipated from the use of Diuretics in those dropsies which originate in organic affections of the liver or the chylopoetic viscera: it is only in those cases connected with debility, and deranged action of the capillary system, that Diuretics can be regarded as certain remedial agents.
5. When the fluid is removed, the administration of tonics is necessary to prevent a relapse.

SECTION XVI.

EMMENAGOGUES†.—MEDICAMENTA EMMENAGOGA.

THESE are medicines which are supposed to promote the menstrual discharge. It has been doubted whether any medicines act directly upon the uterus; the apparent agency of some in promoting its periodical discharge being referred to their influence in producing a condition of the system favourable to

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* M. Krimer divided the nerves of the par vagum in a dog, emptied the bladder, and injected a solution of rhubarb into the stomach; but no trace of it could be found. He connected the divided ends of the nerves by a voltaic pile; in a short time the rhubarb could be traced in the urine: he again interrupted the current, and it wholly disappeared from the secretion.—*Physiologische Untersuchungan, Leipsic*, 1820.—Wilson Phillips had previously ascertained nearly the same thing.

† Derived from ἐμμηνια, the menses, and ἀγω, I induce.

health, and the uterus sharing in the salutary effect. To determine the correctness of this opinion, we must first take into consideration the nature of the uterus in the unimpregnated state; the character and causes of its periodical discharge; and, lastly, whether the organ can be directly acted upon by any medicines taken into the stomach, or any applications to the surface of the body.

The texture of the uterus is muscular, but the fibres are denser, firmer, and more compact than those of the other muscular textures of the body: it abounds with blood-vessels; the arteries are tortuous, and the veins destitute of valves; it is also well supplied with nerves, and with lymphatics on its external surface. The existence of nerves in the substance of the uterus was long doubted; but modern discovery has put both this question and that of its muscularity at rest. Internally, the uterus is lined with a soft, delicate, spongy membrane, composed chiefly of capillary vessels. That part of the cavity, however, which forms the canal of the cervix, exhibits a very different surface; it is firm, callous, and little vascular, with oblique and transverse rugæ, which exude a mucous fluid. Such is the organ—what is its function in the unimpregnated state? How far is it adapted to perform the functions of a secreting organ? Is the periodical discharge a true secretion, or a mere flow of blood from vessels oppressed by a local plethora?

In reply to the first of these queries, it is scarcely necessary to say that its function is menstruation—a discharge recurring once a month; commencing at the period of puberty, and terminating between the fortieth and fiftieth years of age. The second and third queries involve matters of controversy; but the prevailing opinion is in favour of the capacity of the uterus to secrete, and, consequently, that the discharge which it exudes is a real secretion*. There is nothing in the anatomical structure of the organ that unfits it for the function of secretion; and were any arguments necessary to refute the notion that menstruation depends on a general plethoric orgasm, it would be only necessary to mention the facts, bearing on this point, presented by the Hungarian sisters. These two females were united at the lower part of the back, and lived to the age of twenty-two. The same blood flowed in the system of each; for the abdominal vessels were found, after death, united at the loins; yet the uterine function was distinct in both; it differed in its period, and also in the quantity of the discharge. Were the menstrual discharge a mere flow of blood from dilated ves-

* This discharge is peculiar to females of the human race, although Cuvier has stated that he has observed indications of it in females among quadrupeds; and it is undoubted that something like it exists in the monkey tribe.

sels, this state would have been long since ascertained in the examination of the various cases which have terminated in death during menstruation ; but the closest microscopic investigations have displayed no appearances that give support to such a belief. Others, arguing from the analogy of hæmorrhoids, and the swellings of the uterine veins at the moment of menstruation, have contended that the discharge proceeds from the uterine veins: but this opinion has had very few supporters. Indeed, in reflecting on the nature of the organ itself, on its resemblance to other glandular organs in the manner in which it is supplied with blood, and on the adaptation of its internal surface to exhalation, we can have little hesitation in admitting, that the manner in which the periodical discharge is supplied closely resembles that of a secreted fluid*. The uterine arteries are not only exceedingly convoluted, but they are larger, and have thinner coats than the veins, in the unimpregnated state: blood is therefore brought into the organ readily, and in considerable quantity, whilst it is slowly returned from it—a condition of vessels highly favourable to the secreting function. It is true that, previous to menstruation taking place, there are symptoms indicative of general plethora as well as of local congestion ; yet this fact only proves that the discharge is connected with such a condition of the system ; not that it is caused by this state, nor that the relief which follows is attributable to blood being discharged by the uterine vessels. The admission, also, that there is an increased determination of blood to the organ at the period of menstruation, does not militate against the idea that the discharge is a secretion, since it is very well known that every glandular organ, when excited by its appropriate stimulus, becomes a centre, as it were, to which the blood is directed ; and this is strikingly observable in those which are only periodically called into action. Again, if this discharge were merely the effect of a local plethora, it would be blood, which is not the fact ; for it does not coagulate like blood, nor does it contain fibrine ; but " has the properties," as Mr. Brande has remarked, " of a very concentrated solution of the blood in a diluted serum." If it be thus evident, from reasoning, and from the chemical nature of the discharge, that menstruation is not the mechanical result of a local congestion, let us examine how far observation supports the opinion that it is a *secretion*.

We know that glands are excited to the exercise of their secreting function by some specific impression, either mental or corporeal : the salivary glands are excited by the thought of

* M. Lecanu ascertained that the blood drawn from the arm of a woman during the flow of the menstrual discharge contains little more than one half the quantity of globules which the blood of the same individual displays at other times.

savory food; the testicle is excited to the elaboration and excretion of semen by the desire of sexual intercourse; and it is probable that the action of the uterus is influenced by some state of the ovaries; for when these organs are either absent or are much diseased, no menstruation occurs. It is not easy to explain its periodical returns. As the intervals are those of the course of the moon in the revolution of her orbit, they were supposed to be influenced by this planet; but were this the case, the menses ought to correspond with one of the phases of the moon's course, which is not the fact. *Van Helmont* thought to explain it on the then prevailing doctrine of fermentation; *Stahl* referred it to the vis medicatrix labouring to relieve the female constitution of a superfluous accumulation which occurs monthly; whilst *Gall* endeavoured to prove that some external cause, which he could not discover, but not the moon, influences the period, as he ascertained it to be a general law, that all women menstruate at the same epoch. Without admitting any of these opinions, all of them being as untenable as the hypothetical idea of lunar influence, the truth or error of the theory that menstruation is a secretion does not depend on the necessity of an explanation of its periodical return.

The uterus, as has been already stated, resembles a gland in its vascular structure; and this resemblance extends to its diseases—an inflammatory state excited in it being often followed by scirrhus and cancer. Like other secreting organs, also, its function is often imperfectly performed, and the secretion, therefore, is liable to vitiation and derangement. In the first efforts of the organ, the secretion is usually thin, colourless, and deficient, and its recurrence is irregular and protracted: when it is suppressed, it cannot be restored by inducing plethora; nor can the flow, when it has commenced, be checked by venæsection, nor by any other means of depletion. In making this remark, I must not be misunderstood: it is not my intention to assert, that inordinate evacuations in other parts of the system do not influence the uterine discharge; on the contrary, I am perfectly aware that preternatural evacuations induced in the other organic systems will suspend the course of the catamenia, on the same principle that increased action of the intestinal system suspends the action of the cutaneous exhalants; and, *vice versa*, sweating checks diarrhœa. Any argument, founded on the supposition that the structure of the uterus is not sufficiently glandular for a secreting organ, falls to the ground, when we reflect that the gastric juice is secreted by the stomach, which is more simple and less like a glandular organ than the uterus. I shall only add, that the correctness of the opinion that the catamenia are a secretion does not depend altogether on circumstances connected with the state of the organ itself; experience having ascertained that this discharge is intimately connected with the state of the

ovaries. It is not necessary, for the establishment of the truth of this opinion, that we should be able to explain the cause of the periodical return of the discharge. If menstruation depend, as I maintain it does, on the secreting function of the uterus, it is obvious that, in the unimpregnated state, it ought always to happen at its regular period, when the organ is in a natural or healthy state; and that, in order to promote its return, when it is interrupted or suspended, such medicines must be employed as will restore the organ to that precise state or condition on which the exercise of that function depends. It may be doubted, however, whether there are any medicines which will excite the flow of the menses by stimulating immediately the nerves and vessels of the uterus, in the same manner as the kidney is stimulated by medicines which are carried into the system and pass directly to that organ. But it cannot be denied that some medicines appear to act more directly upon the uterine system than others; and it is to these only that the appellation Emmenagogue can be properly applied. They may be such as will act either immediately on the uterus itself, or such as will merely influence that organ as a part of the general system. Emmenagogues, therefore, may be arranged under two heads—*direct* and *indirect.* We can understand the manner in which both operate, and the propriety of employing the one or the other, if we have a clear idea of the nature of the morbid condition of the organ, and whether the obstruction or interruption of the periodical discharge depend on a diseased state of the uterus itself, or is the effect of the presence of other diseases in the system.

In some instances, suppression of the menstruation is a primary affection; "often," as Dr. Denman has justly remarked, "though not universally, succeeded by a certain train of untoward symptoms:" but more frequently it is the result of other diseases; and, therefore, the nature of these, as well as the state of the patient, with respect to vigour and constitution of body, must determine the kind of remedial agents to be selected as Emmenagogues. Thus, when the delay of the regular appearance of the discharge, after it has once appeared, occurs in females with a pale or leucophlegmatic countenance, indicating an atony of the vital powers, stimulant and tonic means are required, to give to the vascular system that degree of power which is requisite to maintain the healthy action of the capillaries; on the contrary, when the complexion is florid, when there is much tension of the system, or when the suppression is connected with great irritation of the uterine system, it is easy to understand that menstruation is more likely to be aided by whatever diminishes excitement and sooths and calms irritation than by stimulants. Thence the fact, that very different, nay, very opposite, remedies are required to remove amenorrhœa in dif-

ferent instances. Stimulants, whether corporeal or mental, undoubtedly tend to an early development of the uterine organs, and, consequently, to the appearance of menstruation sooner than is usual: thus, in tropical climates, and in those females who indulge in luxurious and pampering habits, the age of puberty is earlier than in those who inhabit the temperate and frigid zones, and whose regimen and passions are better regulated. The continued influence of stimulants is said, also, to prolong menstruation beyond the period of life at which it usually ceases; but this is at least problematical. All Emmenagogues are more or less stimulants; and, in cases in which a stimulant influence is contraindicated, they cannot be employed until the excitement be reduced, and then only under certain restrictions.

When the uterine obstruction is accompanied with a *pale* complexion and a languid state of the system, a variety of medicines are prescribed, either with the view of directly influencing the *uterus*, and promoting the menstrual discharge by some specific action; or, by invigorating the habit, of eventually promoting the secretory function of the organ. Medicines of this kind, however, do not always bring on the menstrual discharge, although they improve greatly the general health. By their indiscreet employment, much injury may be done to the organ itself. It ought, besides, to be well understood, that idiosyncracy, natural conformation, diseased states of the uterus itself, or of the ovaries, are often opposed to the salutary influence of Emmenagogues.

It may be doubted, as I have already mentioned, whether there is any medicinal agent which, when taken into the stomach, exerts a directly stimulant influence on the uterus; but, if we admit that some substances find their way to particular organs —for instance, nitre to the kidneys—there is no reason why such should not be the case with regard to the uterus: experience, however, has not yet demonstrated that this is the case; but a stimulant effect may be propagated from neighbouring parts to the uterine vessels: thence, some cathartics, which operate chiefly upon the rectum, are found to influence the uterus.

When the obstruction is accompanied with a *florid* complexion, and the colour of the cheeks is the flush of disease, not the glow of health*, or when a slight cough with pain in the chest and difficulty of breathing accompany the suppression, bleeding, and other antiphlogistic means of treatment must be resorted to before taking into consideration the uterine function; and, until the general excitement be subdued, the employment of Emmenagogues would be injurious. It is questionable whether, in these cases, any of those substances supposed to act directly

* Denman.

upon the uterus should be employed? If they can be administered, they will be most likely to prove beneficial when given immediately after the reduction of febrile excitement.

The employment of Emmenagogues is not confined to cases of simple obstruction or suppression. In some females, the pain with which menstruation s accomplished embitters much of life. This either indicates a peculiar state of the organ, or it is the effect of disease, or at least a tendency to it, in the organ itself; not, as is sometimes supposed, an increased degree of the irritability of the general system. Some of the substances employed as Emmenagogues are supposed directly to lessen uterine irritation, and consequently to facilitate the discharge; thence they are thus closely allied with sedatives and antispasmodics.

In the following table of Emmenagogues, I have arranged them under two distinct heads; the *first* containing those substances which are supposed to operate, by their stimulart influence, on the uterus itself: the *second* those which influence the uterus sympathetically by their action on other organs: or, into *Direct* and *Indirect* Emmenagogues. The first of these divisions I have subdivided into *Immediate* and *Mediate*. In the second of these subdivisions, some substances will be found the direct influence of which on the uterus is doubtful: they maintain their place rather in conformity with the prevailing opinions than from a conviction that their action on the uterine system is such as to authorize the position which they hold.

TABLE OF EMMENAGOGUES.

A. DIRECT EMMENAGOGUES.

1.—Immediate.

a.—ELECTRICITY. *Electricitas.*

2.—Mediate.

* *Organic Products.*

b.—OLEO-RESINS—contained in

Roots—Polygala *Senega.*	17.	3.	Polygaleæ.
Ruta *graveolens.*	10.	1.	Rutaceæ.
Herb.—Juniperus *Sabina.*	22.	8.	Coniferæ.

c.—BITTER PRINCIPLE—contained in

Roots—Rubia *tinctorum.*	4.	1.	Rubiaceæ.

* * *Inorganic Substances.*

d.—MERCURIALS. *Preparationes Hydrargyri.*

B. INDIRECT EMMENAGOGUES.

1.—operating on the kidneys and intestinal canal.

a.—NITRATE OF POTASSA.

b.—BITTER PRINCIPLE—in

Proper Juice—Aloë *Spicata.*	6.	1.	Asphodeliæ.
—— *vulgaris.*	–	–	————

c.—GUM-RESIN—contained in

Roots—Helleborus *niger.*	13.	7.	Ranunculaceæ.
Proper Juice—Camboge.			

2.—operating on the stomach.

* *Organic Products.*

d.—VOLATILE OIL—contained in

Roots—Valeriana *Officinalis.*	3.	1.	Valerianeæ.
Aristolochia *Serpentaria.*	20.	1.	Aristolochiaceæ.
Herb—Artemisia *Abrotanum.*	19.	2.	Compositæ.

* * *Inorganic Substances.*

d.—OXIDES AND SALTS OF IRON. *Oxydi et Ferri Sales.*

Natural.

Carbonate of Iron.
Sulphate of Iron.

Artificial.

Black Oxide of Iron.
Alkaline Solution of Iron.
Ammoniated Iron.
Sulphate of Iron.
Tartrate of Iron.
Carbonate of Iron.

3.—operating on the nervous system.

* *Animal Products.*

e.—CASTOR—formed by the

Castor *Fiber.*	1.	4.	Rodentia.

* * *Vegetable Products.*

f.—OLEO-GUM-RESINS—contained in

Ferula *Assafœtida.*	5.	2.	Umbelliferæ.
Galbanum *Officinale.*	5.	2.	————

g.—DIGITALIA—contained in

Digitalis *purpurea.*	15.	1.	Scrophularineæ.

h.—UNKNOWN PRINCIPLE—contained in
Secale Cornutum.

A. DIRECT EMMENAGOGUES:

1.—OPERATING CHIEFLY ON THE NERVOUS SYSTEM.

1. IMMEDIATE.

a. ELECTRICITY. *Electricitas.*

If a discharging rod attached to a chain communicating with the outside of a charged Leyden jar be applied to the one side of the pelvis, and the knob communicating with the inside of the jar be applied to the opposite side, a feeling is instantly produced as if a small sword was thrust through the part; and a stimulant impulse is given to the uterus by the direct passage of the electrical fluid through it. The stimulant impulse of a shock thus communicated is obvious by the sensation which it excites; but excitement also takes place, although in a less degree, when no sensation is produced, as when a continued current of the fluid is passed through the organ, by making it a part of a circuit communicating with the prime conductor of an electrical machine, or in making it part of the circuit of a Galvanic trough. The direct application of electricity is admissible only when a torpor of the uterus exists, indicated by a suppression of the catamenia, with a pale complexion, and a languid state of the circulation. But, even in this state of the habit and the organ, it should be remembered that, whilst applied in moderation, this agent rouses the activity of the torpid uterus; in large quantity, it injures materially, if it do not altogether destroy the excitability of the organ. When the complexion is florid, particularly if febrile symptoms, with some oppression of respiration, be present; bleeding, purging, and antiphlogistic measures, instead of electricity, are required. In employing electricity, therefore, as an Emmenagogue, it should be first used under the form of accumulated electricity, or the bath, as it is termed; then sparks; next the aura; and, lastly, shocks should be given. At first the shock should be moderate; as, in nervous habits, syncope has followed the incautious communication of powerful shocks; but with ordinary caution in its application, Electricity has been found a powerful agent in amenorrhœa depending either on general debility of the system or on atony of the organ itself.

2. MEDIATE.

* *Organic Substances.*

b. ROOT OF DYERS' MADDER. *Rubiæ Tinctorum Radix.* L. E. D.—Rubia Tinctorum is a native of the south of Europe; but it has been long cultivated in Zealand for the use of dyers. It belongs to the natural order Stellatæ. The dried roots are somewhat translucent, reddish, and have a strong smell. When

perfectly dried, they are pulverized so as to produce three descriptions of powder. The first and second consist chiefly of the fibrillæ and skins of the larger roots; the second is a little bitter only; it is the third, which is called *Crop Madder*, that is imported for medicinal use. Good Madder has a bitter, slightly harsh taste. It attracts powerfully the moisture of the atmosphere, and is injured when it becomes damp. It imparts a pink hue to water at 60°; but when the fluid is boiled, a deep brown tint is produced. Its chief constituent is extractive—a fact which is rendered evident by the effect of muriate of tin, which throws down an oxide of tin combined with the extractive. It is also precipitated by subacetate of lead, alum, the alkaline carbonates, and lime-water. The colouring principle of the plant has been ascertained by Robiquet and Collin to be a peculiar acid, which they have named *Alizarine.* It is procured by digesting the Madder in four parts of sulphuric ether, evaporating to the consistence of syrup, and when it is dried spontaneously, it is reduced to powder, and sublimed into a cone of paper. It sublimes in yellowish-red, brilliant diaphanous acicular crystals. Carbonate of magnesia imparts to the infusion a bright blood-red colour; and, when evaporated, leaves a residue very readily soluble in water, which is an alizarinate of magnesia. When agitated with chlorine gas, the extractive is oxidized.

As an Emmenagogue, Madder has been long employed and relied upon, without any certainty as to the manner in which it acts; although, from its tinging the urine, as well as the bones, of a red colour, it has been supposed that, as it passes into the circulation, it finds its way to the uterus, and directly influences that organ. The late Dr. Barton, an American physician of considerable eminence, placed great reliance on its deobstruent powers; and it was also much esteemed by the late Dr. Home, of Edinburgh, who, in his "Clinical Experiments and Histories," has recorded his decided opinion of its efficacy as an Emmenagogue. He gave it in doses of from ʒss to ʒi, twice or three times a day. It is now rarely employed.

e. OLEO-RESINS.

The volatile oil in the following substances is combined with resin, and is their active principle.

* *Roots.*

1. SENEGA ROOT. Polygalæ *Senegæ Radix.* L. E. D.—Senega Root has a bitter, pungent taste, and is nearly inodorous. The active principle resides in the bark, which, when chewed, produces a hot, tingling sensation in the fauces. It contains a considerable proportion of resin and volatile oil.

As a medicinal agent, this root was first brought into notice nearly a century ago, by Dr. John Tennant, who discovered that it was the secret remedy of the Senagaroo Indians against the bite of the rattlesnake; and, from the similarity of the symptoms of the bite of that reptile and those of pneumonia, he recommended it in that affection. It operates chiefly as a stimulant to the capillary system; and consequently influences the function of the skin and the secreting organs in general. As an Emmenagogue, Senega Root was first employed by Dr. Hartshorne, of Philadelphia. He found that its efficacy is most conspicuous in recent cases of amenorrhœa, when it is administered in the form of a saturated decoction, to the extent of a pint in twenty-four hours, beginning its use about two weeks previous to the menstrual discharge. It is, however, necessary to state, that he previously prepared the habit, as he expressed himself, by the administration of calomel, carried to the extent of producing a gentle ptyalism; and something must be referred to the action of the mercurial on the uterus, independent of the Senega. The experience of Dr. Chapman, another American physician, and Professor of Materia Medica in the University of Pennsylvania, is thus stated by him. "I have," says he, "tried the Senega, both in my public and private practice, to a considerable extent, and with sufficient success to warrant me in recommending it as one of the most active, certain, and valuable of the Emmenagogues. The Senega," adds Dr. Chapman, "may be used either in powder or in decoction, though I greatly prefer the latter mode. My rule," he says, "in the administration of the medicine, in these cases, is to give about four ounces of the decoction, more or less, during the day, according to the circumstances of the case. But at the time when the menstrual effort is expected to be made, and till the discharge is actually induced, I push the dose as far as the stomach will allow, having given as much as two ounces every hour."

"In the intervals of the menstrual periods," Dr. Chapman continues, "I always lay aside the medicine for a week or two, as, without these intermissions, if it does not lose its efficacy, it becomes nauseous and disgusting to the patient. While under a course of Senega, the general system is to be kept properly regulated, equally obviating excessive excitement or debility, by the use of the appropriate remedies. Of all the Emmenagogues which I have tried," he adds, "this is the most efficacious, and will be found useful in all the forms of amenorrhœa; but I think it to be more particularly so in those cases where decidua exist. As yet we are ignorant of the exact process by which this membrane is formed; though of this there is no doubt, that the vessels of the uterus, which pour out the catamenia, are the instruments by which it is accomplished. Nor is it less certain

that, while they are engaged in the formation or support of this new production, menstruation ceases, the two offices exciting modes of action totally incompatible. It is obvious, under these circumstances, to change the state of the uterus and to excite a secretory effort, not only a forcible, but a specific impression must be made upon it. Deny to the Senega these specific energies, and where shall we seek an explanation of its effects? Were it simply a stimulant or tonic, or sudorific, as is more generally supposed, it might induce excitement, or impart tone, or raise a diaphoresis, like many other articles of the Materia Medica; but would it be so signally efficacious as an Emmenagogue?" I have extracted this long quotation from Dr. Chapman's work to make up for the want of any remarks which my own experience enables me to make on the employment of this medicine in the treatment of amenorrhœa. If his remarks be correct, the Senega Root is undoubtedly an Emmenagogue which merits more attention than it has received on this side of the Atlantic.

2. RUE. *Rutæ graveolentis folia.* L. E. D—This plant is a native of the South of Europe, although it is generally cultivated in this country as a garden shrub. It belongs to the natural order Rutaceæ*. It was esteemed as a useful remedy in obstructed menstruation so early as the time of Hippocrates, yet it is of doubtful efficacy. The oil should be preferred to the plant; and, in the form of an oleo-saccharum, it may be administered to the extent of two or three minims for a dose.

* * *Leaves.*

3. SAVINE LEAVES. *Juniperi Sabinæ folia.* L. E. D.—Savine is a native of the South of Europe, belonging to the natural order Coniferæ†.

The leaves of Savine have a strong, disagreeable odour, and a hot, acrid taste, both depending on a volatile oil, which can be obtained separated from all the parts of the plant by distillation with water. Savine, or rather the volatile oil of the plant, is an energetic Emmenagogue; and, from the activity and mode of its action, and its proneness to produce uterine hæmorrhagy, there is reason for thinking that it is taken into the circulation and carried directly to the organ, on which it exerts a stimulant influence. Experience has amply confirmed the power of Savine as an Emmenagogue; but it has also proved that much caution is requisite in its administration, to prevent inflammation of the uterus; and consequently, also, that it is adapted

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* London Dispensatory, art. Ruta. Richard, Hist. Nat. Med. t. ii, p. 279.
† London Dispensatory, art. Juniperus. Richard, Hist. Nat. Med. t. i, p. 471.

for those cases of amenorrhœa only which are attended by a pale countenance and languid circulation. More than half a century ago, it was lauded as an Emmenagogue by Dr. Home; but, from the opinion of it expressed by Dr. Cullen soon afterwards, it was neglected, and has never since regained its reputation. M. Herz, a German writer, has also borne testimony to its beneficial influence as an Emmenagogue. It may be administered in substance, in the form of powder, in doses of from five to ten grains; or the oil may be given as an oleosaccharum, in doses of from two to six minims, combined with ten grains or a scruple of sugar. The Dublin College orders an extact of Savine; but it is useless, as the volatile oil is dissipated by the boiling.

* * *Inorganic Products.*

Mercurial Preparations. *Hydrargyri Preparationes.*—No medicines, perhaps, merit more the appellation of direct Emmenagogues than the preparations of Mercury. If the correctness of the view which has been taken of the function of the uterus be admitted, there is little difficulty in conceiving that the administration of mercurials in obstructed or suppressed menstruation is likely to prove salutary. They operate almost a specific change upon the whole glandular system; and, consequently, regarding the uterus as a gland, if its functions be altered by disease, the same medicines which affect the capillaries in general are likely to operate on those of the uterus, when they are in a morbid condition. Mercurials, carried to the extent of exciting a moderate degree of salivation, have relieved amenorrhœa when every other method of treatment has failed. The preparation best suited for this purpose is calomel, the Protochloride of Mercury; it is mild in its operation, and, at the same time, it is one of the most certain in its influence on the general system. In the combination in which it exists in Plummer's pill, in particular, it has been found highly beneficial, the precipitated sulphuret of antimony with which it is combined greatly aiding its power. It may be given in doses of from gr. v to gr. xii every night and morning, until the gums be sensibly affected.

Upon the whole, from what has been said, it is obvious that Electricity is the only direct Emmenagogue, and that the idea of the others acting upon the uterus itself is rather inferred than certain. It is nevertheless true, that, in whatever manner they act, Emmenagogues stimulate the uterus; and, therefore, some caution is requisite to be observed in their administration. We must be certain, in the first place, that the suppression is

not connected with pregnancy, as not only abortion may be induced, but inflammation may be set up, and lay the foundation of an organic disease of the uterus: in the second place, that the uterus is not in such a state of active disease as to render their influence upon it hazardous.

B. INDIRECT EMMENAGOGUES.

These consist of substances which influence the uterus through the medium of some other organ. This may be effected in three ways:—1. By the substance operating on the kidneys or intestinal canal, and stimulating the uterus by proximity. 2. By the substance operating on the stomach and improving the general health, so that the uterus may share the salutary influence. 3. The uterus may be specifically influenced through the medium of the nervous system.

1. *Substances operating on the Kidneys and Intestinal Canal.*

The substances which produce emmenagogue effects, by their operating on the kidneys and intestinal canal, are diuretics which pass to the kidneys undecomposed, and cathartics that stimulate the rectum.

a. NITRATE OF POTASSA. *Potassæ Nitras.* L. E. D.—In some experiments made upon women forming part of a society established at Leipsic for therapeutical purposes, Nitrate of Potassa was found to possess decided emmenagogue powers when given in doses of from ℈i to ʒi, dissolved in any bland fluid. I have had no experience of its influence as an Emmenagogue.

b. BITTER PRINCIPLE.

ALOES. *Aloës Spicatæ vulgaris.* L. E. D.—Aloëtics have the property of stimulating the rectum; and their influence on the uterus can only be referred to this action on the rectum, and its extension to the uterus producing a state of the organ closely allied to that which is the result of the application of a direct stimulus. The powerful sympathetic influence of aloëtics is well illustrated by the effect which frequently follows their administration after the total cessation of the catamenia. For some time after this event occurs, the uterus retains the disposition to resume that state of vascular action which determines the periodical discharge. In this condition of uterine susceptibility, the excitement of the rectum by an aloëtic purgative almost invariably induces the return of the menses in a slight degree, provided the purgative be given at the period when the discharge had previously been accustomed to appear. Now, if a cathartic is capable of producing so powerful a sympathetic action when this uterine function has ceased to be any longer

essential, we can readily imagine that a more powerful effect is likely to be the result of a similar extension of the action from the rectum to the uterus, at a period of life when the susceptibility of impression must necessarily exist in a high degree. Experience has demonstrated that such an extension of action really occurs. In prescribing Aloës, however, as an Emmenagogue, the cause of the suppression must be kept in view; for this medicine cannot be safely administered in an irritable state of the uterus. To secure its emmenagogue effect, it is supposed necessary to administer Aloës in a solid form, owing to the idea that its effects on the rectum depend on its slow solution; but, as I have elsewhere stated, this supposition is founded on a mistaken idea of its mode of acting: it is equally efficacious whether given in substance or solution; and indeed I have seen it most generally successful when administered in combination with alkalies, which greatly aid its solubility. The administration of a pill composed of a grain of calomel, the same quantity of foxglove, with two or three grains of the extract of conium, at bed-time, followed in the morning by half an ounce of the vinous solution of Aloës and myrrh, in conjunction with the carbonates of soda and of ammonia*, for two or three dyas previous to the expected return of the menstrual discharge, has in my hands generally proved successful.

Aloës form a component of eighteen preparations in the British Pharmacopœias. Those in which it is combined with myrrh or with assafœtida, under the title of Pilula Aloës c. Myrrh, and Pilula Aloës et Assafœtidæ, are the most useful as Emmenagogues.

c. GUM-RESINS.

These substances exist in vegetable bodies; but two only are employed as Indirect Emmenagogues—the root of the Black Hellebore and Camboge.

1. ROOTS OF BLACK HELLEBORE. *Hellebori Nigri Radix.* L. E. D.—This drastic cathartic has been found useful as an Emmenagogue in phlethoric habits, probably from its influence in reducing that state of the system which is as adverse to the secretory action of the uterus as to that of every other glandular organ. Black Hellebore was introduced as an Emmenagogue, by Dr. Mead, and it continued to be much employed until doubts of its efficacy were raised by Cullen and Heberden†, after which it fell into disrepute; but it is still much prescribed on the continent of Europe and in the United States of America. Dr. Chapman thus expresses himself respecting it:—"It has

* London Dispensatory, 6th edition, p. 941.

† Heberden remarks, "Radix Hellebori Nigri facultatem movendi menstrua sibi vindicavit, quam tamen nullo satis firmo argumento usus mihi confirmavit." Commentarii, cap. 62.

many just pretensions. It is especially useful when it purges, in painful menstruation, attended with torpor and constipation of the bowels, and perhaps with some degree of insensibility in the uterus itself. The powder," he adds, "is given in doses of ten grains, in the form of pills, which may be repeated for several days*." How far its action as an Emmenagogue can be relied upon, my experience does not permit me to offer an opinion. From the violence of its action as a purgative, it requires to be administered with caution. The tincture is the best form of preparation: it possesses all the active properties of the root, and may be added to any purgative, and thus aid in stimulating the uterus with less risk than is likely to attend the use of the root or its infusion. The extract of the Edinburgh Pharmacopœia, in doses of from gr. iv to gr. x, in combination with extract of Conium, has been found useful in the amenorrhœa of chlorotic females.

2. CAMBOGE. *Gambogia.* L. E. D.—Camboge gripes more than Aloës, and is as drastic in its operation as hellebore; therefore, as it possesses no peculiar advantages, that I know of, to secure it a place in the list of Emmenagogues, unless it be as an auxiliary to other purgatives, it might be advantageously rejected.

2. *Indirect Emmenagogues operating on the Stomach.*

Emmenagogues which operate through the medium of the stomach are tonics of a stimulant character, those which owe their efficacy to volatile oil; and the salts of iron.

* *Organic Products.*

d. VOLATILE OIL.

* *Roots.*

2. SERPENTARIA ROOT. *Radix Serpentariæ.* L. E. D.—This stimulant tonic produces emmenagogue effects by the influence it exerts on the capillary system. It is given in the same dose and under the same circumstances as when it is employed as an excitant.

1. VALERIAN ROOT. *Radix Valerianæ.* L. E. D.—The Valeriana *officinalis* which yields this rhizome, improperly termed a root in the Pharmacopœias, has been regarded as the plant described by Dioscorides; but Dr. Sibthorp, in his Flora Græca, has demonstrated that this opinion is erroneous, and has given a figure of the Valerian of the ancients the V. *Phu* of Dioscorides. The genus belongs to the natural order Valerianeæ†.

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* Materia Medica.

† Woodville's Med. Bot. 3rd edition, p. 97, pl. 32. London Dispensatory, art. Valeriana. Richard, Hist. Nat. Med. t. ii, p. 269.

The roots of Valerian, as they are termed, consist of long, slender fibres, issuing from tubers. They have a strong, peculiar odour, and a warm, bitter, subacrid taste. Tromsdorff analyzed them*. When distilled with water, they yield a liquid, greenish-white, volatile oil, on which their properties chiefly depend. This oil, which has a strong odour of camphor, becomes yellow and viscid on exposure to the air; and forms with nitric acid an orange-yellow resin, having a powerful odour. The oil is lighter than water; its sp. gr. being 0.934. Sixteen ounces of the dried roots, analyzed by Tromsdorff, yielded ʒii of a peculiar principle; ʒi of a black resin; ℈i of volatile oil; ʒiss of gummy extract; ʒv of fecula; and ʒvi ℈ii of woody fibre. The peculiar principle here alluded to is soluble in water, but not in alcohol, nor in ether. It does not appear to be the active principle of the medicine. The action of reagents on the aqueous infusion of Valerian shews the presence of a free acid, tannin, extractive, and fecula. Alcohol, however, takes up all the active matter of the root. The tincture is not decomposed by water; but all the mineral acids render it milky, even when it is largely diluted with water.

The roots of Valerian, even whilst growing, have a powerful attraction for cats, who are intoxicated by gnawing them in the dry state. They are sometimes adulterated with the roots of a species of Ranunculus; which, although they have a bitter, caustic taste, not present in Valerian, yet are not easily detected.

Valerian appears to exert its influence on the nervous system, first as a stimulant, and afterwards as a sedative. On these properties its influence in relieving spasm certainly depends; but, nevertheless, it is not regarded as a narcotic. Dr. Heberden states that he has seen persons thrown into strong agitations by its use; and, from its effects upon cats, he is disposed to admit its influence on the nervous system to be considerable. Its power, nevertheless, is greatly affected by circumstances: thus, from ʒii to ʒviii of the powder have been taken by some individuals without producing any effect, whilst the same quantities of the same powder have caused in others manifest action on the brain and the intestines; displayed by a sensation of weight in the head, and a sense of fulness in the alimentary canal, flatulence, colic, and tenesmus. To such individuals Valerian ought not to be administered; and it is also contraindicated in congestion of the brain. Experience has amply demonstrated its value in amenorrhœa, in hysterical females; but whether the benefit be derived from its influence on the general system, and the uterus sympathizing with it, or whether it have any direct action on the organ itself, admits of a question. Its employment, except in cases of uterine irritation, is not very extensive.

* Bulletin de Pharm. t. i.

Valerian is sometimes administered in substance, in combination with aromatics; but the powder is a bad form, on account of the largeness of the dose, less than ʒi scarcely ever producing any effect. It is only in this form, however, that it operates on the abdominal viscera. An extract of it is ordered by the Dublin College; but the volatile oil being dissipated in preparing it, this, like all extracts of plants containing volatile principles, is objectionable. As water takes up all the active principles, the infusion might be supposed to be an excellent form; but the effects of the infusion are much less permanent than those of the powder; and in this form Valerian seems to operate chiefly on the nervous centres. There are two tinctures of Valerian; one made with alcohol, the other with the aromatic spirit of ammonia: both are frequently ordered in conjunction with bitter infusions; but neither can be properly combined with decoctions of astringent vegetables, as an insoluble precipitate is produced, by which the efficacy of both medicines is lessened. The alkaline wine of aloës is the most useful addition to Valerian when it is administered as an Emmenagogue.

* * *Herbs.*

3. COMMON WORMWOOD. *Artemisiæ Absinthii summitates.* L. E. D.—Wormwood is an indigenous plant, which belongs to the natural order Compositæ, and is diffused very generally over the surface of the globe. It has a strong, disagreeable odour, and impresses a slightly bitter aromatic taste on the palate. These qualities are given out both to water and to alcohol, and a green volatile oil is procured by distillation with water, on which the virtues of the plant appear to depend. The aqueous infusion is precipitated by sulphates of iron and of zinc, and the acetates of lead, but not by tartrate of antimony and potassa. As an Emmenagogue, it is much inferior to either valerian or serpentaria. It has been administered, however, with advantage in cases of amenorrhœa depending on diminished energy of the uterus, in hysterical and hypochondriacal individuals. It may be administered either in the form of powder, in doses of from ϑi to ϑii; or in that of infusion, made with ʒi of the dried plant and fʒxii of boiling water, in doses of fʒiss. The Dublin Pharmacopœia contains an extract of Wormwood; but if the powers of the plant depends on its volatile oil, this is a bad form of preparation.

* * *Inorganic Substances.*

The Inorganic Substances employed as indirect Emmenagogues, producing their effects by their influence on the stomach, are preparations of iron, both natural and artificial.

1. NATURAL SALTS OF IRON.

The natural salts of iron, employed as indirect Emmenagogues, exist in a state of solution in *Chalybeate Waters*. All these waters are styptic to the taste, and strike a blue-black with infusion or tincture of galls, and a blue with ferrocyanate of potassa. The iron is generally in the state either of a carbonate dissolved in carbonic acid, or of a muriate or a sulphate. The principal waters of this description, in this country, are those of Tunbridge, Brighton, Cheltenham, Sandrock in the Isle of Wight, and Peterhead. The Bath waters also contain a small quantity of Iron. In the waters of Tunbridge and Cheltenham, the Iron is held in solution by carbonic acid, which exists in the Tunbridge waters in the proportion of eight cubic inches in each gallon. The Iron is contained in the state of a carbonate; but when the water is exposed to the air, the carbonic acid escapes, and the oxide of iron, attracting an additional portion of oxygen, is converted into a peroxide, and, becoming insoluble, is precipitated in the form of a red or ochreous deposite. On this account, these waters are most beneficial when drank at the spring; or, if they be conveyed to a distance, they should still afford the inky colour when tested with infusion of galls, otherwise they are of no value as Emmenagogues. The other ingredients in chalybeates of this description, are minute quantities of sulphate of soda, muriates of soda, of lime, and magnesia, and carbonate of lime, which produce no effect on the uterine system. The Peterhead spring resembles those of Tunbridge and Cheltenham.

In the Brighton and Sandrock springs, the Iron is contained in the state of a sulphate. These waters are not decomposed by exposure to the air; and, even after being boiled, they answer to the tests of the presence of Salts of Iron, the infusion of galls, and ferrocyanate of potassa.

Both these kinds of chalybeate waters operate as powerful stimulant tonics, although, in neither, the Salt of Iron exceeds three grains in a gallon of the water. Soon after drinking the usual dose, half a pint, of any of them, the pulse rises in strength, and a glow is felt over the frame. In plethoric individuals, nausea, vomiting, pain of the præcordia, a sensation of weight in the head, slight vertigo, and a feeling of general fulness, are frequently experienced on first drinking the waters; and, if these symptoms do not abate, the use of them should either be discontinued altogether, or should be intermitted, and the patient be bled and purged before their use is resumed. All the varieties of chalybeate waters prove useful in amenorrhœa, connected with a pale, leucophlegmatic, or chlorotic state of the habit. Their influence is on the secretory system, on which they operate in a slow, but uniformly pro-

gressive manner, imparting tone, nervous energy, and general vigour; and in these benefits the uterus shares. In commencing a course of chalybeate waters, if the tongue be furred and the bowels irregular, indicating a disordered state of the alimentary canal, a gentle emetic and a purgative should be administered before taking the waters; and, when the habit of the patient is sluggish, pilula aloës cum myrrha may be administered with each dose of the water. The whole quantity of the water necessary to be taken in one day should be drunk in divided doses, between each of which brisk walking exercise should be used. The beneficial effects of these natural solutions of the Salts of Iron in chalybeate waters most probably depend on their very minute division; but this is not the sole cause, as no artificial imitation of a chalybeate water, however accurate, produces beneficial effects equal to those of the natural springs. It must also be noticed, that these waters are most successful when they are drunk at the fountain-head—a fact which throws considerable light on the cause of the superiority of the natural waters over their artificial imitations. Certainly it is not in towns, in the busy haunts of men, amidst anxieties and rankling cares; nor in situations which tempt us to join in the dangerous enjoyments of the festive board, nor while attending the nocturnal assemblies of heated drawing-rooms, or the crowded theatre; that any remedial agent can be expected to produce a salutary effect: and, therefore, we cannot wonder that a chalybeate taken in such an unnatural condition of life, produces a less salutary effect than when drunk at the spring.

2. ARTIFICIAL SALTS OF IRON.

The tonic effects of Iron, in combination with those agents which give activity to metals, oxygen, chlorine, and acids, have been acknowledged, and are verified by every day's experience. Its salts have been long known as well adapted for cases of amenorrhœa, connected with a feeble state of the general frame. All the preparations of Iron, indeed, are useful Emmenagogues.

A common form of administering Iron in amenorrhœa is that of the BLACK OXIDE of the Edinburgh and Dublin Colleges—the scales from the anvil, purified. This is a compound of two oxides of Iron, in uncertain and inconstant proportions. The protoxide in the preparation of the Black Oxide, from its combining with the acid of the stomach and giving out hydrogen gas, in decomposing the aqueous contents of that organ, has the inconvenience of producing acid eructations. The dose is from gr. v to ℈i, two or three times a day. It may be combined with aromatics.

One of the preparations of iron introduced into the London Pharmacopœia as an Emmenagogue, the LIQUOR FERRI AL-

KALINI, L., is rarely used, and cannot be administered in any aqueous infusion or decoction without being decomposed, the peroxide of iron being precipitated, and nothing but subcarbonate and nitrate of potassa remain in the water. The FERRUM AMMONIATUM is not more valuable. The most efficacious preparations as Emmenagogues are the SULPHATE, and the TINCTURE of MURIATED IRON. The Sulphate may be combined with myrrh, aloës, or galbanum; the Tincture of Muriated Iron may be added to any tonic bitter which does not decompose it; as, for example, infusions of quassia, gentian, and cascarilla. The sulphate should always be in the form of the protosulphate; and, therefore, as this salt is rapidly converted into the persulphate, it should be preserved in alcohol. The compound mixture of iron of the London and Dublin Pharmacopœias is intended to be a carbonate of iron, suspended by the gummy matter of the myrrh in water: but if the bottle containing it be not quite full, or not kept completely closed, oxygen is rapidly attracted from the air, and the carbonate transmuted into the insoluble inert peroxide of iron. This is demonstrated by the change of colour which takes place when the mixture is exposed to the air. If made at the time it is to be used, however, it is an excellent Emmenagogue in doses of f℥i, given twice or three times a day. The quantity of the protosulphate proper to mix with f℥iss of the mixture of myrrh and carbonate of potassa is four grains. Its influence is perceived by the rapid change which it induces on the alvine and renal evacuations; the black colour of the former, and the blue streak when the latter is tested with ferrocyanate of potassa, demonstrating that the chalybeate has entered the circulation.

3. *Indirect Emmenagogues operating on the Nerves.*

* *Animal Products.*

e. CASTOR has been regarded as a beneficial Emmenagogue when the suppression of the catamenia is connected with spasm and hysteria. It is not, however, an Emmenagogue of much value. Dr. Alexander affirms that it produces very little sensible effect upon the habit in much larger doses than those in which it is usually given; and he consequently condemns it as a useless and inert substance.

* * *Vegetable Products.*

f. OLEO-GUM-RESINS.

1. ASSAFŒTIDA, L. E. D., must be regarded rather as a useful addition to other Emmenagogues than as itself capable of stimulating the uterine organs. Its impression on the uterus

depends solely on its influence on the alimentary canal, which it stimulates through its whole length when it is administered in doses from gr. v to gr. xv.

2. GALBANUM. L. E. D.—The plant which yields this oleo-gum-resin is, according to Dioscorides, a native of Syria; but it is remarkable that the numerous travellers who have visited that country have not met with it. As the drug is imported from Smyrna and partly from India, "it is very probable, says Mr. Don, "that the plant is also a native of India." From the examination of the seeds found in the drug, Mr. Don is of opinion that it is not the production of the Bubon *Galbanum;* he has therefore named the plant Galbanum *Officinale*, and informs us that the genus is nearly allied to *Siler**.

As an Emmenagogue, Galbanum closely resembles Assafœtida.

g. DIGITALIS. *Digitalis folia*. L. E. D.—The influence of Foxglove on the generative organs is undoubted. In men it causes erections and pollutions; in women, it produces symptoms very closely resembling those which indicate the approach of menstruation; and one of the effects of an overdose is inflammation of the genital organs in both sexes. Had Foxglove not been employed as an Emmenagogue, these facts would be sufficient to authorize its administration for awakening the energy of the uterus. I have long been in the habit of ordering it in doses of from gr. i to gr. iii, combined with calomel and followed by an aloëtic cathartic on the following morning, with almost unvarying success, in suppression of the catamenia. It is scarcely necessary to say that its use need not to be continued many days after the period of the monthly change, and that it is productive of the greatest benefit when it is given, for two or three successive days, anterior to the time when the change should occur.

h. ERGOT OF RYE. *Secale Cornutum*.—According to Decandolle, the Ergot is a parasitic plant belonging to the natural order Fungi. It grows on the ear of the rye, barley, and wheat; and, from its appearance, is known by the name of the *Spur*. It is, however, more common upon the rye than upon other grains, and thence the appellation Secale *cornutum*. Decandolle conceives that it is a sclerotium, and has imposed upon it the name Sclerotium *clavus*. But I am more disposed to think, with Fontana, M. Virey, and others, that it is not a fungus, but a disease of the grain itself, probably, as conjectured by Gen. Martin Field, from the puncture of an insect. The diseased grain still preserves some of its characters; and it is not improbable that the change is chiefly in the conversion of the fecula of the grain into a kind of mucus; but the gluten, also, undergoes a change,

* Linnean Transactions, 1832.

and a peculiar oil and ammonia are developed, prone to putridity.

The Ergot is a nearly cylindrical, curved, striated body, of a deep violet colour on the exterior and whitish within. When examined by a powerful microscope, the exterior coat seems to be a violet-coloured mass, sprinkled with white dots; the interior exhibits white, brilliant grains resembling starch. It is inodorous, has a mawkish, peculiar taste, and burns as if it contained oil. It imparts its colouring matter and properties to water and to alcohol. The Ergot is specifically lighter than water, whereas sound rye is heavier than water. Vauquelin analyzed Ergot, and procured—1. two colouring principles, one fawn, soluble in alcohol, the other violet, analogous to litmus, but insoluble in alcohol: 2. a sweetish oleaginous matter: 3. a free acid, probably the phosphoric: 4. free ammonia: 5. a vegeto-animal matter, strongly disposed to putridity. None of the usual components of the Rye, starch, gum, sugar, or gluten, are found in it*. When eaten in rye bread, in years in which it greatly abounds, it produces a peculiar disease, somewhat similar to dry gangrene, which was known to Galen. It was epidemic in Silesia, in 1096, and again in 1588. The symptoms attending it are weakness of the lower limbs, amounting almost to paralysis, vertigo, indistinct vision; the pulse small and weak at the wrist; pains in the legs and arms; sometimes lividness in the foot and toes, which terminates in gangrene. The breathing is greatly oppressed, the bowels are but little affected, the tongue is slightly coated, and the face assumes a livid hue. Dissections of this disease have presented an unusual deposition on the adipose membrane on the surface of the peritoneum, dark or livid spots on the intestines, traversing the arch of the colon and descending to the sigmoid flexure and the rectum. The stomach is slightly inflamed and discoloured on the under and larger portion.

The secale cornutum, when taken by either sex in the ordinary state of the habit, produces a disagreeable sensation, resembling formication in the feet, which is speedily followed by strong contraction of the muscles and spasms of the limbs, pain of the head, vertigo, delirium, and opisthotonos, or contractions of the muscles of the loins and back, which force the body into a curve backwards, so that the occiput approaches to the hips. It evidently, therefore, acts through the medium of the motor nerves, and chiefly on the extensor muscles. The question naturally arises—to what does it owe this influence over the extensor muscles? Does it contain an alkaloid resembling strychnia? Chemical examination has not authorized such a supposition. The aqueous solution or infusion is of a

* Journ. de Chim. et Phys. t. iii.

reddish colour, and evidently contains a free acid, which is certainly not gallic acid, but which Vauquelin supposed to be phosphoric, from its fixedness and from its action on lime water, barytic water, nitrate of silver, and acetate of lead. It contains much extractive matter, a copious precipitate being afforded by muriate of tin; and it also contains a small quantity of ammonia, which is liberated at the heat of boiling water. Muriatic acid develops a colour which it does not evolve in rye flour. From these experiments, no satisfactory inference can be drawn regarding the active principle of Ergot.

The chief use to which secale cornutum has hitherto been applied is to produce uterine action, to aid the efforts of parturition when these are insufficient for the expulsion of the child. For this purpose, it is administered in doses of from ℈i to ʒss, bruised and mixed in fʒii of water, and administered at short intervals until the effect is produced. Ample experience has proved the efficacy of Ergot to expel any substance from the uterus when it is in a state of complete inactivity during the process of parturition. Now, admitting this to be true, these premises are not sufficient to authorize the conclusion that it will also aid the menstrual discharge when scanty or suppressed. Dr. Hall, an American physician, who has written on the use of the Ergot in parturition, is of opinion that it is taken into the circulating mass, and, acting as a sedative, produces a state of asphyxia in the fœtus, and such a condition of the uterus as renders it incapable of longer sustaining the child; and, therefore, this tendency in the mother brings on speedy efforts of the animal œconomy to save both mother and child. I confess that this view of the subject is quite incomprehensible to me; and the only idea I can form of the influence of Ergot is that it acts as a specific excitant to the parturient uterus, causing contraction in it and consequently expelling the child. The correctness of this idea is supported by the fact that its administration has been found to be hazardous until the regular pains have ceased and a perfect relaxation has been induced. In this state, it excites again the uterine action; and, from the relaxation of the resisting parts, the obstacle these present to the expulsion of the child in parturition is easily overcome, and expulsion is the consequence. That this is the effect of regular muscular contraction in the stimulated organ may also be reasonably inferred from the feelings described by women who have taken it during labour. The sensation is not that of pain, but a constant nisus is kept up, goading, as it were, the uterus; and, during the contraction, the women describe the sensation to be "as if every thing were forcing from them."

With respect to the influence of Ergot, nothing favourable can be said. If the uterine discharge, the menstrual fluid, arise, as I suppose, from the secreting action of the uterus, it is easy

to conceive that the cause which operates in exciting the expulsion of a child, would be likely, by operating on the muscular contractility of the uterus, to check rather than to accelerate the flow of the menses; for, by constringing the vessels from the general contraction of the organ, and thereby preventing that due supply of blood which is requisite for the performance of the secreting function, it is evident that the secerning function of the organ would be impeded. Experience has proved that it has, indeed, very slender pretensions, if any, to the character of an Emmenagogue. This has been attributed to its transitory effects; but I am more disposed to assign it to the powerful contractions that it excites in the viscus: and on this account it has been found highly serviceable in restraining uterine hæmorrhage, both before and after delivery. It has also produced beneficial effects in cases of leucorrhœa, attended with emaciation and a pale, blanched state of the surface, with much debility, when given in doses of gr. v to gr. x, three or four times a day. Upon the whole, I am disposed to expel the Secale cornutum from the list of Emmenagogues, although its influence upon the uterine organs in parturition is undoubted. In two cases of paraplegia, its use was followed by involuntary emissions of semen. Professor Dewes, of Pennsylvania, has laid down the following rules to be observed during its employment in parturition :—

1. It should never be given before the membranes are ruptured, the os uteri dilated, and the external parts disposed to yield.

2. It should not be used so long as the natural pains are efficient and competent to the end.

3. But should they flag from any cause, it may be given, provided the labour be a natural labour; that is, when the head, or the feet, or the breech, or the knees, are presented.

4. If flooding, syncope, or convulsions, take place, it may be employed to great advantage, if the first and second rules be not violated.

5. It is useful in every kind of premature labour; and at the full time, when the placenta is not thrown off, and the uterus is in a state of atony.

6. When floodings occur after the rupture of the membranes, if the os uteri be well dilated, and the child well situated, and the pains are feeble.

7. When the head of the child, separated from the body, has been left in the uterus.

8. When the uterus is painfully distended by coagula.

The dose of the Secale cornutum, in the cases in which it is indicated, should not exceed thirty grains. The medicine should be preserved entire in a glass bottle with a ground stopper, and powdered only at the time it is to be given; and then it may be

administered in a glass of wine, which Dr. Balardini has found to be preferable to water. Heat and moisture tend to spoil it. It should always be the growth of the year in which it is prescribed.

Except Electricity, there is much uncertainty attending the employment of Emmenagogues. I hope the manner in which I have endeavoured to trace their modes of acting will tend to place their administration on rational principles. The importance of the catamenia in preserving the health of the female habit, is undeniable; and, therefore, every thing that can tend to maintain its regular return, and to promote its due quantity, is of great importance in a practical point of view. In every chronic complaint of a female it is requisite to ascertain the state of the catamenia: but, before advising any medicine for the purpose of influencing the uterus, the cause of the suppression or the irregularity must be minutely investigated. Without obtaining such a knowledge of the state of the organ, our practice must ever be uncertain: in floundering about and trying various remedies, without rule or discrimination, we may, it is true, stumble by accident upon something effectual; but much evil may be previously produced.

SECTION XVII.

DIAPHORETICS*.—MEDICAMENTA DIAPHORETICA.

Syn. Sudorifica.

DIAPHORETICS are "medicines that augment perspiration." The skin, which is the organ of this function, consists of three layers, the *cuticle*, the *reticulum*, and the *corium*. The *cuticle*, or exterior layer, is destitute of both vessels and nerves. It nevertheless resists suppuration and even maceration for a long time, and, when destroyed, is very quickly reproduced. It has no obvious pores, but permits a ready passage to caloric, carbon, hydrogen, oil, acids, and watery vapour. Anatomists and physiologists differ greatly with regard to the nature and formation of this portion of the skin. According to the prevailing opinion, it is a homogeneous, inorganic matter, spread like a varnish over

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* From διαφορεώ, differo, discutio, derived from δια, through, and φερω, I carry.

the surface, an exudation of the parts beneath it. Lewenhoek imagined that it contained pores: Humboldt could detect no pores in it by means of a microscope which magnified 312,400 times: the passage, therefore, of fluids through it must be the result of simple imbibition. It is united to the corium or true skin by the *reticulum*, a fine mucous net-work, first noticed by Malpighi. Neither nerves nor vessels have been observed in the reticulum. In Europeans it is colourless, and its existence has been denied; but it is coloured and obvious in Negroes and the coloured races of mankind. It appears to be the connecting medium between the cuticle and corium. The *corium* or true skin is a tough, extensible membrane, varying in thickness, formed of dense fibres crossing and interlacing one another, and through the openings or meshes of which pass capillary bodies, each consisting of the sentient extremity of a nerve surrounded by a plexus of blood-vessels. It is furnished also with numerous sebaceous follicles, which secrete and diffuse an odorous oil over the skin. In a state of health, this oil is thin and limpid: in disease, it is viscid and greasy.

The importance of perspiration for the preservation of health is well understood; but the laws which regulate it are still imperfectly determined. It is a general function of the skin; but whether it is possessed by every part of it, or whether every part throws off the same quantity in a given time, has not been ascertained. It is, however, probable that some parts perspire more freely than others. The perspired matter exhales either as a thin, invisible vapour, which is termed insensible perspiration, or flows out in a liquid form, as sweat. Various attempts have been made to determine the quantity of the cuticular discharge*. From the time of Sanctorius, who first endeavoured to determine it experimentally, to that of Lavoisier and Seguin, little confidence could be placed in the results of the experiments, as the amount of the pulmonary exhalation was not deducted in calculating the loss which the body sustained in a given time. Much of this difficulty was overcome by enclosing the body in a silk bag rendered impermeable to moisture by being varnished with caoutchouc, and having only one opening for breathing, the sides of which were pasted round the mouth. They ascertained that the medium quantity of moisture exhaled in the form of insensible perspiration amounts to nearly eighteen grains in the minute, or three pounds, three ounces, and a hundred and sixty grains, troy, in the twenty-four hours†; and, as this was the result of repeated trials, we may regard it as the average quantity in a state of health. But Mr. Cruickshanks enclosed his hand in a glass vessel, and collected thirty grains of

* The most extensive experiments on this subject were made by Mr. Jurine, of Geneva. (*Hist. de la Soc. Roy. de Med.* vol. x.)

† Mémoires de l'Academie des Sciences, 1790, p. 610.

fluid in an hour: now, as the hand is one sixty-sixth of the surface of the body, the perspiration, at this rate, should be nearly thirty-three grains in a minute, or six pounds one ounce and two hundred and sixty grains in twenty-four hours. The hand must, therefore, either perspire more than the rest of the body, or there must be an error in the experiment. Many circumstances tend to vary the loss by perspiration, not only in different individuals, but in the same person at different times, and under a diversity of circumstances; for instance, the vigour of the frame, the nature and quantity of the ingesta, and the temperature of the atmosphere. Thus, perspiration is diminished immediately after a meal, and augmented during the process of digestion: it is promoted during sleep, in a dry state of the atmosphere, in a current of air, and under a diminished barometrical pressure. But these circumstances are supposed to promote perspiration independently of vitality; and, therefore, Dr. Edwards has divided insensible perspiration into that which results from ordinary physical influence, and that which is dependent on vitality; or, into *exhalation* and *secretion*. Both are liable to be affected by external agents. In low temperatures, the loss by exhalation exceeds that by secretion, because the cold suppresses secretion much more than it impedes evaporation. It may, indeed, be maintained that, even in low temperatures, the cutaneous capillaries are still stimulated, and consequently that the portion of the insensible perspiration which is the result of vital energy must be supplied: but it is in the ratio only of the stimulus; whilst the exhalation, which depends on physical influences, is less diminished, because the air, being heated by contact with the body, is enabled to hold more moisture in solution than the air farther removed from the body; and thence evaporation is favoured. The evident intention of perspiration is to prevent the temperature of the body from rising above that degree which a state of health requires, and to operate as a balance to the heating influence of increased arterial action: it also counterbalances the secretions; as, for instance, that of the kidneys, which is diminished as the perspiration is increased, and augmented as it is diminished—a physiological fact of much practical value.

Many experiments have been made to ascertain the chemical nature of the perspired fluid. It is supposed that its peculiar odour depends upon exhaled hydrogen gas, variously modified by the accession of other constituents*; for instance, oily matters, an acid, and gelatine. It appears, however, rather to depend on the secretions of the mucous follicles, which probably differ in different parts of the body, mingling with the perspiration, as the

* Experiments on Insensible Perspiration, by W. Cruickshanks.—Hist. de la Société Royale de Médicine, tome ii; and also the experiments of Abernethy, in his Surgical and Physiological Essays.

excretion or fluid which they secrete is different in different parts of the body. Thus, in the armpits the odour is hircine; in the feet it resembles that of tan; in the genitals it is fœtid. This odour appears to be also, in some measure, connected with food and habit; for savages are able to distinguish the nation of persons by smelling them; and if the details of history are to be credited, we must believe that the odour of the perspiration of Catherine de Medicis was as agreeable as that of the sweetest-scented flowers, and that of our countryman, Lord Herbert of Cherbury, was equally delightful. From all that is known on the subject, we may conclude that perspiration consists of two distinct kinds of matter—*aeriform* fluids, with bases of carbon*, hydrogen, and nitrogen†; and *aqueous* fluids containing in solution some free lactic acid, lactate, phosphate, and muriate of soda; and an oleaginous principle; with a vestige of animal albumen.

Contemplating the nature of the perspiratory function, we may conclude that it is intended to answer two purposes—first, to convey caloric from the body, and thereby to moderate and regulate its temperature; secondly, to carry off a large quantity of carbon and hydrogen from the circulating mass. There is a marked distinction between plants and animals in the importance of this function. In plants, the exhalation from their surface is very great; in some plants, more than their own weight in twenty-four hours; the whole of the superfluous nutriment taken into their systems being thrown off by perspiration. In animals, although the skin is an outlet for much superfluous matter, yet the greater part is ejected from the body by the alimentary canal, the kidneys, and the lungs. Disease is frequently the consequence of a sudden check to the perspiratory function; means, therefore, have been sought for to restore it: into the nature of these, and in what manner they produce their effects, we have now to enquire.

Diaphoretics were originally regarded as stimulants, which were supposed to be absorbed, and to augment the vascular excitement. It is reasonable to suppose that this opinion would result, from observing the effect of exercise, and the application of external heat. Experience has rectified the fallacy of this opinion, and enabled us to reason upon the operation of Diaphoretics on sounder principles. They may operate in two ways: 1st, by stimulating generally, and so augmenting the force of the circulation as to propel the blood forcibly through the minute or capillary vessels of the *corium*, by which both the secreting power of the skin and the excreting function of the exhalants

* Experiments of Count de Milly.—Histoire de l'Academie Royale des Sciences et Belles Lettres de Berlin, 1777, p. 35.

† Ingenhouz, Epériences sur les Végétaux, t. i, p. 152; Trousset, Annales de Chimie, t. xiv, p. 73.

are increased; 2ndly, by the absorption of the diaphoretic substances taken into the stomach, and the direct application of these to the cutaneous capillaries. It is easy to conceive that, in the healthy state of the system, perspiration is always the result of stimulating, either directly or indirectly, the cutaneous exhalants; and sweating follows increased vascular action, whether this arise from muscular exertion or from substances taken into the stomach. But in disease, when the temperature of the body is elevated, and the pulse strong and frequent, the skin may remain dry. In this state there is evidently diminished action of the exhalants, whilst the cutaneous capillaries have their secreting power impeded by over-distension, from defective organic action and nervous energy; and, therefore, this condition must be overcome before diaphoresis can be produced. When the body is in a healthy state, and the cutaneous exhalants, consequently, are neither morbidly constricted nor the capillaries relaxed from want of nervous energy to maintain the current of the blood, sweating always follows increased vascular action. Those substances, therefore, which augment the force of the general circulation, whilst, at the same time, they relax the cutaneous exhalants, are, undoubtedly, the most powerful Diaphoretics. Few substances produce this double effect alone; but it is readily induced by some combinations. Thus, opium increases at first the action of the heart and arteries; ipecacuanha, by the nausea it causes, diminishes the action of the surface; the combination of these two causes copious diaphoresis.

Those Diaphoretics which operate by augmenting the force of the vascular system increase the frequency and the power of the pulse, and raise the temperature of the body previous to the flow of perspiration: on the other hand, those which act by stimulating the cutaneous exhalants, without augmenting the force of the general circulation, exert a primary influence on the nervous energy of the stomach, and the skin responds by that inexplicable connection to which the term *sympathy* has been applied.

The primary effect of diaphoresis is the evacuation of a large portion of the aqueous part of the blood, and, therefore, it might be supposed that this vital fluid would become thicker; but various circumstances concur to prevent such a result: amongst others, thirst always accompanies sweating; and as this forces us to take fluids into the stomach, the waste of the aqueous matter thrown off by the skin is rapidly supplied. At this time, also, other fluid excretions are diminished—the urine, for instance—so that the watery matters which would be carried off by the kidneys are diverted to the surface; and even several substances, that naturally find other outlets, are expelled by the the skin. This is clearly demonstrated in some diseases. Thus,

in cases of ischuria renalis, or deficient action of the kidneys, the perspiration has been found to contain uric acid. Dr. Percival relates a case in which the perspired matter was so saturated with the salts of the refluent urine as to crystallize on the surface of the body in form of a white powder.

One unquestionable beneficial effect of Diaphoretics is the determination of the blood from within to the surface, thereby relieving congestions, and maintaining that due balance of the circulation which appears to be essential to the preservation of health. Their salutary effect is also displayed in the increased power of the capillaries, and in their relaxation of the surface in febrile affections. The relaxing effect of Diaphoretics is indeed the most important property they possess as remedial agents; and on it their utility in inflammatory affections depends. Were it, however, attempted to induce diaphoresis in inflammatory or febrile diseases by stimulating Diaphoretics, the desired effect would not only be prevented, but the hazardous symptoms would be aggravated. This fact is too seldom kept in view; and, in ordering Diaphoretics in fevers, practitioners often forget that the substances employed as such almost always increase vascular action before they produce diaphoresis. Several circumstances, therefore, are necessary to be attended to in the administration of this genus of medicines in a practical point of view.

1. Whenever Diaphoretics are indicated, the patient should be confined to bed, but not overloaded with bed-clothes, which also should be of a light, spongy texture. If the pulse be full, hard, and quick, and the skin hot, blood-letting, if not contra-indicated from some peculiar circumstance, should preface the use of the Diaphoretics; and the bowels, also, should be freely opened. It is a correct opinion, that free perspiration is not consonant with a quick, hard pulse, and a temperature of the skin exceeding 102° of Faht.: if sweating occur in this state, it is generally partial and rather injurious than salutary. Even after the reduction of the phlogistic diathesis, the Diaphoretics to be selected are those which nauseate and relax the surface.

2. The free use of diluents is necessary during the administration of Diaphoretics, unless the stomach be in a highly irritable state. If antimonial Diaphoretics, however, be employed, acidulated drinks should not be given too soon after the dose of the antimonial, as vomiting would be induced. When the temperature of the surface is high, the diluents should be cold, or nearly so; but when it is moderate, they should be tepid. So important is dilution in promoting the action of Diaphoretics, that even simple cold and tepid fluids introduced into the stomach during the hot stage of fever often produce diaphoresis.

3. During the administration of Diaphoretics it is essential

to use bad conductors as coverings; both the body clothes and bed clothes of the patient should be flannel, which, being of a light, spongy texture, not only preserves an uniform temperature, but also absorbs the moisture as the perspiration flows. When a linen shirt is worn, and the patient lies in sheets, the moisture accumulates; for linen, being a better conductor of caloric than air, carries off the heat too rapidly, condenses the vapour of perspiration, and chills the surface. Attention to this circumstance is most essential, if it be requisite to keep up the sweating for ten or twelve hours, or longer; and especially if sleep become necessary during the continuance of the sweating. The older practitioners invariably resorted to the use of flannel during diaphoresis—a custom which has been too hastily reprobated by some modern physicians, as not only unnecessary, but even injurious: they recommend, instead of flannel, frequent changes of well-aired linen, asserting that this is more refreshing to the patient; that, from its comfortable feel, it has a tendency to allay irritation, and, consequently, to aid in subduing the restlessness and inquietude of fever; and that it is essential for carrying off the fomes of the disease. The last part only of this opinion is well founded, and few practitioners would place a patient, labouring under an infectious fever, in flannel; indeed, under such circumstances, perspiration, to the extent which requires the use of flannel, is neither necessary nor desirable.

4. Attention must be paid to the state of the bowels and kidneys. If perspiration be necessary in the low stage of fever, purging must be studiously avoided, and should be checked if it occur spontaneously whilst sweating is flowing; as it is almost certain to check the sweating, and to aggravate the disease, by diverting the blood from the surface to the interior, and exposing the patient to cold. The utmost care, indeed must be taken to prevent the admission of cold air to the surface; and no cold liquids should be taken into the stomach whilst the sweat is flowing, and for some time after it has ceased. This is not at all at variance with the opinion which I have already advanced, that sweating is excited by the introduction of cold water into the stomach in the hot stage of fever. During the administration of Diaphoretics, every thing which has a tendency to promote the secretion of the kidneys should be avoided. The avoiding frequent changes of linen is in conformity with this rule; as, in effecting these changes, the surface must be necessarily exposed, and as much drink is generally given to promote the sweating, the redundant fluids will be suddenly determined to the kidneys, and the action of the cutaneous exhalants checked.

5. The morning, directly after sleep, is the best period of the day for administering Diaphoretics, as the system is then

easily excited, and the surface is more relaxed. Experience has demonstrated that many persons, in whom perspiration cannot be induced at any other period of the day, may be readily made to sweat at that time. When perspiration accompanies diseases, it generally occurs in the morning; there is then a natural decline of febrile excitement, which aids the action of Diaphoretics; and thence it is the most favourable time for their operation: and, besides, as the administration of diluents is necessary to maintain the diaphoresis, this is a more convenient period for their administration.

6. When sweating is to be checked, the skin should be carefully dried with soft, warm towels, the patient should be moved into dry flannels, and the covering of his bed gradually lessened; allowing the arms to be cautiously exposed to the air. By these means the injurious consequences which a sudden revulsion might occasion are avoided.

Diaphoretics operate in two distinct modes:—1st, some excite the cutaneous capillaries and exhalants to a degree sufficient to increase both the secretory and the excretory functions of the skin beyond that point at which the perspired matter is carried off in the insensible form: thence it appears as a copious watery excretion or sweat; and the substances inducing it are distinguished from other Diaphoretics by the term Sudorifics, or promoters of sweating. 2dly, some operate in the same manner, but so moderately that they merely augment the ordinary insensible perspiration. It is true that both these results may be obtained by modifying the dose of the substances employed, and the circumstances under which they are administered; but, nevertheless, there are some substances, in which all circumstances being equal, produce a more powerful effect than others. For these reasons, Diaphoretics may be arranged into—

1. *Sudorifics*,—substances causing a copious, watery, cutaneous excretion, or flow of sweat.

2. *Diaphoretics*,—substances which only augment the ordinary perspiration.

Sweating may be produced by substances taken into the stomach, and by applications to the surface. It may also be induced by violent muscular action, throwing so much blood upon the surface as to excite powerfully the secreting function of the skin, and, consequently, greatly augment the perspiratory discharge. Exercise, therefore, may be regarded as a remedial sudorific; and it has been found of much use in dyspeptic affections, in which the skin is generally harsh and dry. It is easy to understand this effect of exercise; for, if we admit that the function of digestion may become depraved by too large a quantity of blood being thrown upon the gastric vessels, the determination to the surface, which is the result of exercise, will necessarily relieve this morbid condition of the stomach.

TABLE OF DIAPHORETICS.

A. SUBSTANCES WHICH OPERATE AS SUDORIFICS.

1. when taken into the stomach.

* *Organic Products.*

a.—EMETINA—procured from Cephaëlis *Ipecacuanha.*	5.	1. Cinchonaceæ.
b.—DAPHNINA—obtained from Daphne *Mezereum.*	8.	1. Thymeleæ.
c.—CYTISINA—contained in Arnica *montana.*	19.	3. Compositæ.
d.—MORPHIA—contained in Opium, Acetate of Morphia, Citrate of Morphia, Sulphate of Morphia, Muriate of Morphia.		
e.—GUAIACUM—proper juice of Guaiacum *officinale.*	10.	1. Zygophylleæ.
f.—VOLATILE OILS—contained in		
Roots—Aristolochia *Serpentaria.*	20.	6. Aristolochiæ.
Asclepias *gigantea.*	—	– Asclepiadeæ.
Wood—Lauras *Sassafras.*	9.	1. Laurineæ.
Leaves—Rhododendron *Crysanthum.*	10.	1. Ericeæ.

** *Inorganic Substances.*

g.—ANTIMONIALS—

Antimonial powder ?	*Pulvis Antimonialis ?*
True James's powder.	——— *Jacobi vera.*
Precipitated Sulphuret of Antimony.	*Antimonii præcipitatum Sulphuretum.*
Tartrate of Antimony and Potassa.	*Antimonium Tartarizatum.*

2.—when applied to the surface.

h.—WARM AIR BATH.

i.—VAPOUR BATHS.

k.—WARM WATER BATHS.

3.—by violent muscular action.

B. SIMPLE DIAPHORETICS.

1.—which operate when taken into the stomach.

* *Organic Products.*

Animal.

a.—MUSK—a secretion of
Moschus *Moschiferus.* 1. 8. Ruminantia.

Vegetable.

b.—SOLANIA—contained in
Solanum *Dulcamara.* 5. 1. Solaneæ.

c.—VOLATILE OIL—contained in
Roots—Dorstenia *Contrayerva.* 4. 1. Monimieæ.
Herbs—Melissa *officinalis.* 14. 1. Labiatæ.
Rosemarinus *officinalis.* 2. 1. ————

d.—CAMPHOR.

** *Inorganic Substances.*

e.—SALTS—

Carbonate of Ammonia.	*Ammoniæ Carbonas.*
Citrate of Ammonia.	*Ammoniæ Citras.*
——— of Potassa.	*Potassæ Citras.*
Acetate of Ammonia.	*Ammoniæ Acetas.*

f.—WATER.
Cold Water.
Tepid Water.

g.—EMPYREUMATIC OIL.

2.————by entering the circulation.

h.—SULPHUR.

i.—SULPHURET OF POTASSA.

k.—MERCURIALS.

3.————applied to the surface.

l.—FRICTIONS.

m.—COLD AFFUSION.

ORGANIC SUBSTANCES WHICH OPERATE AS SUDORIFICS WHEN TAKEN INTO THE STOMACH.

a. EMETINA.—This substance, separated from cephaëlis ipecacuanha, has not yet been introduced into general practice in Great Britain. Ipecacuanha, in moderate doses, is well calculated to produce sudorific effects; but it is seldom administered alone for this purpose, being generally combined with opium, the

narcotic influence of which it moderates. It forms the active ingredient of the Pulvis Ipecacuanhæ compositus of the Pharmacopœias. In the directions for forming this powder, equal parts of ipecacuanha root and opium are ordered to be rubbed together with eight parts of sulphate of potassa. The sulphate operates as a mechanical aid in reducing the tough opium to a fine powder, which is necessary to secure the efficacy of the compound. In the original powder of Dr. Dover, four parts of nitre and four of sulphate of potassa were deflagrated together, and one part of opium, one of ipecacuanha, and one of liquorice root powder were rubbed up with the residue. This was an inconvenient preparation, as it attracted moisture from the air. In the present preparation, the diaphoretic influence of the ipecacuanha is augmented by the opium, whilst the soporific quality of that narcotic is diminished by the ipecacuanha. The combined influence of both, exciting the cutaneous capillaries, produces a powerful and certain sudorific effect. It may be advantageously combined with camphor or with nitrate of potassa, but it ought not to be joined with astringent substances; the Emetina, in these cases, combines with the tannin, and is rendered inert. The dose of this powder is from gr. v to gr. x. Its sudorific effects, when once begun, should be maintained by copious dilution with tepid fluids; but these should not be taken immediately after the administration of the powder, otherwise it may be rejected by vomiting. It should also be remembered that the diluents should not be acidulated, as the combination of the vegetable acids with Emetina produce a compound, which is more likely to run off by the bowels than to act as a Diaphoretic; at the same time it is advisable to add something to the tepid water to prevent the nausea being extended to vomiting. Lemon peel added to toast-water answers this purpose.

b. DAPHNINA.—This is the active principle of the bark of the Daphne *Mezereum*, a native of the north of Europe, belonging to the natural order Thymaleæ, cultivated as an ornamental shrub in this country. It is procured by digesting the bark in alcohol, filtering the tincture, and evaporating to dryness. The residue is then to be treated with water, and the filtered aqueous solution precipitated by the proto-acetate of lead. This precipitate is to be washed and diffused through water, and the lead separated by sulphuretted hydrogen gas; the fluid is next to be filtered and evaporated to dryness: and the residue being redissolved in strong alcohol without the aid of heat, and the filtered solution left to spontaneous evaporation, crystals of Daphnina are obtained by washing with cold alcohol, redissolving, and crystallizing. Thus prepared, it is in prisms connected in bundles, colourless, transparent, and brilliant, and very soluble in hot water. The warm aqueous solution deposites crystals on cooling: these are very

soluble in alcohol and ether. The alkalies, lime water, and barytic water tinge the solution of a golden-yellow colour; it is not precipitated by the acetate of lead. Nitric acid converts Daphnina into oxalic acid. From these experiments, it is evident that Daphnina is a principle sui generis; but whether the medicinal properties of Mezereum are to be attributed to this substance is not yet decided.

The bark of Mezereon yields its virtues to water and also to vinegar. Different chemists have analyzed various parts of this plant. M. C. G. Gmelin and M. Royer found, in the bark, wax; an acrid resin; *Daphnina;* a red colouring matter; an uncrystallizable and fermentable sugar; an azotized gum; ligneous fibre, a brown colouring matter; malic acid; malates of lime, of magnesia, and of potassa. But, besides these, the bark of Mezereon contains a volatile matter, insoluble in water; and which, not being found in the decoction, is supposed to be the cause that the acrimony of the bark is much greater than that of the decoction. When this decoction is precipitated by the subacetate of lead, a portion of Daphnina is thrown down with the gum.

As a remedial agent, Mezereon operates as a stimulant Diaphoretic, exciting powerfully the heart and arteries, and determining to the surface; but it is apt to cause vomiting and purging. It has been found useful in rheumatism and in some chronic cutaneous diseases. It was long supposed to be a remedy for syphilis; but, according to Mr. Pearson's experience, it has no power of curing the venereal disease; "and I have," says he, "very seldom found it possessed of medicinal virtue, either in syphilis or in the sequelæ of that disease, in scrofula, or in cutaneous affections." Now, my experience enables me to say that this censure is too severe. I admit that the value of the remedy has been greatly overrated; but that it operates powerfully as a stimulant sudorific is equally certain; and I have seen the decoction administered with much advantage in chronic rheumatism, and in conjunction with the arsenical solution in obstinate cases of lepra vulgaris. Even Mr. Pearson, in opposition to his general censure, admits that he has seen it confer temporary benefit in lepra. The decoction, made with ʒii of the bark to ℔ii of water, is given in doses of fʒiv thrice a day. How far the addition of Mezereon to the compound decoction of sarsaparilla is useful, I am not prepared to say from my own experience.

c. CYTISINA. — This substance was discovered by MM. Chevallier and Lassaigne*. It is of a yellow colour; is bitter, nauseous, and inodorous. Exposed to the air, it attracts moisture; it is very soluble in water, but very little in strong

* Journ. de Pharm. June 1819.

alcohol, and not at all in ether. Its aqueous solution is neither acid nor alkaline, and is not precipitated by any of the metallic salts used in medicine. In doses of three grains, it operates as an emetic; and in smaller doses, as a diaphoretic.

Arnica *montana*, of which Cytisina is the active principle, is a native of the Alps and Pyrenées, and the north of Europe. It belongs to the natural order Compositæ. Its flowers have a slight aromatic odour, a bitter acrid taste, and impress a sensation of pungency and heat to the throat. The powder operates as a sternutatory when snuffed up the nostrils. I have found that the infusion contains Igasauric acid, a resin which has the odour of the plant, gum, albumen, some salts, and Cytisina. The flowers of Arnica are the officinal parts of the plant. They may be administered in powder, in doses of six to eight grains, or in the infusion, made with two drachms of the flowers to one pint of water, of which f℥i may be given for a dose. An etherial tincture of Arnica is employed on the Continent.

Arnica, besides exerting a decided influence on the skin, through the medium of the stomach, operates especially on the spinal nerves, and also on the brain. An hour after a full dose has been taken, the patient is attacked with vertigo, cephalalgia, a sensation of formication on the skin, heats, rigors, and tetanic twitchings in the extremities. In large doses, it causes vomiting and gripings. The circulation is affected, the pulse quickened, the temperature of the body elevated; either sweat flows freely, or the urine is greatly augmented. From these effects, it is evident that Arnica is a stimulating sudorific: and from the twitchings, as Igasauric acid is present, I am disposed to think that it contains also *strychnia*. It is much employed in Germany in intermittents, low fevers, chronic rheumatism, and gangrene; but is rarely employed in this country. It has been advantageously used in various forms of paralysis, more especially that of the bladder*.

d. MORPHIA, and all its salts, particularly the *Acetate*, *Sulphate*, and *Muriate*, operate as sudorifics, and augment the power of other sudorifics when combined with them. They are never prescribed alone, but generally with ipecacuanha or antimonials. They operate chiefly by their excitant influence, and therefore are given in small doses. Much, however, depends on the state of the habit: when the skin is very sensible, these salts readily promote sweating; but in the opposite condition of the skin this is scarcely perceptible. It is evident that they are likely to prove beneficial in all diseases which require the aid of copious diaphoresis. They may be given in doses of gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$, repeated once in three or four hours. They are contraindicated in hectic.

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* Ann. de Med. tome iii.

e. GUAIACUM. *Guaiacum.* L. E. D.—This substance, which for a long time was improperly regarded as a resin, is the concrete juice of a tree, the Guaiacum *officinale*, a native of the West Indies and the tropical regions of America, belonging to the natural order Zygophylleæ. Both the wood and the guaiacum are brought to Europe for medicinal use. The wood, lignum vitæ, exhales, when heated, an aromatic odour, and when chewed impresses a bitter, acrid, biting taste on the palate—qualities which it affords to water, when rasped and boiled. The Guaiacum is obtained by boring the junks of the wood longitudinally, and putting one end of them in the fire; as the heat increases, the Guaiacum exudes from the opposite end. When in a soft state, the Guaiacum is run into boxes and thus sent to Europe; on which account these packages contain it of every quality. It is in masses of a greenish-brown colour, breaking with a shining, vitreous fracture: the edges of the fragments are thin and translucent: it softens in the mouth, melts in a greater heat, and loses its green colour, which, however, it again acquires on exposure to light and air. It is inodorous when in the mass; but when powdered or melted, it exhales an aromatic odour. Its taste resembles that of the wood, leaving a sensation of heat in the throat when it is swallowed. It is only partially soluble in boiling water; and, when filtered, affords a decoction of a green colour, which shews the presence of a salt of lime when tested with oxalate of ammonia. Alcohol readily dissolves 95 parts in 100, and offers some curious results when submitted to the action of different substances. Thus, many recent vegetable substances—horse-raddish, the potatoe, and many other roots, if sliced and dipped into the tincture—receive a colour on all the open orifices of the sap vessels, which renders them visible. Milk, when agitated with it, acquires a blue colour. If water be poured into the tincture, it is instantly precipitated of a white colour. Sulphuric and muriatic acids, even in small quantity, precipitate the tincture. Chlorine changes it to a beautiful blue, which afterwards becomes brown; and with nitric acid the tincture passes successively to green, blue, and brown; even a piece of paper, soaked in it and held over the vapour of nitric acid, is tinged blue. A blue colour is communicated by sweet spirit of nitre, if recent, owing to its containing some uncombined nitrous acid; but when it has been long kept, no colour is produced. The pure alkalies do not precipitate the tincture—a fact of practical utility in prescriptions.

Muriatic acid produces little action on Guaiacum; sulphuric acid, aided by gentle heat, carbonizes it; and sulphate of lime is found in the charcoal of the residue. Nitric acid is decomposed by it more rapidly than by the resins, and the oxygenized Guaiacum is dissolved in the remaining acid, from which it is precipitated in its altered state by muriatic acid. The sulphuric

produces no precipitate. Crystals of oxalic acid are formed in the nitric solution when it is left at rest. When submitted to destructive distillation, Mr. Brande procured, from a thousand grains of Guaiacum, 5.5 grains of acid water; 24.5 of a brown turbid oil; 30 of light empyreumatic oil; 30.5 of charcoal; and the remainder gases, consisting of carbonic acid and carburetted hydrogen. These results, and the effects of acids and the reagents on the tincture of Guaiacum, are sufficient to shew that it is a substance sui generis; and widely different from resin and gum-resin.

Guaiacum was employed as a remedy for syphilis so early as 1508, from observing that it was used for the same purpose by the natives of St. Domingo. But in St. Domingo the fresh and young wood was employed for making the decoction. A curious account is given of the mode of using it, by M. Louis, in his work entitled "Parallele des Traitements, &c." Two young men, Frenchmen of rank, who could not obtain a cure of a severe syphilitic affection in Europe, went to St. Domingo. They were treated in the hut of a native at Puerto Rico. The practitioner was a female. She bruised and cut with her teeth the small branches of a young Guaiacum tree, and boiled them in an open vessel. The patients drank two pints of this decoction every morning, at two or three draughts; they were ordered then to walk out, or to exercise themselves with fencing, or else they worked in a gold mine, not far from the village, for two hours; and returning home, covered with sweat, they changed their shirts, dined, and drank only water. About three o'clock in the afternoon they drank the same quantity of the decoction of the fresh Guaiacum wood, and performed the same exercises. They were perfectly cured in six weeks, without any inconvenience, except a swelling and inflammation of the gums. The nodes in their bones disappeared; their nocturnal pains left them in fifteen days; and, after returning home, they remained permanently well. The decoction of the wood has been given in this country to the extent of a quart a day in secondary syphilis; but although it has been found to be a useful auxiliary in removing some of the symptoms—such, for instance, as ulceration of the tonsils and incipient nodes—yet Mr. Pearson, who is high authority upon this subject, remarks, "in no instance has the powers of this medicine eradicated the venereal virus." It does not appear, however, that the same violent exercises have been pursued during its administration as in St. Domingo.

From its action on the skin, the Decoction of Guaiacum has proved serviceable in impetigo, and some other cutaneous affections—for instance, in that ulceration of the nostrils which is termed Ozoena, and in scrofulous states of the membranes and ligaments. It appears to be useful in these cases from its stimulant properties, and its determination to the surface. In

chronic rheumatism, attended with cold extremities, the ammoniated Tincture has been used: and when arterial action has been subdued, if it be given in large doses, of from f℥ss to f℥ii, at bed time, and its operation aided in the morning with copious dilution, in a tepid state, it seldom fails of affording relief to all the symptoms. As long as it produces only a slight or partial warmth of the body, the dose of the Tincture may be increased, even to f℥iv: but if it purge much at this dose, it should be decreased, unless the purging be accompanied with warm sweating —a thing not likely to happen. In cases of atonic gout, in which the pains wander from joint to joint, it is also prescribed with advantage: but the boasted efficacy with which its introduction as a gout medicine was proclaimed, has not been realized. Dr. Chapman, an American Professor of Materia Medica, writes thus:—"There is a morbid affection of the eye, of a gastric origin, hitherto not sufficiently noticed, where, although no external inflammation exists, or so slightly as hardly to be perceived, there is great intolerance of light, sometimes very acute lancinating pains through the ball; though, more generally, the sensation is that of a dull, obtuse ache, attended with much heat and aridity of surface, which, whatever may be its nature, is very successfully treated by the Guaiacum." He appeals to his own experience of the efficacy of this medicine, and affirms that he never saw the disease cured by any other. It is given in the form of the ammoniated tincture, in doses of f℥i three or four times a day. I have never seen the disease described by Professor Chapman; but it is probably connected with a scrofulous diathesis, in which case this remedy may prove useful. In administering either the decoction of the wood or the Tincture of Guaiacum, the patient must be kept in bed, if we expect to produce its sudorific effects; as, otherwise, instead of producing diaphoresis, it will excite the urinary discharge. To promote diaphoresis, Guaiacum may be given in substance, in doses of gr. x to ℥ss, made into a bolus, or it may be combined with water, by means of mucilage of gum. The Decoction of the wood is a very inert preparation; and the Tincture, when given with aqueous vehicles, should be rubbed up with the mucilage to suspend the precipitate. Dr. Paris recommends a solution to be made by rubbing equal parts of quicklime and Guaiacum together, and allowing it to settle. This solution mixes with aqueous matters without decomposition. The dose of the Tincture is from f℥i to f℥iii.

f. VOLATILE OILS.

These are too stimulant to be employed as Sudorifics, except in diseases of a diminished excitement.

1. SERPENTARIA ROOT. *Serpentariæ Radix.* L. E. D.—When the skin is hot and dry, and requires the employment of a Sudo-

rific, and yet the relaxing Diaphoretics cannot be employed, Serpentaria is one of the best of the stimulant Sudorifics; its activity depends on volatile oil and resin; and on that account the form of tincture is preferable to that of infusion. It has been found useful in dyspeptic affections, accompanied with a dry skin; and forms an excellent addition to the Cinchona bark, or the salts of Quinia, in protracted cases of intermittents, and in atonic gout. The dose of the Tincture of the Pharmacopœias is from f℥ss to ℥ii, in any light, bitter infusion or decoction.

2. MUDAR. *Asclepiadis giganteæ Radicis Cortex.*—The species of Asclepias yielding this bark is a native of Bengal, belonging, as its name implies, to the natural order Asclepiadeæ. The root, which is the active part, is long, branching, woody, and covered with thick lactescent bark. In preparing it for medicinal use, it is dug up in April and May, well washed, and allowed to dry in the air, so as to inspissate the proper juice. The cuticle is then scraped, the root decorticated, and the bark dried. The bark is of a dull, whitish-fawn colour, smooth on one surface, and slightly corrugated on the other; its taste is rank and nauseous; its odour like that of pease-meal.

The Mudar has been long employed by the native practitioners of India, in syphilis*, lepra, elephantiasis, rheumatism, and many other diseases. It is a powerful stimulant sudorific, exciting the cutaneous capillaries, and diminishing velocity of the general circulation. Its influence on the glandular system is also well ascertained: in many respects it resembles that of mercury. It proves most beneficial in low states of the habit, indicated by pallidness, emaciation, disordered digestion, and imperfect assimilation: in the opposite condition of the body, it proves decidedly injurious. During its use, the diet should be vegetable; wine and every stimulant being carefully avoided. In large doses, it produces much constitutional disturbance, especially on the brain and nervous system, and nausea. It may be given in the form of powder, in doses of gr. iii to gr. x, repeated every second or third hour. In doses exceeding ten grains, it operates on the kidneys. In India, the native doctors apply it externally as a suppurative.

3. SASSAFRAS. *Sassafras, Lignum et Radix.* L. E. D.—Sassafras is a stimulant Sudorific when the surface of the body is kept warm during its administration. Experience has confirmed its efficacy in gout and rheumatism. If it do not produce sweating, it causes febrile excitement; and this generally occurs in plethoric persons of a dry, bilious, temperament. The influence of this Diaphoretic on the cutaneous capillaries has suggested

* Mr. Twining, of the Bengal Medical Service, affirms "that it has an especial power of promoting the exfoliation of diseased bones."

its employment in skin diseases; but when these are of an inflammatory description, it ought not to be prescribed. It is usually taken in the form of infusion, made with half an ounce of the chips and two pints of water. The volatile oil being its active principle, decoction is a bad form of preparation.

Sassafras is now rarely employed, except as an ingredient in the compound decoction of Sarsaparilla. The oil, as an oleosaccharum, would be a more certain method of communicating its influence in general: it might be given in doses of from m. iii to m. vi.

4. The Leaves of Rhododendron. *Rhododendri Crysanthi folia.* L. E. D.—The leaves of the Golden-flowered Rhododendron, although highly prized as a sudorific in Russia, where it is indigenous, has disappointed the hopes of practitioners in this country. In Siberia, a weak infusion of these leaves is used daily as a tea: in a stronger decoction, it produces effects not unlike those of intoxication; and has consequently been called *Intoxicating Tea* in Russia. To produce its diaphoretic effect, the Siberians infuse ʒii in fʒxii of boiling water, for a night, in a warm place. The whole of this infusion is taken in the morning upon an empty stomach: it soon nauseates, and excites perspiration; and, while this continues, food is proscribed. After some hours, it produces a copious, black, fœtid stool; and, if the disease be rheumatism, the patient rises free from pain. Dr. Halliday, of Moscow, in a letter to Dr. Paris, says that the severest fits of gout are cured by repeating the medicine for three successive days. In large doses, besides nausea, it causes vomiting, delirium, and all the other symptoms of intoxication; and, when these subside, a proportional diminution of excitement takes place. The plant has been brought to this country and submitted to trials, both in gout and rheumatism; but it has disappointed the hopes of those who have prescribed it. Whether this is owing to its suffering from drying or exportation, or owing to the constitution of the patients being different, I will not pretend to determine.

* * *Inorganic Substances.*

g. ANTIMONIAL PREPARATIONS.

1. Pulvis Antimonialis. *Antimonial Powder.* L. E. D.—This powder is a compound of oxide of antimony, antimonious acid, and phosphate of lime. According to the London and Dublin Pharmacopœias, it is formed by burning together one part of sulphuret of antimony and two parts of shavings of hartshorn: the Edinburgh College orders equal parts. When brought to a white heat, the sulphur is completely expelled, and the oxide, absorbing more oxygen, passes into antimonious acid. It is an inodorous, insipid, dull white powder, insoluble in water and scarcely soluble in acids.

The utmost diversity of opinion exists respecting the utility of this preparation, many practitioners contending that it is perfectly inert, others asserting "that it is one of the best Antimonials which we possess*." From the results of its administration in my practice, I cannot place any confidence in its diaphoretic powers. In general, it displays no influence whatever on the system. It has been given in doses of sixty, eighty, and one hundred and thirty grains, without any sensible effect. Its occasional activity may be ascribed to the oxide being accidentally in the state of a protoxide.

2. JAMES'S POWDER. *Pulvis Jacobi vera.*—The celebrity of the powder of Dr. James, as a certain diaphoretic, has led to many unsuccessful attempts to imitate it: and the antimonial powder of the Pharmacopœias was intended as a substitute for this empirical remedy. According to the analysis of James's powder by the late Dr. Pearson, 100 grains contain 57 grains of peroxide of antimony and 43 of phosphate of lime: according to the analysis of Mr. Phillips, the proportions are 56 grains of the peroxide and 44 of the phosphate. But were these analyses correct, this powder would prove as inert as its imitation; for the peroxide of antimony produces no effect on the living system. I have ascertained that James's powder contains a protoxide of antimony, to which its diaphoretic influence is due. Signor Pully, an Italian chemist, affirms that it consists of 7 parts of protoxide of antimony, + 4 of phosphate of lime, + 3.5 of potassa, intimately combined with peroxide of antimony. The dose is gr. v to gr. x.

3. PRECIPITATED SULPHURET OF ANTIMONY. *Antitimonii precipitatum Sulphuretum.* L. E. BROWN ANTIMONIATED SULPHUR. *Sulphur Antimoniatum fuscum.* D.—The dose of this preparation as a diaphoretic has been much understated. It may be given to the extent of gr. x, in combination with calomel and opium: but it is uncertain in its operation; and is seldom employed, except as an ingredient in the compound calomel pill of the London Pharmacopœia.

4. TARTRATE OF ANTIMONY AND POTASSA. *Antimonium Tartarizatum.* L. E. D.—This is the most certain of the antimonial diaphoretics. In doses of one sixth to one fourth of a grain, in combination with calomel and opium, frequently repeated, it rarely fails to produce copious diaphoresis. This effect might, indeed, be anticipated, from the greater solubility of tartar emetic than any of the other antimonials. Next to this is James's powder: all the others are uncertain in their effects. No medicines are so much modified in their effects by idiosyncracy as antimonials: in one person, small doses of tartar emetic will induce only moderate sweating; in another, the

* London Med. Gazette, December 1831.

same dose will cause alarming vomiting and purging, and extreme depression, both of bodily strength and mental energy. In prescribing tartar emetic, it should be recollected that it is decomposed by the alkaline carbonates, the medicinal soluble salts of zinc, lead, bismuth, and mercury; and that an insoluble tannate is formed with the protoxide of the tartrate, when it is added to the astringent vegetable infusions and decoctions, with the exception of those of oak bark. The tannate thus formed is inert; on which account, the decoction of yellow Cinchona bark is the antidote of tartar emetic when it is overdosed.

In acute rheumatism, I know nothing that proves more serviceable than a combination of one grain of calomel, a quarter of a grain of emetic tartar, and from one grain to two grains of opium. Some authors recommend the Tartrate of Antimony and Potassa to be compounded with prepared chalk: but this preparation is apt to run off by the bowels, instead of causing diaphoresis. Upon the whole, when the intention is to determine to the surface, the Tartrate of Antimony and Potassa, given in simple doses, frequently administered, is more manageable than any other of this class of remedial agents. When it is given in large doses, it subdues inflammatory action without inducing nausea or vomiting, after the first or second dose, or even exciting diaphoresis. As this mode of employing tartar emetic has excited much attention, some account of it may not be deemed unprofitable. If three, four, or six grains of this salt, dissolved in a glassful of water, be taken for a dose, one or two vomitings, and sometimes one or two alvine evacuations, follow; but if the same quantity be repeated two or three hours afterwards, neither vomiting nor purging will ensue; nor will they occur even if the dose be augmented to half a drachm or more, and its use continued for several successive days: under these circumstances, no other inconvenience except thirst is experienced. There are, nevertheless, exceptions to this rule; and, occasionally, inflammation and ulceration of the pharynx, œsophagus, and stomach, supervene. The pulse is lowered in a remarkable manner, and reduced in frequency: and sometimes the most copious sweating is induced. The administration of large doses of tartar emetic was suggested by Dr. Rassori, an Italian physician, who also taught that inflammation operates as a protecting power against the influence of tartar emetic, and that the degree of morbid excitement may even be determined by the extent to which the dose can be carried with impunity. The utility of this mode of administering tartar emetic in restraining inflammatory action is undoubted; but the diaphoretic influence of the medicine is most certainly secured when it is given in small doses, frequently administered.

2. SUBSTANCES WHICH OPERATE AS DIAPHORETICS WHEN APPLIED TO THE SURFACE.

h. BATHS.

The stimulant influence of caloric upon the living habit is well ascertained: it operates powerfully upon the cutaneous exhalants, and causes diaphoresis in whatever manner it is applied, within certain limits. As I formerly stated, it may be applied through three media—*air*, *aqueous vapour*, and *water*.

1. WARM AIR BATH.—This bath consists of air, the temperature of which is artificially raised above that of the body in a state of health. Warm air chambers were used as luxuries by the ancient Romans: and as a medicinal agent the Warm Air Bath was employed by the older physicians*. In air at 90° to 100°, copious perspiration is excited; at 130°, the surface is powerfully excited, but sweating does not always follow; at 150°, a sensation of smarting is experienced in some parts of the body, especially the eyes and nose, and, in females, in the nipples; the general surface feels pungently hot; the superficial veins are dilated; the urine is lessened in quantity; and it is not until after a short time that a copious sweat breaks out over the whole body. If the latter effect do not take place, the pulse beats strongly, increases in rapidity, sometimes beating 160 in a minute, and headache and vertigo supervene. A *Sudatorium*, or hot air bath, was suggested by the late Dr. Gower†, in 1819, when physician to the Middlesex Hospital. His apparatus consisted of a wicker, oblong arch, which was placed over the patient and covered with blankets. At the end of this frame, and under the covering, a metallic tube was fixed, which opened over a lamp, and rose as a kind of chimney to convey the air heated by the lamp to the space surrounding the patient. At the temperature of 85° to 90°, air applied in this manner causes profuse sweating; it is not stimulating to the surface, and has a soothing effect on the nervous system; and it is more certainly productive of sweating than either the warm water bath or the vapour bath. It has been found serviceable—1, in chronic rheumatism, and other painful affections of the joints; in rigidities of the limbs: 2, in psoriasis and some other scaly eruptions: 3, in congestive fevers, in which the powers of the habit are unequal to restore the balance of the circulation; indicated by a cold, clammy state of the skin; a feeble pulse; the breathing hurried; the countenance anxious and livid; and the whole corporeal energies oppressed. It is peculiarly indicated, also, in the state of collapse attending Indian cholera: but, in many of the cases

* Hoffmani Opera Omnia, t. i, p. 465.

† Auxiliaries to Medicine, 8vo. London.

in which it was used in that disease, the temperature was elevated to a degree which, in the depressed state of the vital powers, was productive of the most injurious, and, in some instances, fatal consequences.

Various vapours, such as sulphurous acid, chlorine gas, and the vapour of iodine, have been added to the Warm Air Bath; but its diaphoretic powers are not augmented by these additions; and it is generally necessary to throw in watery vapour after the application of these gases and medicinal vapours, which altogether alters the character of the bath.

2. The Vapour Bath. *Balneum Vaporis.*

When, instead of air, aqueous vapour is employed as the vehicle of caloric, the effects are somewhat different from those arising from the air bath.

In Russia, the Vapour Baths are steam chambers or stoves; they are fitted with benches rising above one another; and the vapour is produced by throwing water on stones heated to redness by a furnace underneath. The vapour at the bottom of the room is 112°, at the top it is 180°. The bathers sit at first on the lower benches, and gradually ascend to the higher. The relaxation induced by this Vapour Bath is greater than that experienced in the water bath. This is perhaps due to the degree of stimulus caused by vapour being less than that produced by water of the same temperature, whilst the relaxant property is equal; and, therefore, as the relaxant power is not counteracted by an opposing influence, the necessary consequence is the increase of effect. When vapour is used, also, it is applied to the interior of the thorax, at least to the air tubes, as well as to the surface of the body; and something may be thus effected by a greater extension of surface.

The Vapour Bath employed in this country is of a more limited character; in general, the head is not enclosed in the bath, so that the patient does not breathe the warm vapour, although he may do so at his pleasure. Vapour at 106° to 120°, if not breathed, is equal in its influence on the body to water at 98°; but when the vapour is breathed, 110° is equivalent to the highest degree of the warm water bath, namely, 98°. At these temperatures, the Vapour Bath is a more powerful derivative than the warm water bath, and consequently it is more certainly diaphoretic; whilst, at the same time, it is less soothing and tranquillizing. This form of bath is peculiarly serviceable in the early stage of catarrhal affections, especially if the vapour be breathed, so as to be applied to the mucous membrane. The temperature should not exceed 106°; indeed, in every case, if the perspiration can be obtained at a low temperature, the more it is likely to prove salutary.

3. Warm Water Bath.

Under this name are comprehended two varieties of water baths:

a. The Tepid Bath.
b. The Warm Bath.

a. The Tepid Bath, *Balneum tepidum*,—consists of water of a temperature from 86° to 92°. At 86° water scarcely feels warm, and certainly exerts no stimulant influence on the skin, and is rather to be regarded as a refrigerant than a Diaphoretic; at 92° the warmth is agreeable, and the effects on the habit are soothing. It is useful in dry and irritable conditions of the skin, accompanying febrile affections; and many individuals, from idiosyncracy, who cannot tolerate the warm bath, derive much advantage from the employment of the Tepid Bath. In such persons it excites diaphoresis; but, in general, this is not the result of its employment. It has been found most salutary in convalescence from acute diseases, when brisk exercise is taken after it.

b. The Warm Bath. *Balneum calidum mitius.*—The temperature of this bath is between 92° and 100° Faht. It is applicable to almost every purpose for which warm-bathing is indicated, with the exception of a few cases which demand the use of the hot bath. Its excitant powers on the cutaneous capillaries is sufficient to cause perspiration, whilst, at the same time, they sooth the nervous and vascular systems. It may be said rather to solicit than to drive the blood to the surface: it allays irritation, relaxes spasm, relieves pain, and displays a secondary sedative influence, whilst its primary effect is stimulant and directly Diaphoretic.

The Warm-water Bath was employed for medicinal purposes, and indulged in as a luxury in the earliest ages of society. As an article of luxury, we read of its use in the book of Genesis; in the works of Herodotus and Xenophon, and in those of all writers who have transmitted accounts of the customs of the Asiatic nations. In the Odyssey we find that it was used by the Greeks at a very early period of their history. It is probable that they received it from the Egyptians; and it is undoubted that the Greeks transmitted it to the Romans. With that luxurious people the use of hot baths was carried to the highest pitch. In curing diseases, it has also been employed from the earliest times. The effect of heated water upon the living body differs according to its temperature. The first effect of the Warm-water Bath is on the nervous system; the fluid impresses an agreeable and soothing feeling to the skin, uneasy and irritable sensations are abated, and a tranquil and pleasing languor steals upon the senses. According to the degree of temperature, the action of the heart and arteries is

increased; but, after a time, the pulse softens and perspiration breaks out. The ultimate effect is the relaxation of the surface—a result of the warm bath which seems to depend on the combined influence of the caloric and the water; for it is produced by neither alone. In examining the effects of the Warm Bath, they appear to operate on two principles:—1. They act upon the body nearly in the same manner as upon other masses of matter: 2, they operate upon it, as it is endowed with vitality. The second mode of operating is that which chiefly interests us. Looking at the Warm Bath in this point of view, we find that it stimulates gently the sensibility of the body. The influence of heated water, as an excitant, is felt before its diaphoretic effects are displayed, and in the direct ratio of the temperature employed. In the Warm Bath, at 98°, the sensation is agreeable; it is almost intolerable in the hot bath at 106°. This appears, at first view, inexplicable,when we reflect upon the high temperature which the body can bear in hot air: and we are inclined to enquire why the sensation of heat is so much greater when caloric is introduced by the medium of water? Various circumstances contribute to produce this effect:—in the bath the surface does not exhale, which is a cooling process; and the aërial perspired matter probably forms a warm atmosphere around the body.

Besides the sensibility, the warm bath affects, also, the irritability of the system: the pulse is moderately quickened; it is also fuller than before; but after a short time this effect is modified by the condition of the body. In health, the pulse is at first accelerated; but, according to the series of experiments made by Marker in a bath between 87° and 97°, the morbid velocity of the pulse in fever is diminished; in both cases it becomes slower in proportion to the length of time the person remains in the bath. This effect also varies in different persons. Now, although the ultimate result of the Warm Bath be the reduction of the velocity of the pulse, yet, in general, its first impression is to increase it. The Warm Bath, indeed, in this respect, agrees with all other stimulants: it first excites, and ultimately produces a state the opposite of excitement. Nor are these effects different, with the exception of the degree, from those of the hot bath between 100° and 104°: in the hot bath at 104°, the velocity of the pulse is increased after the patient has been twenty minutes in the bath; the arteries beat violently to the ends of the fingers, even after immersion for half an hour: the breathing becomes laborious, the vessels acquire turgidity, and the surface is red; but, after three quarters of an hour, sweat bursts forth; and, in fifteen minutes after coming out of the bath, the pulse and the heat become natural, and much languor is experienced. The effects of the Warm and Hot Baths differ in this respect—the former is relaxant and sudorific; the latter,

stimulant and sudorific. In the Warm Bath, the lessened tension of the skin diminishes the tension of the whole frame; thence, the phlogistic diathesis is relieved, and the sudorific effect of the hot bath depends on its powerful stimulant properties: thence the Warm Bath is better calculated to stimulate the capillaries to that extent which favours diaphoresis than the hot bath; its salutary effect is the result of its derivative, relaxant, and diaphoretic powers.

As a therapeutical agent, our attention in the present instance must be confined to its diaphoretic influence. In acute inflammatory affections, the Warm Bath is always serviceable, provided blood be previously abstracted; and this is especially necessary when the inflammation is accompanied with pain and spasm. In chronic inflammations, the same prefatory measure is demanded; but as, in these, the determination of blood is usually confined to some particular organ, local bleeding is preferable to general bleeding previously to the use of the Warm Bath. The irritable state of the stomach and mucous membrane of the alimentary canal, the dry and unhealthy condition of the skin, and the cold extremities, strongly indicate the employment of the Warm Bath in dyspeptic affections. Besides equalizing the circulation, its influence on the nervous system tranquillizes the hypochondriacal feelings usually attendant on dyspepsia: it is always a safe, generally a most salutary, remedy; and to these effects we may ascribe the advantages which follow its employment in the intervals of gout and rheumatism, in conjunction with friction and percussion. In febrile affections, it is found to prove beneficial in the cold stage of intermittents, chiefly on account of its derivative influence; and it is still more useful when there is much nervous irritation present. But some caution is required in plethoric states of the habit: this condition should always be removed by the employment of the lancet before resorting to the use of the Warm Bath.

Notwithstanding the apparent simplicity of the application of the Warm Bath, there is no remedy so frequently abused: thence the necessity for rules to regulate its use; and these are applicable to every form of the bath, whether air, vapour, or water be employed.

1. In persons of plethoric, apoplectic, or hæmorrhagic habits, or where there exists organic disease of the heart, the utmost caution is requisite in the employment of the Warm Bath, unless previous depletion has been resorted to; and, even after this, the temperature of the bath should not exceed 96°, and its equivalents if air or vapour be used. Equal precaution is necessary during the presence of the catamenia and during the latter months of pregnancy. Warm bathing is altogether contraindicated in great debility and relaxation of the system, and even when the nature of the disease indicates its utility;

yet, if the individual case afford an instance of any of those conditions to which we have just referred as requiring caution, the nature of the attack does not alter the necessity for caution in its employment.

2. When the use of the bath is determined upon, the degree of temperature must be regulated by the particular nature of the case and the condition of the patient. If diaphoresis be our object, the heat of the bath should not exceed 98°; but many persons find a lower temperature more agreeable and soothing; and this predilection should not be counteracted. The temperature of the bath should be sustained at the same degree as long as the patient remains in it. The time for remaining in the bath must be determined by circumstances: if much relaxation be desirable, the time should be considerable; and, if the disease be of a chronic character, or if it be cutaneous, the period may be extended to two or more hours. In acute diseases, the bath must be employed at the time in which its influence is required: in chronic diseases, however, when much diaphoresis is required, it should be used in the evening, and the patient should sleep in blankets; but when this is not the object, it may be taken in the forenoon, about two hours after breakfast; so that the patient may exercise himself in the open air after it, between the time of using it and dinner; although an unnecessary exposure to the air, if the weather be cold or damp, must be avoided.

3. At whatever time of the day the bath is used, it should not be too often repeated, except in cases of spasm and severe pain, in which its relaxant and anodyne, rather than its diaphoretic influence is required.

4. In delicate habits, a warm sea or salt-water bath is preferable to one of simple warm water, not only because it is less relaxing and there is less risk from exposure after its use, but because it is more derivative, and the stimulant influence of the saline matter on the skin continues after coming out of the bath. The nature of the saline impregnation modifies the action of the bath; thence, the various thermal springs differ in their effects, and sea water differs from all of them.

5. In employing the Warm Bath as a Diaphoretic, friction should always be used in the bath; and diluents with flannel clothing when the patient is taken out of it. Among the ancients, the bathers were anointed with oil and other unguents on emerging from the bath; and thus, by preventing too copious perspiration, the body was slowly cooled. Indeed, in all the ancient authors who mention baths, we find that the *Unguentarius* was the principal officer attached to the bath; and in this respect we should do well to imitate our forefathers.

3. DIAPHORESIS FROM VIOLENT MUSCULAR ACTION.

Violent exercise produces that vascular action which is the exciting cause of positive sweating under states of the body unaccompanied by a morbid constriction of the cutaneous exhalants. It can scarcely, however, be regarded as a therapeutical agent; but it is wrong to assert that muscular action has never been employed as a remedy; for, although it has not been prescribed by the physician, yet it has been employed frequently by the vulgar, and with decided advantage. Paroxysms of ague have been shortened by bringing on the perspiratory stage by running, immediately the cold fit was found to be approaching; and I have more than once seen acute rheumatism cured by taking a long and fatiguing walk. It is true that this remedy, in either disease, can be employed only by the man of determination and courage, whose energy of mind rises superior to his corporeal sufferings. In the one case, namely, the paroxysm of ague, the sensation of indolence and weariness, and the bruised feeling which is extended over the whole body, with the confusion of ideas and the irksomeness of the attempt to bend the attention, for any time, to one object, unnerves even the strongest man and unfits him for exertion; whilst, in the other, acute rheumatism, the sense of pain appears almost to be sufficient to prevent walking, even in the stoutest-hearted individuals; yet persons occasionally appear who are capable of overcoming these difficulties, and have found their advantage in the boldness of their resolution. In one disease, however, to which humanity in all its pride is humbled—Insanity—exercise, in the manner necessary to produce a sudorific effect, is often successfully employed as a remedy. In this case it performs what powerful stimulants effect in some other diseases: it diffuses the blood over the system, and tends to restore that balance of the circulation which is always disturbed in this greatest of maladies.

B. SIMPLE DIAPHORETICS.

1. SUBSTANCES WHICH AUGMENT THE ORDINARY PERSPIRATORY FUNCTION WHEN TAKEN INTO THE STOMACH.

* *Organic Products.*

Animal.

a. MUSK. *Moschus.* L. E. D.—Its diaphoretic powers are feeble; and, therefore, it is rarely prescribed as a Diaphoretic in this country.

Vegetable.

b. SOLANIA.—This is the active principle of the Solanum

Dulcamara, a plant very common in our hedge rows, flowering in June and July*. It belongs to the natural order Solaneæ. Solania is a white, inodorous, opaque powder, of a slightly bitter taste, and displaying the characters of an alkaloid. It is insoluble in cold water, and requires eight thousand times its weight of hot water for its solution; but it is soluble in alcohol, in ether, and acids. With acids it unites and forms neutral salts, which have a bitter taste. It is procured by precipitating a strong decoction of bitter-sweet with ammonia, collecting the precipitate, drying it, and treating it with boiling alcohol. This menstruum takes up the Solania and deposites it on cooling†. In bitter-sweet it is combined with malic acid.

Solania has not yet been employed in medicine, but Dulcamara is in common use as a Diaphoretic. The decoction of the twigs, collected in autumn, has been advantageously given in lepra and some other cutaneous diseases, in conjunction with arsenic, or with bichloride of mercury. The dose of the decoction, made with ℥i of the bruised twigs and a pint and a half of water boiled down to a pint, is from f℥i to f℥ii, administered three times a day. It frequently excites nausea at first; and on this, probably, the diaphoretic powers of the plant, in some degree, depend. If its use be continued for some time, the strength of the decoction should be gradually augmented. It precipitates sulphate of iron, nitrate of silver, and acetate of lead, which, therefore, cannot be prescribed with it; but it produces no effect on the bichloride of mercury, nor on tartar-emetic, lime water, nor the alkalies.

Although the decoction excite nausea and vomiting, it can scarcely be regarded as capable of acting as a poison. In large doses, it operates as a narcotic, causing vertigo, dilatation of the pupils, slow and intermittent pulse, and trembling of the limbs; but no instance of death from its influence is recorded. The best antidote is the subcarbonate of potassa. It has been chiefly used in cutaneous diseases.

c. VOLATILE OIL.

1. CONTRAJERVA ROOT. *Radix Contrajervæ*. L. E.—The Dorstenia *Contrajerva*‡ is a native of Peru, Mexico, and the West Indies, belonging to the natural order Artocarpeæ. The root, which is the part employed, is an ovoid, tapering body, compact and rugose, with numerous fibres: externally of a brownish colour, internally whitish. The odour of the dried root is peculiar, somewhat aromatic; the taste warm, bitterish,

* Woodville' Med. Bot. 3rd edit. p. 240, pl. 85. London Dispensatory, art. Solanum. Richard, Hist. Nat. Med. t. ii, p. 95.

† Journ. de Pharm. t. vi, p. 374, and t. vii, p. 414.

‡ Woodville's Med. Bot. third edition, p. 705, pl. 240. London Dispensatory, art. Dorstenia. Richard, Hist. Nat. Med. t. i, p. 553.

and astringent. It is generally administered in the form of powder, in doses of gr. v to ʒi; and, on the Continent, an alcoholic tincture of the root is employed; but it has the inconvenience of being decomposed by water.

Contrajerva is a stimulant Diaphoretic of little power. Owing to its influence in retarding the progress of putrefaction in dead animal matter, it has been employed in low states of fever; but with little advantage. In combination with the carbonate of lime, it has been found useful in the dentition of weakly infants; where there is much acidity of the stomach, and the tone of the habit requires to be supported.

The remaining Diaphoretics, which owe their efficacy to combined Volatile Oil, namely, Balm, Melissa *officinalis*, and Rosemary, Rosemarinus *officinalis*, are seldom employed, except as domestic medicines, and might be rejected from the list of Diaphoretics.

d. CAMPHOR. *Camphora.* L. E. D.—Experience has clearly ascertained that Camphor influences the cutaneous capillaries and produces a tendency to diaphoresis, without increasing the velocity of the pulse. Camphor, however, except as a fumigation, is seldom employed alone as a Diaphoretic: in combination with antimonials and opium, it ensures the action of these substances on the skin. As a purgative, its diaphoretic influence is undoubted; and amongst the substances usually added to the warm-air bath, nothing proves more serviceable than Camphor.

* * *Inorganic Substances.*

f. SALTS.

1. CARBONATE OF AMMONIA. *Ammoniæ Carbonas.* L. E. D.—This salt operates through the nervous system, and causes diaphoresis when aided by external warmth and plentiful, tepid dilution. It is probable that, in producing this effect, the Ammonia is taken into the circulation, and applied to the superficial capillaries—an opinion supported by the well-known fact, that the liniment of Ammonia, applied to the neck as a counter-irritant in inflammation of the tonsils, is invariably followed by copious perspiration, provided the patient be kept warm. Carbonate of Ammonia is indicated as a Diaphoretic in the sinking stage of typhoid fevers, and other diseased conditions in which, notwithstanding the presence of much debility, diaphoresis is still desired. In combination with guaiacum and opium, considerable advantage has been obtained from it in obstinate cases of chronic rheumatism; and, in such cases, its internal administration is aided by its external application in combination with camphor. To produce its diaphoretic effects, the dose should not be less than twelve, nor more than twenty grains. In larger doses it causes vomiting. The best vehicle for administering it is the almond emulsion.

2. CITRATE OF AMMONIA. *Ammoniæ Citras.* This salt, which is generally prepared at the moment of its administration, by saturating recent lemon-juice with carbonate of ammonia, possesses very moderate diaphoretic powers. It does not crystallize until its solution be evaporated, without heat, to the consistency of a thick syrup, when it shoots into long prisms. Its taste is cooling and moderately saline. It is very soluble in water; and is so easily decomposed, that the Ammonia is separated by the application of a moderate heat. According to the analysis of Vauquelin, it consists of citric acid 62, + ammonia 38, in 100 parts; or, 1 eq. acid = 58, + 1 ammonia = 17, making the equivalent 75. It may be prepared for medicinal purposes by adding fifteen grains of the carbonate of ammonia in solution to gr. x of citric acid. It possesses less diaphoretic power than the solution of acetate of ammonia; but it is not so nauseous, and consequently it is more generally used as a vehicle for other Diaphoretics—as, for instance, antimonials and opium; but, for this purpose, it is requisite to render the solution perfectly neutral.

3. CITRATE OF POTASSA is equally efficacious as a Diaphoretic, and more generally employed than the Citrate of Ammonia. It consists of citric acid 55, + potassa 45, = 100. It is also usually prepared at the moment of administering it; and, when given in a state of effervescence, is well adapted for allaying nausea. A scruple of the carbonate of potassa, dissolved in water, is added to half an ounce of lemon juice, diluted with mint or any distilled water. Some practitioners still recommend the old method of taking the saline draught, namely, first swallowing the solution of the alkali, and immediately afterwards the lemon-juice, so as to extricate the whole of the carbonic acid in the stomach. This method has its advantages; the alkaline solution allays the irritability of the stomach, whilst the distension of the viscus by the carbonic acid, which is thus closely applied to its nerves, affords a certain degree of tone, without interfering with the diaphoretic operation of the neutral salt. The more common method, however, is to give it during the act of effervescence, by mixing the acid and the alkali before the mixture is swallowed.

4. SOLUTION OF ACETATE OF AMMONIA. *Liquor Ammoniæ Acetatis.* L. E. D.—Acetate of Ammonia is seldom administered in the solid form. In solution, which is the old Spiritus Mendereri, it is very frequently employed. To prepare it, the acetic acid contained in distilled vinegar is saturated with carbonate of ammonia: the carbonic acid flies off in the gaseous form, and the acetate, produced by the union of the acetic acid and the Ammonia remains in solution. The variable strength of distilled vinegar renders this solution seldom of the same strength—a circumstance of little moment as far as regards its

diaphoretic powers, but of some consequence in prescribing it in conjunction with many substances. A strictly neutral solution, which should be ascertained by means of litmus and turmeric paper, is requisite. When the alkali predominates, the solution of tartar-emetic, occasionally prescribed with it, is decomposed; when the vinegar is in excess, the usual dose of the antimonial excites vomiting. The excess of the carbonate of ammonia, also, renders this preparation injurious as a collyrium. As a Diaphoretic, or as a cooling lotion, or collyrium, it is decomposed by many substances which might be inadvertently ordered in conjunction with it. Decomposition occurs with alum and lime water, but no precipitate is thrown down when the solution is strictly neutral: with bichloride of mercury a precipitate takes place; and when the alkali predominates, the acetate of lead, also, is thrown down, which, however, is owing to the carbonic acid of the excess of carbonate of ammonia forming an insoluble carbonate of lead. On this account, it is of great importance to have a perfectly neutral solution when it is administered, even in a diluted state, to wash down pills with the acetate of lead. The acetate of lead is not hurtful; but the carbonate is extremely deleterious, bringing on colica pictonum, and paralyzing the entire intestinal canal. The addition of magnesia to this solution extricates ammoniacal gas; which is owing to the magnesia forming a triple salt, an Acetate of Ammonia and magnesia, and consequently setting at liberty a portion of the Ammonia. It is also incompatible with the mineral acids, the alkalies and their carbonates, sulphates of iron, of zinc and magnesia, bichloride of mercury, and nitrate of silver.

Were this salt easily procured in the solid form, the solution would always be of a uniform strength; but its volatility prevents its crystallization from being readily effected. It may, however, be procured by careful evaporation, or by throwing streams of gaseous ammonia and of acetic acid into the same receiver, kept cool. If strong acetic acid be used for making the solution, and this be evaporated by a gentle heat, it crystallizes in needle-form crystals. By a slow sublimation, it is obtained in long, slender, flatted crystals, terminating in sharp points, of a pearl-white colour. This salt impresses the tongue with a sensation of coldness; and then of sweetness, mixed with a mawkish taste. It is very deliquescent. The constituents of neutral Acetate of Ammonia, as far as can be ascertained, are—acetic acid 75, + Ammonia 25, in 100 parts.

The ordinary Solution of Acetate of Ammonia is an excellent Diaphoretic when aided by keeping the surface warm, and by tepid dilution: it lowers the pulse, and abates febrile heat; thence it is well adapted for cases of inflammatory fevers, and all diseases of excitement. When perfectly neutral, so that antimonials may be combined with it, without suffering decom-

position, it is an admirable vehicle for administering antimonials and opium, greatly aiding the effect of both on the skin. The usual dose is from f3iv to f3xiii, which may be given in any bland fluid. It is easily retained on the stomach, and often allays the irritability of that organ.

g. WATER. *Aqua.*—This diaphoretic agent requires to be examined in two distinct states:

a. Cold Water.
b. Warm Water.

a. Cold Water implies that the temperature of the fluid does not exceed 65° Faht. Water, at this temperature, when taken into the stomach, promotes the function of the skin, and favours diaphoresis. The greater part of the matter of perspiration consists of water; and if the skin be kept warm, so as to check the action of the kidneys, the quantity of perspiration is generally in the ratio of the quantity of fluid taken into the stomach. But, besides this cause of the diaphoretic influence of water, it is also well known that the sudden impression of a draught of Cold Water upon the nerves of the stomach acts most forcibly in promoting diaphoresis. This effect of Cold Water is well known to men of intemperate habits, who, on retiring to bed in a state of intoxication, and awaking in the night, with a dry, feverish, parched tongue, a quick pulse, and a hot skin, find immediate relief by swallowing a large draught of Cold Water: the cutaneous capillaries immediately consent with the stomach, and copious perspiration quickly ensues. By imitating this practice in fevers, a similar result is obtained: but much of the effect produced depends on the management of the patient during its administration. If the surface be kept warm, and the body be surrounded with non-conductors, a small quantity of water will produce the effect required.

b. Warm Water.—The production of a sudden reduction of heat, in delicate frames of body, even in fever, when the excitement is high, is hazardous; and, therefore, warm or tepid diluents are employed to effect the same result as cold water. In general, when tepid fluids are administered to excite sweating in continued fever, the quantity of water swallowed must be large; the surface ought to be kept warm, and small quantities of saline or aromatic matters combined with the tepid drink.

Besides being diaphoretic itself, water, both cold and hot, is the general auxiliary of all other Diaphoretics; nor can their influence upon the skin be maintained for a sufficient length of time without its aid. When the fluid is intended rather to keep up perspiration than to induce it, the temperature of the water or the aqueous fluid should be at least 80°; when the object is to provoke sweating, the temperature should be about 100°, and the quantity considerable. The same rules, indeed, are neces-

sary for regulating the administration of diluents, as for the external employment of water. When the temperature of the body is under 94° in disease, cold drink should not be administered: in fevers, therefore, when it is indicated, the temperature of the patient should be ascertained: he should remain in bed, in flannels, and the fluid be administered in small quantities, frequently repeated.

Upon the whole, the advantages of water as a sudorific, and for aiding in maintaining the sudorific effect of other Diaphoretics, is sufficiently obvious: the pure state is the best for obtaining its diluent effects. Nature points out the indication for our guide, both as to its administration at first and the continuance of it, in the sensation of thirst which accompanies every state of febrile action in which diluents and Diaphoretics are required. Where this sensation is present, we cannot err in administering water; the temperature of the body and the state of the skin determining whether it shall be cold or warm.

h. EMPYREUMATIC OIL.

The only oil of this kind which has been employed as a Diaphoretic is that of the liver of the cod fish. It has been prescribed in chronic rheumatism: but in the only case in which I ever ordered it, severe nausea and vomiting supervened: indeed, I am inclined to believe that few stomachs are able to bear it with impunity.

2. SIMPLE DIAPHORETIC SUBSTANCES WHICH ENTER THE CIRCULATION.

i. SULPHUR. L. E. D.—This simple substance, when taken into the stomach, passes into the circulation, and, augmenting the natural perspiration, is carried off through the cutaneous exhalants united with hydrogen—a fact demonstrated by silver, worn in the pockets of those taking it, becoming blackened in the same manner as if it had been exposed to a stream of sulphuretted hydrogen gas. As a Diaphoretic, Sulphur is prescribed in cases of chronic rheumatism, and some other skin diseases; and, in combination with oil, under the form of oleum sulphuretum, in chronic catarrh: but this is an acrid, nauseous preparation, and, consequently, is seldom administered. It is a simple solution of Sulphur in fixed oil; but, when heated, a decomposition of this oil takes place, and sulphuretted hydrogen gas is evolved. When properly prepared, it has a reddish-brown colour, a fœtid odour, an acrid taste, and a viscid consistence. The dose is from m. v to ʒss, in any bland vehicle. The dose of Sulphur, to produce its diaphoretic effects, should not exceed half a drachm.

k. SULPHURET OF POTASSA. *Potassæ Sulphuretum.* L.

E. D.—In combination with potassium, sulphur forms a solid and a fluid preparation, hepar sulphuris and hydrosulphuret of Potassa; both of which are diaphoretic. The solid Sulphuret, hepar sulphuris, when recently prepared, is a liver-coloured substance; but it soon becomes green by the action of the oxygen of the air. It is hard, brittle, and breaks with a vitreous fracture; its taste is bitter, acrid, and caustic; and it leaves a brown stain on the skin. In making this preparation, the subcarbonate should be first exposed to a red heat in a crucible, before it is mixed with the sulphur. In melting the ingredients together, the Potassa, which is an oxide of potassium, is decomposed, the oxygen uniting with a portion of the sulphur, forms sulphuric acid, which combines with a part of the Potassa and produces a sulphate; whilst the remainder of the sulphur attaches itself to the uncombined potassium and forms a Sulphuret. This preparation, therefore, is a compound of Sulphuret of Potassium and of Sulphate of Potassa. When dry, the solid Sulphuret has scarcely any odour; but, when moistened, it exhales the smell of sulphuretted hydrogen gas, owing to the decomposition of the water, and the union of its oxygen with one part of the sulphur and its hydrogen with another: the consequence of which is the formation of Sulphate of Potassa, and Hydroguretted Sulphuret of Potassa. That is to say, the sulphuric acid formed unites with a portion of the Potassa, and forms an additional quantity of Sulphate of Potassa, whilst the sulphuretted hydrogen combines with the Sulphuret of Potassium.

The liquid Sulphuret, or hydroguretted Sulphuret of Potassa, is a liquid of a reddish-brown colour. When newly prepared, it has not much odour; but, by keeping, it acquires a very fœtid smell; it feels soapy between the fingers, and stains the cuticle a greenish-black. The acids and the metallic salts decompose it, and the latter are converted into sulphurets. It ought to be preserved in well-stopped bottles, as it rapidly attracts oxygen from the atmosphere, is decomposed, and the greater part converted into sulphate of potassa. Neither sulphuric, nitric, nor muriatic acid can be prescribed, even when largely diluted, with these preparations. If sulphuric acid be added, a precipitate of sulphur and sulphate of potassa takes place; when muriatic acid is added, the precipitate is sulphur in the state of a hydrate.

Both these preparations have been employed as Diaphoretics in chronic asthma and chronic catarrh, and in several cutaneous affections; and, in combination with conium, in cancer, at least as palliatives.

l. MERCURIALS.

Mercurials, in whatever form, when introduced into the

habit, are excreted by the skin, provided they do not pass off by the bowels; and this is particularly the case when the doses are small. This action of the salts of Mercury upon the capillary system has been long known; and, in having the cuticular discharge promoted by them, it is probable that the skin only shares as a secreting organ in the general influence which they exert on the glandular system. The Mercury in these salts exhales from the skin, in a metallic or reduced state—at least, we draw this conclusion from observing the effect of it upon gold and silver worn in the pockets of those under a course of Mercury, but we cannot be certain whether this reduction takes place at the surface. All the preparations of Mercury, which exert a decided influence on the habit, are either oxides or chlorides, in which state they are taken into the circulation. How long they continue unaltered after being admitted into the blood it is impossible to say; but the probability is that some change takes place in the glandular system, upon which, undoubtedly, they exert their stimulant influence. In promoting the cuticular discharge, therefore, Mercury seems to operate as a general stimulant to the glandular system, in which of course the skin shares as a secreting organ; and, if we can draw a correct conclusion from the consequences, we are authorized to say that the mercurial oxides and chlorides employed, undergoing decomposition, give out oxygen or chlorine, which may be their active principles. Be this as it may, the effect of mercurial preparations upon the cuticular discharge is demonstrated by daily experience; but, nevertheless, they are not administered as direct Diaphoretics, but merely as powerful auxiliaries in promoting the influence of other Diaphoretics. A query may be advanced, whether the action of Mercurials is confined to the capillary system? In reply, it must be admitted that Mercurials stimulate generally the vascular system; that the action of the heart and arteries is increased during a mercurial course, when the preparation is given in such a manner as to prevent it from operating as a purgative; but it is equally true that the peculiar effect of Mercury cannot be ascribed to its general stimulant influence; some specific action takes place upon the glandular and capillary systems, independent of the general increased force of the circulation; and it is to this that we are to ascribe its effects as a Diaphoretic.

Calomel, the *Proto-chloride of Mercury*, is the preparation usually selected for obtaining the action of Mercury on the skin. In prescribing it in combination with other Diaphoretics, it should be known that, if ammonia be ordered in combination with it, the Calomel is decomposed, the protoxide or black oxide is formed, and chloride of ammonia remains in the solution. The sulphuret and the hydro-sulphuret of potassa decompose Calomel and convert it into the proto-sulphuret or black sul-

pburet. In both cases, the activity of the medicine is greatly impaired by the change which takes place; and the dose of Calomel, which otherwise would be amply sufficient to produce its diaphoretic effect, becomes, by this decomposition, utterly inadequate for that purpose. Sulphuret of antimony also decomposes Calomel.

Calomel is scarcely ever exhibited alone, with the view of obtaining its diaphoretic effect. When combined with tartar emetic, James's powder, guaiacum, opium, or ipecacuanha, it imparts certainty to the sudorific powers of these substances. These combinations are given with advantage in all inflammatory affections, in cutaneous eruptions, and in chronic rheumatism. As a Diaphoretic, the dose of Calomel is one grain.

3. SIMPLE DIAPHORETICS WHICH OPERATE WHEN APPLIED TO THE SURFACE.

Whether sweating or mere diaphoresis be produced, the cause of the perspiration, as far as the substances we have already examined are concerned, is the increased action of the whole vascular system; but as far as relates to the few remedial agents under this head, the increased excitement is wholly confined to the cutaneous vessels.

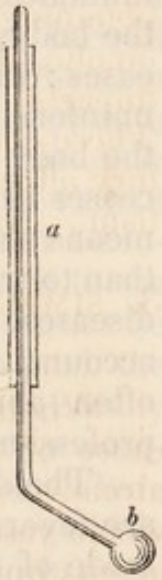
m. FRICTIONS.

These operate upon the cutaneous vessels directly, and may be considered equivalent to muscular exertion in producing sweating.

n. THE COLD AFFUSION.

When cold water is dashed upon the body, labouring under a state of febrile excitement, its effects are a diminution of the heat of the skin, and the force and frequency of the pulse, diaphoresis, and sleep. These effects are not solely the result of the sedative influence of cold; for although this be great, and the abstraction of caloric is sufficient to reduce at once the temperature of the body from 106° to 94°, yet this alone would not produce that diaphoretic effect on which much of the advantage derived from the cold affusion depends; we must, therefore, look out for another cause, and we find it in the sudden and powerful shock which this mode of applying cold water gives to the whole system, and the salutary reaction which ensues. The use of the cold affusion as a Diaphoretic is indicated when the skin is hot and dry, the tongue parched, the face flushed, accompanied with headache and pulsating at the temples, restlessness, and watching. Perhaps it is less adapted to the fevers of our temperate climate than to those of tropical regions, when the general excitement is at its greatest

height. It is of much importance, however, to ascertain that no visceral inflammation exists, that the catamenia are not present, and that the patient is not in the latter months of pregnancy, as, in such conditions of the habit, dangerous effects might follow the employment of so powerful a remedy. Even when no circumstance of the kind just mentioned contraindicate the use of the cold affusion, still the following precautions are necessary to be always kept in view.



1. The *temperature of the body* should be accurately ascertained by introducing the bulb, *b*, of a small curved thermometer, *a*, under the tongue, with the lips closed upon the instrument, or within the axilla. If the heat be under 96°, the cold affusion should not be applied; neither can it be used if perspiration be already present, even though the heat of the body at the moment be much greater than usual. Dr. Currie remarked that, under these circumstances, the application of cold water is accompanied by a diminution of temperature, and a deficiency of reaction, which are at least hazardous.

2. *When a sense of chilliness* is present, although the thermometer indicate a morbid degree of heat, the cold affusion is dangerous; suspending respiration, producing a feeble, frequent, and irregular pulse, and sudden collapse which threatens, if it be not always followed by, extinction of life.

3. When fever is advanced, the temperature of the water should not be more than 15° or 20° below that of the body.

4. The patient, immediately after the use of the Cold Affusion, should be placed in bed, and some warm wine and water administered, to encourage the reaction, which is the object of the remedy.

Before applying the Cold Affusion, the hair of the patient should be removed; he should be stripped naked, and, being seated in a tub, four or five gallons of water, at 40° to 60°, should be thrown over him; and this should be repeated two or three times, or until a rigor come on; after which he should be immediately removed to bed. The period of the evening exacerbation of fever, which in general occurs from six to nine o'clock, is perhaps the best time for using the affusion; but it may be advantageously employed at any time of the day, if the symptoms indicate the propriety of such a step. It is sometimes of advantage to add salt to the water; and Dr. Currie was of opinion, that by this addition the affusion is not only more grateful to the feelings of the patients, but it may be used for a length of time with much less hazard than when fresh water is employed.

The diaphoresis which follows should be maintained by free

dilution with tepid fluids, as if it had been induced by any other of the means which have been described.

THERAPEUTICAL EMPLOYMENT OF DIAPHORETICS.

Direct Diaphoretics, in augmenting the action of the cutaneous capillaries, are well adapted for relieving internal congestions; diminishing febrile excitement, and, by the cooling influence of evaporation, reducing the morbid temperature of the body. They were very early employed in the cure of diseases: indeed, the common observations of men, in the most uninformed state of society, must have taught them that, when the body is labouring under febrile excitement, this immediately ceases if a sweat breaks out. It was natural, therefore, that means should have been sought for to promote this state, rather than to trust to it as a natural crisis: thence, in the treatment of diseases, sweating is a prevalent and proper remedy. On this account, however, the employment of Diaphoretics has been often abused—a charge not exclusively confined to the unprofessional.

The diseases in which Diaphoretics are decidedly indicated are fevers; but, as these vary in their characters, so also the mode of using Diaphoretics must vary. In intermittent fevers, they have been administered in three ways—1, immediately before the cold stage, to prevent the accession of the paroxysm: 2, during the paroxysm, with the intention of bringing it to a speedy termination: and, 3, during the interval, to promote the natural perspiration, and to aid the return to health.

1. The cold stage is the first of the succession of symptoms which constitute the paroxysm of intermittents: it may be removed by exciting an opposite state; and accordingly we find that, when sweating can be induced about the commencement of this stage, the paroxysm is either lessened in violence, or it is shortened in duration, or altogether prevented. Now, how is sweating, in this case, to be effected?

Among rude nations, the simplest means for warming the body artificially are resorted to: the Negroes in Jamaica, for instance, Dr. John Hunter informs us, stretch themselves out in the sun; other equally rude tribes endeavour to diffuse the blood and throw it upon the surface by exercise, and therefore run vigorously as soon as they feel the least indication of the approach of the cold stage of the paroxysm. From the writings of Celsus we learn that the ancients employed the warm bath at the period of the anticipated accession. The bath was used half an hour before the rigor was expected; after which some sudorific medicine was administered, and, the patient being put into bed, the sweating, as soon as it occurred, was kept up by warm diluents. In a period nearer to our own times, Sydenham used to put his patients into bed, about four hours before the

expected accession of the paroxysm, and excited sweating by the most powerfully stimulating sudorifics; keeping it up in the same manner for several hours. But these means often served to heighten the symptoms of the hot stage by augmenting the heat of the system, and, instead of shortening the paroxysm, have protracted both it and the disease, and even converted intermittent into continued fever. The most usual modes of inducing diaphoresis, in this case, is by means of an emetic. I am aware that it may be doubted whether the advantage derived from an emetic, in this stage of the paroxysm, be attributable to its diaphoretic effect, or to the agitation it produces proving a stimulus to the system in general; and, if we consider that other mechanical means—such, for instance, as running, and violent muscular exertions—produce the same result, we shall be inclined to adopt that opinion which attributes the benefit to the agitating influence of the emetic: at the same time it cannot be denied that the known sympathy between the stomach and the surface is such, that the nausea produced in the one is generally followed by diaphoresis in the other. This practice of producing sweating by vomiting, however, is not admissible where there is a determination of blood to the head, and consequently other methods of inducing sweating must be resorted to; and the best are either antimonials or ipecacuanha combined with opium. The opium may be given in the form of tincture, to the amount of forty drops at first, and then half that quantity repeated every quarter of an hour, for three or four successive times. By whatever means the sweating is induced, it should be kept up until the paroxysm has run its course and declined, and this is best effected by tepid diluents; but, if the catenation be not broken, and the hot stage has come on, then cold fluids are more grateful to the patient, and also more beneficial in other respects. With regard to a repetition of these means, we must be guided by the effects produced: thus, if the paroxysm be only alleviated, the Diaphoretics should be repeated under the same circumstances; if it be stopped, and there be some appearance of a return, then they may also be repeated: but, when the strength is deficient, this method cannot be carried far without incurring some risk. In the selection of Diaphoretics, we must employ the stimulating, not only to diffuse the blood over the system, and maintain the cutaneous function, for the immediate purpose of warding off the paroxysm, but also to support the tone of the extreme vessels: while, in order to subdue the paroxysm when present, the nauseating and relaxing are preferable.

2. For fulfilling the second intention of administering Diaphoretics in intermittents—namely, to shorten the hot stage by promoting a flow of sweat—emetics have been also employed; but vomiting is certainly not so well suited to this as to the first

stage of the paroxysm; and every indication may be better fulfilled by nauseating Diaphoretics, particularly antimonials, combined with opium. The best Diaphoretics for this purpose are the tartrate of antimony and potassa, or the true James's powder, or ipecacuanha combined with opium, in the form of Dover's powder. It was well observed by Dr. Lind that opium has a marked power in this stage of intermittent—a circumstance which is to be ascribed rather to its stimulant influence, exerted at the moment that the nauseating effect of the Diaphoretics combined with it relaxes the surface, than to its sedative powers. But in paying this tribute to opium, it is requisite to state that, if symptoms of synocha prevail, then opium and all stimulants are to be avoided. In this state, the saline mixtures, the citrates and acetates of ammonia, and the citrate of potassa, given in a state of effervescence, the vegetable acids and blood-letting, are indicated; particularly when the pulse is hard and full, and difficulty of breathing or dyspnœa is urgent. When the diaphoresis is actually induced, nothing further is requisite than to maintain it by the mildest tepid diluents; to keep the patient in flannel; and, if the sweating continue long, to support the strength by gentle cordials.

3. With regard to the third intention of administering Diaphoretics in ague, although sudorifics cannot be recommended to be given during the interval, yet nothing tends more to prevent the recurrence of the paroxysm than the keeping up the proper cuticular discharge; and the stimulating Diaphoretics are the best adapted for fulfilling this intention. Some writers on the treatment of intermittents, however, contend that the mildest are to be preferred. Both opinions, to a certain degree, are correct; the propriety of employing the stimulant or the milder Diaphoretics in the apyrexia depending altogether on the temperament and condition of the patient, independent of the disease. Thus, if the pulse be strong, full, or hard, if pains resembling those of rheumatism or pleurisy, or any other symptoms of an inflammatory habit be present, however complete the interval or apyrexia may be, stimulant Diaphoretics ought not to be exhibited; but, if the contrary be the case, or if the continuance of the disease have reduced, as it generally does, this diathesis, then the most useful Diaphoretic is the serpentaria; and it may be advantageously combined with sulphate of quinia or any other tonic. The salts of ammonia, especially the carbonate, have also been added to the cinchona bark for this purpose; and it has even been asserted that much of the benefit arising from the use of arsenic is owing to its promoting the cuticular discharge, along with its tonic effect. The climate, the age of the patient, and the nature of the prevailing epidemic, are also to be taken into account in prescribing Diaphoretics in the intermission or apyrexia of ague. All debilitating causes, not less than the

power of habit, tend to protract these fevers; and, therefore, taking every incident into consideration, we may regard it as a general rule that the stimulating Diaphoretics are more frequently required than the milder and relaxing in the apyrexia of intermittents.

In continued fevers, sweating has always been regarded as one of the most important means of securing a crisis. In using this term, it is not intended to imply that any peccant matter is thrown off, as was once supposed. A natural or spontaneous crisis in fever seldom occurs beyond the tenth or twelfth day after the disease has displayed itself; and an artificial crisis—that is, a crisis induced by remedial agents—is rarely induced after the third or fourth day. The sooner after the appearance of the fever that the attempt to produce a crisis is made, the more probable is the chance of success. In continued fever, sweating is generally accompanied with an abatement of the symptoms, and is the process employed by Nature in relieving fevers. Where relief is obtained by spontaneous sweating, the sweat is always thin and generally diffused; and we may rest assured that, under no other circumstances, does sweating prove beneficial in continued fever. The benefit resulting from sweating in continued fever cannot be denied; but, at the same time, it must be admitted that several circumstances are requisite to be kept in view to secure its beneficial effects. In the *first* place, the type of the fever should be carefully determined. This is of great importance, inasmuch as the first effect of many sudorifics is to increase the force of the heart and arteries, and consequently to augment phlogistic symptoms. In synocha, therefore, or rather in that stage of continued fever in which inflammatory symptoms prevail, if we employ Diaphoretics, the mildest must be selected; and, even in fevers attended with great depression, the administration of stimulant sudorifics requires considerable precautions. In the *second* place, the period of the fever must be kept in view. Every continued fever may be divided into three periods. 1st. That of accession: 2nd. that in which the fever is fully formed: 3rd. that in which it shows a tendency to terminate, whether in death or in recovery. Sudorifics have been found most successful in the first period; and this seems to depend on the nature of every fever, which being a succession of paroxysms, the means that arrest the first paroxysm may stop those which should follow; and also on the fact, which experience has confirmed, that the chance of a fever being cut short by sweating is diminished the longer it continues. When a continued fever is completely formed, although it is impossible to prevent it from running its course, yet sudorifics may obviate the violence of the symptoms; and they may prove beneficial, even at later periods, if given about the commencement of the exacerbations. If much debility, however, be expected, and the

Diaphoretics we have administered do not quickly relieve the symptoms, then their use should not be continued: for the last stage of fever, being one of debility, sweating is not to be promoted in this period of these diseases. The symptoms that chiefly indicate their use in continued fever are considerable arterial action, a small concentrated pulse, heat, a dry skin, restlessness, thirst, and limpid urine without sediment; but a strong pulse, a great determination to the head or the thorax, spontaneous sweating, general or partial, especially if attended with a miliary eruption, strongly contraindicate their employment. In every case in which sweating is likely to prove useful, it flows readily and is general: on the contrary, when it flows with difficulty, is partial and inconsiderable, it is seldom salutary; if the febrile symptoms increase, it is even dangerous.

In the treatment of intermittents it was formerly the practice to extort sweating by violent stimulating means: this is highly improper, both in continued fever and intermittents; for, even when sweating is induced, if it do not produce a rapid abatement of symptoms, it will be generally found to have an injurious effect by reducing the strength of the patient. When sweating is requisite, the mildest means should be employed; and no medicines are more appropriate for this purpose than the antimonial preparations. Whether James's powder or emetic tartar are to be preferred, it is difficult to determine: as far as regards the due action by the skin, my own experience would make me lean to the side of the emetic tartar, both on account of its certainty of operation and the facility with which its dose can be regulated. In checking such sweats, however, whether they are spontaneous, or the consequence of stimulant sudorifics and external heat, we must cautiously avoid the application of cold to the surface. The best mode of lessening it is by moderate purging; employing the saline purgatives acidulated with diluted sulphuric acid.

The importance of the internal and external use of cold and warm water in febrile affections, cannot be sufficiently urged. The immediate effects of the cold affusion are a diminished degree of heat, and of the frequency of the pulse, followed by diaphoresis and sleep. It is in the commencement of continued fevers that the cold affusion is most useful: in the more advanced stage of these diseases, or where there is much debility, the tepid affusion, from 75° to 87°, is more advisable than the cold affusion. Under this term is also comprehended sponging, and washing the body with tepid water. The same cautions, however, are to be attended to, whether the tepid affusion or sponging and washing be employed*.

* See Currie's Medical Reports on the Effects of Cold and Warm Water in the Treatment of Fevers: the Observations of Dr. Wright in the seventh volume of Medical Facts and Observations: and Dr. Jackson's Treatise on the Fevers of Jamaica.

With respect to the internal use of cold water to excite diaphoresis in continued fevers, it is necessary to remember that it is only after the hot stage is completely formed, when the temperature of the body is greatly above the natural standard, that cold water and cold drinks can be safely and advantageously administered. They produce effects similar to those of the cold affusion, but in a less degree, lowering the heat of the surface, lessening the frequency of the pulse, and disposing to diaphoresis and sleep. After the sweating has become general, the farther use of cold fluids is undoubtedly inadmissible: but this does not refer to the commencement of the sweating, since at this time, as Dr. Currie remarks, they both aid in reducing the temperature of the body and in promoting the flow of sweat. It must, however, be recollected that much of the benefit resulting from sweating in continued fever depends on the discrimination and judgment of the practitioner.

In the phlegmasiæ, sudorifics are not so generally indicated as in idiopathic fevers. In acute rheumatism, however, they are much employed. Spontaneous sweating is one of the symptoms of the disease, and, as experience has pointed out that its appearance always relieves the pain, the use of Diaphoretics is considered to be particularly indicated. Acute rheumatism, nevertheless, is now seldom treated with sudorifics; for, if they do not rapidly relieve the pains, the disease invariably increases in violence. When gout was considered to depend upon the presence of some morbific matter in the habit, which required to be expelled, the skin was supposed to be the natural emunctory for this purpose, and Diaphoretics were freely employed. More correct views of this painful affection have set aside this practice in a great degree; but, still, after purging and the use of sedatives, Diaphoretics are employed as auxiliaries. There can be only one opinion respecting the propriety of employing sudorifics in dysentery: and ipecacuanha, in combination with opium, is here our best hold. It may be given in large doses, in combination with extract of gentian, which prevents it from exciting vomiting, as recommended by Mr. Twining, in the Calcutta Transactions. In doses of from three to six grains, administered in this manner, it allays irritation and tenesmus, and aids the favourable termination of the disease more decidedly than when nausea is induced. The general covering of the body should be light, but of a non-conducting character.

Among the ancients, sweating was very commonly employed for the cure of dropsy, and it has been also used by the moderns, when the disease is accompanied with a harsh dry skin: but sweating cannot be regarded as generally applicaple in dropsies. After sweating, the excretion of the urine is sometimes increased, and the accumulation of the dropsical fluid so much diminished that a bandage is required; but, as it is probable that these

effects depend on the reduction of the inflammatory diathesis, this is more quickly and effectually produced by the use of the lancet than by Diaphoretics. There is no doubt, however, that sudorifics are useful auxiliaries in the management of dropsy; they are, however, much less useful than cathartics; but they have one advantage; namely, that of not impeding the other methods of cure.

In cutaneous diseases, Diaphoretics, particularly the antimonials, have been found beneficial. All the preparations of Mercury that prove useful in these troublesome affections owe much of their efficacy to their action on the capillary vessels of the skin. Many of the vegetable remedies, also, which have been found useful in skin diseases belong to this order of medicines; and we may ascribe the benefit derived from the employment of the warm bath chiefly to its diaphoretic influence. Many of the remedies used in syphilis are sudorifics; such, for instance, as mezereon, guaiacum, mercury, and the antimonials. How far the beneficial effects are due to their diaphoretic powers, I will not venture to decide. In warm climates, where there is a constant determination to the skin, vegetable Diaphoretics have succeeded more frequently in curing the disease than in cold regions; but certainly it would be supposing too much to ascribe the cure to the syphilitic poison being thrown off from the surface by the diaphoresis. I am of opinion that we must look a little beyond our own art to ascertain the causes of the easy cure of syphilis in warm climates; to the relaxed habits of the natives; to their simple and mild diet, and to the degree of indolence and rest which is the natural consequence of a tropical climate; nevertheless it is certain that, in the treatment of syphilis, diaphoresis in the commencement is of great importance. Diaphoretics are advantageously prescribed in many other morbid affections; but it is unnecessary to enter further into details; enough has been said to show their general importance in the treatment of diseases.

SECTION XVIII.

EPISPASTICS—MEDICAMENTA EPISPASTICA.

EPISPASTICS, in the ancient acceptation of the term, meant substances that inflame the skin; but the term includes also those which cause *vesication* and *suppuration*. The ancients arranged Epispastics according to their effects: the gentlest they named *phœnigmoi;* the next, *sinapismi;* the third, *vesicatorii;* and the fourth, or most powerful, *caustici*. This division is

judicious; but the latter term, caustici is too general a phrase, comprehending not only caustics that destroy the vitality of the part, by the excess of their stimulant power, such as the actual cautery, but those, also, that operate by their chemical properperties, which belong to *Escharotics*. I have, therefore, arranged Epispastics under the following four divisions:—1, *Rubefacients;* 2, *Vesicants;* 3, *Suppuratives;* 4, *Actual Cauterants.*

1. RUBEFACIENTS are substances that redden the skin, by exciting moderate inflammation of the capillaries; and cause a certain degree of pain by stimulating the extreme nerves of sensation. This may be effected by *mechanical* or *vital* means.

The operation of a moderate Rubefacient is purely local; it augments the action of the cutaneous capillaries, and acts as a counterirritant; but that of a powerful Rubefacient is general, the excitement which it causes extending over the whole habit. Thus, if a liniment, composed of two parts of fixed oil and one part of ammonia, be rubbed on the neck, in inflammation of the tonsils, the inflamed organs are relieved by the inflammation set up on the surface acting as a counterirritant; but if these proportions be reversed, diaphoresis is also induced, and the febrile symptoms are mitigated in violence. But it is necessary to remark, that when Rubefacients are applied to relieve local pains, or inflammation not accompanied by general fever, they seldom operate in this secondary manner. Their general effect, therefore, may depend on a change of morbid action begun in a part and extended by sympathy to the whole of the system; it must, consequently, be regarded as accidental. In this case, the local action more than counterbalances the general excitement, and produces what is termed a derivation of action. Another effect of Rubefacients is to be referred to the pain which they induce diverting the attention of the patient from the seat of morbid action. In treating of the influence of mind in modifying the operation of medicines, I pointed out the difficulty of curing some painful diseases as long as the attention is powerfully directed to the seat of the disease: Rubefacients operate by withdrawing this, and thereby enabling the natural efforts of the system to repair any irregular action in the affected part. If their influence can be maintained for a sufficient length of time, the diseased action which it had arrested will not return; thence, in many instances, the proper employment of this variety of Epispastics is productive of much benefit in internal inflammations, in scrofulous affections of the joints, and in strumous swellings. It has been contended that Rubefacients owe much of their benefit to the friction employed; but in many cases no friction is employed. Strong friction, however, may be employed to produce a rubefacient effect.

2. VESICANTS.—Most of the substances operating as rube-

facients, when augmented in strength, cause an effusion of serum between the cutis vera and the cuticle, and thus become Vesicants. The primary action of a Vesicant, therefore, is that of a rubefacient, extended beyond the ordinary limit: the heat, redness, swelling, and pain, are greater; and affusion is the result of this increased action. The skin being an exhalant organ, a large quantity of fluid is thrown off by it, in the usual exercise of its healthy function; and this is increased when the extreme vessels are excited: but still the cuticle is sufficient to transmit this within a certain limit; and it is only when the imflammatory action exceeds this limit that the cuticle loses its exhalant functions, and vesication occurs. Perhaps something is also due to the effect of the hasty secretion of the serum, which, containing a larger quantity of coagulable matter than in its usual state, the cuticle calculated only to transude a thin fluid, is incapable of allowing this denser fluid to pass through it; and thence it is forcibly raised from the true skin. The serum of blisters has been chemically examined by M. Magueron, in the Hôtel des Invalides: he found that it contains a much larger proportion of albumen than exists in the ordinary exhalation from the skin. In one hundred parts of the fluid of a blister, he obtained eighteen parts of albumen, two of muriate of soda, one of carbonate of soda, one of phosphate of lime, and seventy-eight of water. He ascertained that the nature of this fluid is the same, whether the blister be caused by Vesicants, properly so called, or by sinapisms, or by hot water, or by the stings of insects.

The benefit arising from the blisters was formerly ascribed to the discharge which they produce; but it was first observed by Stoll that this is too small to be productive of much benefit; thence he remarks, "non suppuratio sed stimulus prodest;" and it is on this account that the repetition of blisters in inflammation of mucous membranes is more useful than a continued discharge from one. It is true that the effusion of serum internally is checked by blisters; and it has been affirmed that they effect this by "extracting serum from the mass of blood in the adjoining vessels*:" but, if the counterirritant effect lessen the determination of blood to the internal organ, the effusion of serum will be necessarily lessened, independent of any diminution of this component of the blood which a blister can effect. If the degree of morbid action be lessened, the consequences of high action will not follow. The benefit which they produce is truly to be attributed to their local stimulant action, as counterirritants, and the sympathy which exists between the skin and the mucous and serous membranes. This was known to the ancients: Hippocrates, who invented blisters, applied them

* Cyclopœdia of Practical Medicine; art. Counterirritation.

in the hope of transferring diseased action from the interior to the surface, or, as it has been termed, on the doctrine of revulsion.

Their stimulant influence is also sometimes useful in rousing the general powers of the system in low fevers, and in subduing states of inordinate action of the moving fibres. They have even been found to influence the mental energies; and thence have been applied by men engaged in public business when great displays were required*; but, although their first or exciting effect on the mental faculties be excitant, yet their secondary is depressing; and, on this account, the action of a blister is followed by a disposition to sleep. The general stimulant influence of blisters points out the necessity of caution in their application, until excitement be reduced by bleeding, purging, and other depleting measures, in inflammatory diseases. It has been asserted that they ought not to be applied over parts covered with an erysipelatous eruption; but this precaution is unnecessary: on the contrary, the new action induced by a blister is often productive of the most permanent sanative results. They are, however, contraindicated in several conditions of the habit; for example, when the excitement which they induce is likely to be followed by collapse. It is on this account that children do not bear blistering with impunity, and sometimes suffer from phagedenic ulceration after the application of a blister. I have seen even gangrene and death follow the application of a blister on an infant. This effect of blisters on children, however, may be prevented by never allowing the blistering agent to remain longer applied than is absolutely requisite for exciting the degree of inflammation to raise the cuticle: thus, if the plaster of cantharides be used, it should be removed in four or six hours at the utmost. When a disposition to phagedena or gangrene displays itself, the local application of the chlorides and poultices, with the administration of tonics internally, should be immediately resorted to. Blisters, as I have already stated, are frequently employed to rouse the powers of the habit in the low stages of fever, particularly in typhus; but, when the powers of the system are much reduced, they should not be applied to the feet and ankles; for they either fail to rise, owing to the very diminished excitability of the part, or, if they act, the blistered surface is apt to run into gangrene. Vesicants are, in fact, to be regarded as counterirritants rapidly exerting their influence; and, as we shall afterwards find, they are, in this point of view, remedies of considerable importance.

3. SUPPURATIVES do not produce their effects in the same

* This was the custom of the celebrated Dunning, the barrister; and my friend, the late Sir James Mackintosh, informed me that he had once tried the influence of a blister when he had to make a display in the House of Commons, and was satisfied with its effects.

manner as *rubefacients* and *vesicants*. The inflammation produced by the two latter is erythematic; that excited by Suppuratives is phlegmonous. Suppuratives differ from actual cauterants: the former cause inflammation which terminates in small pustules, that run their course and suppurate freely: the second produce deep-seated ulceration and destruction of the part to which they are applied. The advantage of Suppuratives over rubefacients and vesicants is the permanence of their effects; although some part of the benefit is due to the discharge and the derivation of a large supply of the circulating fluid to the part. Much, however, depends on the nature of the Suppurative, and the manner in which it is applied. It should be always remembered that, after Suppuratives have been in continued action for some months, they cannot at once be discontinued without risk. Thus, apoplexy has occurred almost immediately after drying up an issue, in the same manner, and on the same principle, as when a sore leg, or an ulcer has been suddenly healed. The difference between the discharge from the operation of a *vesicant* and a *suppurative* depends upon the action of the former being confined to the capillaries or exhalant vessels; whilst that of the latter is extended to deeper-seated and more important arterial branches.

4. ACTUAL CAUTERANTS destroy the life of the part to which they are applied, and excite the energies of the surrounding parts to a degree approaching to inflammation, which enables them to throw off the dead matter or eschar. The stimulus which is thus communicated to the healthy parts is readily maintained by mechanical and chemical irritants, introduced into the ulcerated cavity; and these, causing a determination of blood to the part, operate in the same manner as suppuratives. But, in the first instance, the shock communicated to the nervous system by the application of so powerful an agent as the actual cautery is considerable; and, while we know that, in certain diseases, this is highly salutary, the knowledge of it is sufficient to guard us against its indiscriminate employment. A question may arise respecting the cause of the efficacy of Actual Cauterants—whether, like blisters, something be not due to the degree of pain which they excite diverting the attention from the seat of disease? In reply, it may be stated, that the effect is often produced before a degree of vascular action is set up sufficient to cause much pain; and that, in some cases, scarcely any pain follows, and yet a powerful change is effected in the habit.

In whichever manner Epispastics operate, they exert an immediate influence on the skin; a secondary on distant organs. Nature confirms the truth of this remark, by displaying the powerful influence of cutaneous eruptions over functional dis-

eases of the internal organs: even in exanthematous fevers, the febrile action generally subsides as soon as the eruption appears; nor is the occasional opposite effect any argument against the general result.

TABLE OF EPISPASTICS.

A. SUBSTANCES WHICH IN CERTAIN QUANTITY, OR DILUTED, OPERATE AS RUBEFACIENTS.

* *Organic Products.*

a.—ACRID OIL, contained in

Bulbs—Allium *Sativum.*	6. 1.	Asphodeleæ.
Fruit—Capsicum *annuum.*	5. 1.	Solaneæ.
Seeds—Sinapis *nigra.*	15. 2.	Cruciferæ.

b.—VOLATILE OILS.

Oil of Turpentine,
Oil of Cajuput.

* * *Inorganic Substances.*

c.—AMMONIA.

d.—ACIDS.

e.—HOT WATER.

B. SUBSTANCES WHICH OPERATE AS VESICANTS.

* *Organic Products.*

Animal.

a.—CANTHARIDINE, contained in

Cantharis *officinalis.*	4. 5.	Crustacea, Coleoptera.
——— *vittata.*	———	———
Mylabris *variabilis.*	———	———

Vegetable.

b.—ACRID OIL, contained in

Roots—Ranunculus *acris.*	13. 7.	Ranunculaceæ.
——— *sceleratus.*	———	
Seeds—Sinapis *nigra.*	15. 2.	Cruciferæ.

* * *Inorganic Substances.*

c.—AMMONIA.

d.—NITRATE OF SILVER.

e.—STEAM.

f.—HEATED METAL.

C. SUPPURATIVES.

* *Organic Products.*

a.—ACRID OIL, contained in

Bulbs—Lilium *album.*	6. 1. Liliaceæ.
Barks—Daphne *Gnidium.*	8. 1. Thymaleæ.
——— *Mezereum.*	———

b.—OLEO-RESINS.

Burgundy Pitch,
Galbanum,
Ammoniacum.

* * *Inorganic Substances.*

c.—ACIDS.

d.—TARTRATE OF ANTIMONY AND POTASSA.

* * * *Mechanical Means.*

e.—ISSUES.

f.—SETONS.

D. SUBSTANCES WHICH OPERATE AS ACTUAL CAUTERANTS.

a.—MOXA, formed of

Artemisia *Chinensis.*	19. 1. Compositæ.

b.—CALORIC, communicated by

White-hot Iron.

A. ORGANIC SUBSTANCES WHICH OPERATE AS RUBEFACIENTS WHEN APPLIED TO THE SKIN.

a. ACRID OIL.

This epispastic agent is never employed in its separate state; but, in its natural combinations with other vegetable constituents, it forms the active principle of several rubefacients.

1. GARLIC. *Allii sativi Bulbus.* L. E. D.—The plant of which this is the bulb is a native of Sicily, belonging to the natural order Asphodeleæ: it is cultivated in every part of Europe*. The bulbs are small, and congregated in a common membrane. The separate bulbs are named *cloves.* They have a strong, disagreeable, penetrating odour, and an acrid taste. According to the analysis of Bouillon Legrange, they contain

* Woodville's Med. Bot. third edition, p. 749, pl. 256. London Dispensatory, art. Allium. Richard, Hist. Nat. Med. tome i, page 382.

albumen, saccharine matter, fecula, and an acrid volatile oil on which their rubefacient property depends. On distillation with water, they yield this oil: it is at first yellow, and lighter than the water; but, as the distillation advances, it becomes heavier. It is so acrid, that in its separate state, undiluted, it rapidly blisters the skin; and is so penetrating, that, when garlic is applied to the surface, even to the soles of the feet, its odour is soon detected in the breath; and, when the cloves are taken into the stomach, the odour is perceptible in the discharge of issues. This acrid oil has some degree of volatility, but not much; for the odour seems to depend upon another volatile oil, intimately combined with this acrid oil. The acrid principle is extracted by alcohol and vinegar.

Garlic is not much used as a rubefacient, owing to the disagreeable nature of its odour; but it has been found useful as a local stimulant in atonic deafness. In deficient action of the urinary bladder, a poultice of garlic applied over the pubes rarely fails to produce the discharge of the urine. It is scarcely necessary to caution against its employment, even as a rubefacient, in inflammatory states of the habit.

The bulb of the Onion, Allium *cepa*, and that of the Leek, Allium *porrum*, indeed the bulbs of all the species of Allium, possess rubefacient powers; but, on account of their offensive odour, they are seldom employed.

2. CAPSICUM. *Baccæ Capsici Annui.* D.—The Capsicum *Annuum* is a native of South America, an annual, easily cultivated in this country, bearing its fruit ripe in September. It is arranged in the natural order Solaneæ*. The fruit, which is the officinal part of the plant, is a juiceless berry, conical or ovate; of an orange, red, green, or yellow colour; two-celled, with reniform seed. The best cayenne pepper is made from bird pepper, Capsicum *baccatum*. It is often adulterated with salt, sometimes with red oxide of lead: the former is detected by the taste; the latter, by boiling the pepper in vinegar, and adding sulphuretted hydrogen water; if a dark precipitate be thrown down, lead is present.

The odour of the berry, when recent, is aromatic, but this is impaired by drying; the taste is hot and acrid, and remains long on the palate. Boiling water takes up the active principle of Capsicum: the infusion is not affected by acids and alkalies; but it is altered by muriate of lime, bichloride of mercury, carbonate of potassa, salts of baryta, sulphates of iron, zinc, and copper, acetate of lead, nitrate of silver, and lime water. Infusion of galls also throws down a precipitate in it. When evaporated to dryness, it affords a residue resembling starch in con-

† Woodville's Med. Bot. 3rd edition, p. 226, pl. 80. London Dispensatory, art. Capsicum. Richard, Hist. Nat. Med. t. ii, p. 718.

sistence. When Capsicum is boiled with alcohol and strained, the solution deposites, on cooling, a fatty matter of a beautiful orange-red colour, excessively acrid, but possessing no volatility. On dissolving the residue, or rather mixing it with boiling water, the fluid becomes very pungent and acrid; and, when evaporated to dryness, leaves a residue, from which ether takes up a yellow orange-coloured oil. This is the acrid principle of Capsicum. The acrid principle of Capsicum, therefore, has the character of a fixed oil, but differs from it in being soluble in water: it is also very soluble in weak, cold alcohol, and in solution of potassa. It gradually acquires the consistence and appearance of wax when long exposed to the air and light. The residue, after this action of alcohol, is a gummy matter of a mawkish taste, combined with a red colouring principle; it has not the adhesiveness of gum, and approaches rather to the character of jelly than that of gum. According to the analysis of Braconnot, Capsicum consists of *fecula*, acrid fixed oil, a red waxy matter, a gummy matter, animalized matter, citrate of potassa, muriate and phosphate of potassa.

As a rubefacient, Capsicum is not much employed in England; but, in the West Indies, cataplasms of it are applied in the same manner as mustard cataplasms in this country; and it is preferable to mustard, from the less hazard of vesication that follows its use; and which, in low states of fever, when such cataplasms are employed to relieve coma and low delirium, is always inconvenient. Capsicum cataplasms have been used with advantage in sciatica and chronic rheumatism, when local stimulants are required. The tincture, evaporated to the consistence of a thin extract, and spread over the pained part, is even more useful than the cataplasm. Some individuals, troubled with cold feet, have derived benefit from wearing socks, dusted with cayenne pepper.

3. Flour of Mustard. *Sinapis Nigræ Farina.* L. E. D. —The acrimony of Mustard depends on an acrid oil, which remains in the marc after the bland oil has been expressed from the seeds. If flour of mustard be rubbed on the skin, or cataplasms, made with equal quantities of crumb of bread and flour of mustard, kneaded into a pultaceous paste with water, be applied to it, redness, pain, and inflammation, are induced. It is difficult, however, to regulate the mere rubefacient influence of Mustard: it very frequently excites vesication, and, in that case, may prove injurious. As a rubefacient, it is generally thought to be improved in activity when vinegar, instead of water, is used for making the cataplasm; but this depends greatly on the kind of Mustard employed. The flour of the brown Mustard, which often contains the husk of the seed, is injured by vinegar; whereas fine yellow Mustard, composed solely of the farina, is equally efficacious, whether water or vinegar be used for making

the sinapism: alcohol injures its powers. Recently ground flour of Mustard is more active than that which has been long kept. When sinapisms are applied to the skin, their first effect is heat on the part, which increases to burning of almost intolerable intensity, so that a patient cannot long support it: a sensation of general fulness, with throbbing of the temples, follow. The rubefacient effect is not equal to the intensity of the pain; and it seldom takes place until after the sinapism be removed, and the skin long remains of a deep crimson or purple hue. If the plaster be too long left on the place, vesication and even gangrene have been known to ensue: thence, in cases where the sensibility of the patient is low, sinapisms should not be allowed to remain on longer than an hour. They are valuable remedies when it is important to raise a quick and efficient counterirritant effect; and as no absorption takes place, they are less objectionable in cases of general inflammation than garlic. They are indicated in all cases of local determinations, and in low states of the vital functions, as in typhus fever.

b. VOLATILE OILS.

All volatile oils are local excitants, and may be employed as rubefacients; but two only are specially used as such.

1. OIL OF TURPENTINE. *Oleum Terebinthinæ.* L. E. D. —This oil may be employed either in its separate state or in combination in what is termed Burgundy pitch. This resinous substance is collected by wounding the bark of the Norway fir, and afterwards boiling the concreted juice in water and straining it through cloths in a press. It is only moderately rubefacient; thence its use is confined to cases where slight counterirritation is desirable; as in the coughs of children and of old people, when it is applied to the chest, spread on leather, as a plaster.

2. CAJUPUT OIL. *Cajuputi Oleum.* L. E. D.— This oil, diluted with an equal quantity of olive oil, is a useful Rubefacient in gout and rheumatism, and aids also in restoring vigour to joints weakened by sprains. It possesses, however, no particular advantages over any other volatile oil.

* * *Inorganic Substances.*

c. AMMONIA. L. E. D.—For rubefacient purposes, pure Ammonia is extricated from the decomposition of muriate of Ammonia by the mineral alkali contained in soap. A plaster is made by combining ʒi of soap with ʒii of common litharge plaster; and, when nearly cold, adding ʒi of muriate of Ammonia in fine powder. From this nearly a scruple of Ammonia in a pure state is slowly evolved and exerts its action on the skin at the moment of its extrication. Too much of the muriate should not be used, as the first action is less than that which fol-

lows, owing to the inflammation induced. If it be requisite to maintain the rubefacient effect, the plaster must be renewed as soon as the decomposition of the muriate is completed; but the quantity must be successively less in each plaster after the first. Where the quick influence of a rubefacient is required, as in attacks of violent spasm in the viscera of the thorax or the abdomen, or in gout in the stomach, and similar affections, this is a very useful form of rubefacient.

The solution of pure Ammonia, softened by being formed into a kind of soap with bland oil, is also a useful and very frequently employed rubefacient. It is one of those superficial excitants which extends its action to the general system, causing diaphoresis; a quality of great importance in many local inflammations when the strength will not admit of the employment of the lancet or much depletion. The proportions of the Ammonia and the oil may be equal; but some habits of little susceptibility require two parts of the Ammonia to one of the oil.

d. ACIDS. *Sulphuric Acid*, combined with ten times its weight of lard, forms a liniment which produces a rubefacient effect. The *strong Acetic Acid*, when diluted with an equal weight of water, reddens the skin, and may be employed as a rubefacient. But neither of these acids is much used for rubefacient purposes.

e. HOT WATER.—Moderate degrees of heat—namely, between 120° and 150°, especially in combination with water—act as rubefacients on the skin. Poultices and fomentations, therefore, are often successful in removing, by counterirritation, slight internal inflammations. A rubefacient property, joined to the pediluvium, by augmenting its temperature, aids greatly its derivative influence. Fomentations also, when used very hot, relieve spasmodic affections: and this can be referred only to their rubefacient influence.

B. SUBSTANCES WHICH OPERATE AS VESICANTS, AND WHICH, PROPERLY DILUTED, MAY BE EMPLOYED AS RUBEFACIENTS.

* *Organic Products.*

Animal.

a. CANTHARIDINE.—This substance is the active principle of the Spanish fly, or blister beetle, Cantharis *officinalis;* of the Potato fly, Cantharis *vittata*, employed as a vesicant in America; of Meloe *niger*, and the Mylabris *variabilis*. The latter is a Coleopterous insect, lately introduced from China, as a vesicating agent, which seems to possess in an eminent degree all the vesicant properties of the blister beetle. The Meloe *niger* although it has the advantage of not causing strangury, yet has not been employed as a vesicatory in this country: it has

not been determined whether its active principle is Cantharidine.

The Emplastrum Cantharidis of the Pharmacopœias, the substance commonly applied for producing a blister in this country, has some disadvantages attending its employment. It consists of one part of finely powdered Cantharides, blended with one or two parts of wax plaster. In the first place, the formation of the plaster by heat injures the activity of the Cantharides; in the second place, there is great waste, as only those particles of the powdered insect which are upon the surface are of use. It would, therefore, be much better were some kind of semi-adhesive paste contrived for forming the basis of the plaster, upon which the powdered Cantharides could be sprinkled before applying the plaster to the skin. Were Cantharidine easily prepared, the most certain blister would be a solution of that substance in oil; but the tediousness of the process, and the smallness of the product, render it impossible to employ it for ordinary purposes. The plaster of Cantharides causes, first, a sensation of heat and pricking in the part, attended with some general excitement and increased quickness of the pulse: if it remain on a sufficient space of time—namely, from six to ten hours—the cuticle is raised, and betwixt it and the true skin a yellowish serum is deposited. Sometimes fresh blisters continue to rise round the first blister after the plaster has been removed. Both the degree of excitement, and the character of the effused serum, and its quantity, are greatly modified by circumstances connected with the general habits of individuals and the disease for which the blister is applied. In many persons, the acrid principle of the insect is carried into the circulation and produces strangury; especially when the blister is applied to the scalp. In this case, the hair should be removed some hours before applying the blister, if the necessity of the case admit of delay. The usual time for permitting a blistering plaster to remain applied is ten or twelve hours, when it is usual to puncture the blister, and, after discharging the fluid, again to apply the plaster. This practice is to be reprobated, inasmuch as it does not answer any beneficial purpose, and it favours the absorption of the Cantharidine and the consequent production of strangury. As soon as a blister has risen, it ought to be removed, and the fluid discharged. In children, in particular, this rule should always be attended to; as, owing to great irritability of skin, they are not only more easily blistered than adults, but, when the blistering plaster is permitted to remain too long applied, spreading, irritable, sometimes gangrenous ulcers are apt to supervene. When this happens, the strength of the patient must be sustained by bark, or other tonics, the irritability of the part soothed by poultices made with a strong decoction of poppies, and every method

which can change the irritable state of the habit into one of tone must be adopted.

Blisters, by whatever means raised, should be applied as near as possible to the affected part. They should also be as large as the nature of the part will permit; large blisters causing no more pain than small. In every instance, the plaster should be kept in close contact with the skin by a few strips of adhesive plaster or a bandage; nevertheless, the pressure ought not to be so great as to restrain the inflammation of the capillaries and prevent vesication. Strangury is best prevented by interposing something between the blistering plaster and the skin. Gauze, or muslin, or thin paper moistened with oil, pressed down upon the blistering plaster, answers the purpose effectually, and does not prevent vesication, and enables the plaster to be removed in a more cleanly manner. When the tendency to strangury is great, the blistering plaster ought not to remain on longer than necessary to effect vesication, which takes place generally at the distance of eight hours, even if the blister have been removed two hours before, and no vesication be then present. When strangury occurs, it is allayed by diluting freely, and introducing a pill containing a few grains of opium within the retum, or throwing into the gut a pint of warm water containg from thirty to fifty minims of the tincture of opium.

* * *Vegetable Substances.*

b. Acrid Oil.—This is the active vesicating agent in the following vegetable substances.

1. Crowsfoot Ranunculus, Ranunculus *acris.* D.—Water Crowsfoot, Ranunculus *Sceleratus.* D.—Both of these species of Ranunculus possess powerful vesicant properties. The first of them, the Ranunculus *acris**, or upright Meadow Crowsfoot, is an indigenous plant, belonging to the natural order Ranunculaceæ. It is a common weed in the pastures, flowering in June and July. The root is creeping and horizontal, with numerous fibrils on the under surface: the stem rises erect, to the height of two feet, branching into dichotomous or forked divisions, for supporting the flowers. The leaves spring from the root upon long petioles; are deeply divided into three divisions, and these are again subdivided. The flowers are yellow, large, terminal, supported on villous, petiolated footstalks; the calyx is spreading and hairy, and the nectary covered with an emarginate scale. The leaves of this plant, when bruised and applied to the skin, rapidly inflame and blister.

The Ranunculus *sceleratus* and R. *flammula* are still more

* Woodville's Med. Bot. 3rd. edition p. 482, pl. 179. London Dispensatory, art. Ranunculus.

acrid plants than the *acris*. They are aquatic plants, with hollow, branching stems, supporting leaves less divided than those of the *acris*. The flowers are yellow, numerous, small; and the fruit is a small cylindrical capital. All the parts of the plants are arcrid; but the flowers and seed-vessels are most so just before they are ripe. The only disadvantage attending the employment of these plants as vesicants, is, that they lose much of their acrimony when dried.

2. FLOUR OF MUSTARD. *Sinapis Nigræ Seminum farina.*—When a large proportion of Flour of Mustard is combined with a small proportion of crumb of bread and water, it quickly produces vesication, and proves useful in all cases that require an immediate counterstimulant influence. It possesses no advantage over cantharides; and it has one disadvantage, that the sores caused by it are difficult to heal.

** *Inorganic Substances.*

c. AMMONIA.—When a piece of bibulous paper is soaked in strong solution of Ammonia, and applied upon the skin, it instantly raises a blister, thence it is employed in spasms and sudden attacks of inflammation of the thoracic or abdominal cavities.

d. NITRATE OF SILVER *Argenti Nitras.* L. E. D.—Although this substance is, strictly speaking, a chemical escharotic, yet it is also a vesicant when properly applied. For this purpose, the portion of the skin to be blistered is moistened, and a piece of the Nitrate passed lightly over it, first across and then in the opposite direction, so that the whole of the moistened surface may feel the influence of the caustic, but not to an extent sufficient to produce an ulcer. In three or four hours a blister rises, the fluid of which is pus; and this being discharged by a puncture at the most depending part, no dressing is required. The advantage of this method of blistering over that by cantharides is the facility of the application, the rapidity with which the effect is produced, and the complete absence of general excitement, as no absorption of any kind takes place. It operates as a simple counterirritant, and can be quickly repeated so as to renew and maintain the impression. I have found it admirably adapted in pulmonary affections attended with much febrile excitement. Twenty of these blisters may be made over the surface of the thorax, in as many days, with the best effects. It is equally useful in diseases of the joints and deep-seated pains. The only caution required is moderation in the application: when too much of the Nitrate is rubbed on the part, the pain is excruciating, and its influence on the vascular system is sufficient to counteract any benefit which might result from its contrastimulant property.

e. AQUEOUS STEAM.—Water cannot convey caloric to act

as a stimulant under a temperature of 98°; but it is not until it arrives at 180° that it is rubefacient; and at 212° its vesicating property is instantaneously exerted. This effect is not altogether local, as demonstrated in scalds: it rouses generally the vascular system, quickening the pulse and producing febrile excitement. From the instantaneous manner in which the vesication is produced, the application of Steam might be very useful as a vesicant if it could be conveniently applied. Various modes of applying water in the form of Steam have been suggested. The theory of its operation is evident. By the sudden conversion of Steam into water, much caloric is extricated. Water, when heated, expands like other bodies: this is moderate till the temperature be 212°, when the expansion is prodigious; but the Steam thus formed does not acquire any higher temperature than 212°; the additional caloric being rendered latent, and required for maintaining its gaseous form. In returning, therefore, to the fluid state, all this caloric again becomes free or insensible, and, by the law which regulates caloric, it must pass into the surrounding bodies. It has been calculated that 1000° of caloric enter water to convert it into Steam and maintain it in that state: thence the whole of this must be given when water passes from the gaseous to the liquid state: and thus we have a vesicant power. One difficulty, however, attends the application of Steam, namely, that of limiting its action. Could it be applied by guarding every part around that which is to be blistered, by substances which do not rapidly absorb caloric, all the advantages of vesication would be procured. Gout in the stomach, spasm, acute inflammation of the heart and pleura costalis, and, in fact, every deep-seated pain, might be benefited by its employment.

f. HEATED METAL.—This method of blistering was proposed by Sir Anthony Carlisle. It consists in applying a piece of polished metal heated in boiling water; it possesses one advantage over blistering by steam—that its influence can be limited, and that it is altogether more manageable. Any piece of polished metal, not too large, and sufficiently thick to retain the heat for a few seconds, will answer the purpose.

C. SUBSTANCES WHICH OPERATE AS SUPPURATIVES.

* *Organic Products.*

a. ACRID OIL.

Acrid Oil forms the active principle of the following substances:

1. BULB OF THE WHITE LILY. *Lilii albi bulbus.*—The beautiful plant which bears this bulb, although a native of the East, is now naturalized to this climate, and forms one of the most splendid ornaments of our gardens. It belongs to the

natural order Liliaceæ*. The bulb consists of thick, fleshy, imbricated scales, which contain, in combination with much mucilage and starch, an acrid, volatile oil, on which its suppurative properties depend. The bruised bulb, macerated in fixed oil or in alcohol, yields up its oil to these vehicles, which, applied to the skin, bring out a crop of pustules. It is now very rarely used.

2. Inner bark of the Mezereon. *Mezerei Daphnis et Gnidii cortex.*—These two barks, under the name of garou, have been, for many years, employed in France for maintaining the discharge from issues. It is in common use with the peasants of the Pays d'Aunis, and was made known to the profession by Dr. Le Roy in 1767. The peasants, from whom Le Roy borrowed this mode of using the Daphne, employed it as a vesicant, applying the soaked bark on the sound skin, covering it with an ivy leaf, and renewing the application once in twenty-four hours. All the species of Daphne possess the same acrid inner bark, and are indiscriminately used for yielding the garou. It is prepared by soaking the branches in water and vinegar, raising the bark and separating the inner from the exterior layer. When dried and fit to be used, it has a fibrous texture, is of a pale green colour, has a faint, unpleasant odour, and a corrosive, acrid taste.

This acrid principle of the bark of Daphne is an alkaloid, which Vauquelin discovered, and which is known under the name of Daphnina.

The bark of the Mezereon has been employed as an Epispastic, from time immemorial, in some parts of the Continent. If a small portion of the prepared inner bark be soaked in vinegar and applied closely to the skin, it first reddens and inflames it, and, by repeating the application, a superficial suppurating sore or ulcer is slowly produced. It affects, however, the cuticle only, and does not form a deep ulceration or positive wound, although the discharge be considerable: the redness is, in extent, limited by the size of the covering, whether this be an ivy leaf or a portion of oiled silk, which answers very well. Sometimes small phlegmons surround the ulcer thus made, and induce an almost insupportable itching; but this inconvenience is easily obviated by the application of a pledget of cold water over the part. A pommade or ointment of the expressed juice of the bark of the Daphne is also made for the purpose of dressing issues, and it is much preferable to the savine or any other ointment. It has one great advantage in particular over the savine ointment—it may be kept for any length of time without

* Woodville's Med. Bot. third edit. p. 743, pl. 254. Richard, Hist. Nat. Med. tome i, page 350.

losing its effects. I am astonished that it has not been introduced into the British Pharmacopœias.

3. Savine Ointment. *Ceratum Sabinæ.* L. D.—This ointment is prepared from the Juniperus Sabinæ. (See Emmenagogues.) It is a common agent for maintaining the discharge from blistered surfaces. The acrimony of the Savine depends on an acrid, volatile oil, which is much injured by boiling it with the lard, the usual mode of preparing the ointment: indeed, so delicate is this plant, as far as regards its acrimony, that even the powder of the dried leaves is much less active than the bruised fresh leaves. The powder is employed on the Continent as an escharotic for destroying excrescences and cicatrizing syphilitic ulcers; but, although these are the expressions of the French physicians, yet I cannot see any advantage that can result from the cicatrization of a venereal sore as long as the habit remains infected; and, when that ceases to be the case, the sore will heal without any difficulty. When the Savine Ointment is good and well prepared, it has a lively green colour and the peculiar odour of the fresh plant. During its employment for maintaining the discharge of issues, it is requisite to remove, once in three or four days, a whitish coating which forms on the surface of the sore, and which impedes the influence of the ointment when it is not removed.

b. Oleo-resins.

These operate as local excitants, causing deep-seated and most active phlegmonous inflammation, similar to those suppuratives which have been last noticed.

1. Burgundy Pitch. *Pix Abietina.* L. *Pix Burgundica.* E. D.—This is an exudation from the Spruce Fir, Pinus *abies*, obtained by making incisions through the bark down to the wood. It flows thick and languidly, and concretes in flakes at the bottom of the incisions, adhering so firmly as to require to be separated by force. These flakes, after being melted by boiling in water, are strained through cloths. Burgundy Pitch, thus obtained, has a terebinthinate taste and odour, is brittle, opaque, and of a light-fawn or reddish-yellow colour. It is softened by a moderate heat, and is very tenacious. As a suppurative, its influence is slight; it produces a pimply eruption, which yields a purulent exudation, and causes much itching. Its chief excellence consists in its adhesiveness, which enables it to remain attached, and thus to maintain, for a considerable time, a moderately counterirritant effect. It has been found useful in chronic catarrh and dyspnœa.

Burgundy Pitch forms the bases of several compound suppurative plasters, the most useful and effective of which is the warm plaster, *Emplastrum calefaciens* of the Dublin Pharma-

copœia, which owes its greater activity to the addition of one part of plaster of cantharides to seven parts of the plaster of Burgundy Pitch. In some habits, it blisters; but, in these, this inconvenience is easily remedied by lessening the proportion of the blistering plaster. I have found it serviceable in those cases of dyspepsia which are connected with a state of subacute inflammation of the stomach. On account of the cantharides which it contains, strangury sometimes follows its use; thence it is contraindicated in cases of general excitement.

2. Compound Galbanum Plaster. *Emplastrum Galbani compositum.* L. *Emplastrum Galbani.* D. *Emplastrum Gummosum.* E.—All these plasters differ in their components; but all of them contain Galbanum, on the excitant influence of which their suppurative powers depend. They do not produce the same pustular eruption as the Burgundy pitch plasters; but their influence seems to extend deeper, and to stimulate the larger superficial vessels. They are generally employed to accelerate the suppuration of indolent scrofulous and encysted tumours, and also to impart action to the indurations which often remain around abscesses after they are discharged.

3. Ammoniacum. L. E. D.—This gum-resin, when dissolved in vinegar and the solution inspissated by heat, forms an excellent suppurative plaster, which does not produce pustules on the surface, but, like galbanum, stimulates deeply, and consequently aids the suppurative process in indolent swellings. In many instances, instead of forwarding suppuration, it favours resolution: thence, in combination with mercury, it is successfully employed to discuss indurated glands, nodes, tophi, and indolent tumours.

* * *Inorganic Substances.*

c. Acids.—When the mineral acids are combined with a moderate quantity of lard, the mixture operates as a suppurative, causing successive crops of pustules to appear on the skin.

d. Tartar Emetic. *Tartras Antimonii et Potassæ.* L. E. D.—When a strong solution of Tartar Emetic, or an ointment containing it in the form of fine powder, or a plaster sprinkled over with its powder, is applied to the skin, a vivid inflammation gradually succeeds, and a thick crop of large pustules rises upon the spot: these suppurate freely, and terminate in crusts. In producing these effects, Tartar Emetic exerts no corroding influence on the cuticle; and consequently it is more or less effective according to the condition of the skin at the time of its application, and the mode of applying it. It has been judiciously recommended to excite the part before applying the Tartar Emetic, "either by friction with warm flannel, or a flesh brush, or by some stimulating application of a penetrating quality, such as camphorated spirit or strong vinegar." The sensibility of the

skin being thus augmented, the Tartar Emetic, if immediately applied, instead of requiring two or three days to produce some large and scattered pustules, is often followed, in the course of a few hours, with a thick crop of pustules, differing in size according to the strength of the application. If the ointment be employed, the best proportions are two drachms of Tartar Emetic in fine powder, one drachm of lump sugar, also in powder, and six drachms of simple ointment. The manner in which the ointment is applied varies much its effect: thus, if the part be merely smeared with it, little more than a rubefacient effect is produced; if slight friction be employed, distinct pustules will follow; and if the friction be continued for fifteen or twenty minutes and be pretty brisk, the speedy formation of a full crop of confluent pustules will be the result. If, instead of using the ointment, a solution of Tartar Emetic be preferred, the skin should be first rubbed with a piece of flannel, and then the solution applied as hot as it can be borne. The pustules are thus rapidly produced: they are small and numerous, and speedily heal, leaving no traces behind them; so that this method of applying Tartar Emetic is peculiarly adapted for females. If the powder of the Tartar Emetic be sprinkled on the common wax plaster, the result is much less certain than either of the methods of using it just described. In some instances, no effect whatever is produced; whilst in others a severe ulcerated surface is exposed on removing the plaster; and the pain attending it is often more than sufficient to counteract the intention of the suppuration by the excitement which is induced. By proper management of the ointment, a full pustular eruption may be almost always procured in five or six hours; and as its counterirritant influence is equal to that of a blister, it is preferable to other suppuratives in many cases of deep-seated inflammations. The manner in which Tartar Emetic produces this effect is not well understood; neither can any satisfactory reason be given for its not stimulating equally the whole of the surface to which it is applied. It has occurred to me that the cuticle may be partially abraded by the friction applied either before or at the same time as the ointment, and the extreme vessels be thus affected in spots. One argument against this opinion might be brought forward—that the application of the solution of Tartar Emetic, if sufficiently strong, produces the same effect. Even in this case, however, the preparation partially affects the larger branches of the capillaries, and there the pustules may chiefly appear. I offer this opinion, however, as a mere hypothesis.

The application of Tartar Emetic as a suppurative, although not invented by Dr. Jenner, yet was introduced to the profession by that distinguished physician. It is now very generally employed as a counterirritant in all deep-seated pains and inflammations; and particularly in pulmonary inflammation. It does

not always readily produce its pustular effect; owing to the greater density and less sensibility of the cuticle in some persons than in others. Suppurative inflammation, thus excited, is a more permanent mode of producing counterirritation than blistering; and it may be employed with less hesitation than blistering by cantharides, as no absorption into the system takes place. Some inconveniences are said to arise from the employment of Tartar Emetic as a suppurative—for instance, if it be taken into the habit, it produces sickness, particularly when applied to children. Dr. Griffith, an American physician, published a case, in which he states that the Tartar Emetic ointment caused salivation; and Dr. Jackson, another American physician, has met with similar instances. With regard to the power of the Tartar Emetic ointment to produce sickness, I cannot deny the possibility of the case; but, in a very extensive use of this ointment, I have never met with such results. Some inconvenience, if the habit of the patient be very irritable, may result from continuing the application of this ointment after the pustules are fully formed. Ulceration takes place, and occasionally sloughing. If the application be continued after ulceration has supervened, symptoms resembling those that occur when arsenic is applied to an ulcer—coma, feeble pulse, and paralysis—are apt to shew themselves. It also occasionally excites an irritation, sometimes very severe, of the genital organs. Tonelli, an Italian physician, formed an hypothesis that, independent of its irritant property, this ointment induces a specific effect on the lungs, owing to its abstraction of oxygen from the blood. It is unnecessary to make any comment on so visionary an opinion.

* * * *Mechanical Means.*

e. ISSUES.—Any substance, calculated to cause mechanical irritation when introduced into a wound, is sufficient to form an Issue. The wound may be made by the knife of the surgeon, or by the application of potassa fusa or nitrate of silver upon the skin: thence these are the means most frequently employed. In the application of Potassa, it is necessary to limit its effect by defending the adjacent parts by a piece of adhesive plaster with an aperture in it, over which the caustic is placed. When the eschar has separated, either the Curaçoa orange, Aurantium *Curassaventium*, or the common dried pea, or a small portion of mezereon bark, is the usual mechanical irritant introduced to maintain the discharge.

f. SETONS.—The lancet-bladed needle, threaded with a skein of silk, or the bistoury of the surgeon, is the agent for forming Setons. A portion of the skin is pinched up, and the instrument passed through it. If a skein of silk be not used, a tape of caoutchouc, or a stripe of sheet lead may be introduced through the wound; and, by shifting these daily, and occasionally

smearing them with a little resin or savine ointment, the wound may be kept open and a discharge induced. The inflammation, at first, is often so considerable as to require to be moderated by the application of a poultice.

Issues and Setons, by exciting inflammation, attract a large supply of blood to the surface; and, as they also constitute drains, they are well adapted for relieving deep-seated inflammations and inordinate determinations of blood to internal organs. They prove occasionally salutary in apoplexy, palsy, and similar affections; and, by their evacuant property, prevent injurious results from the drying up of old ulcers, or the repulsion of chronic cutaneous eruptions. On this account, Issues or Setons which have been long open should not be hastily dried up: they should be gradually diminished in size and depth, and, at the same time, a moderate contrastimulant effect maintained by means of purgatives.

D. SUBSTANCES WHICH OPERATE AS ACTUAL CAUTERANTS.

Actual Cauterants comprehend all substances employed to cause disorganization of the part for the purposes of counter-irritation. Many substances may be used with this intention; but I will confine myself to those most frequently employed. I may preface my account of these with a few general remarks.

By the term actual cauterization, in contradistinction to potential cauterization, is meant the application of free caloric to a limited portion of the surface of the body. Potential Cauterants operate as chemical agents, destroying the life of the part by combining with its elements, and leaving the dead part to be slowly thrown off from the body by the vital powers of the surrounding parts. When *Actual Cauterants* are employed, the action of the caloric is confined to a limited portion of the body, as far as its destructive influence is exerted; and, beyond that, its stimulant influence rapidly rouses the energy of the surrounding parts to throw off the eschar, instead of paralyzing them, as is the case with the potential cautery: the sloughing, therefore, takes place much sooner than when the potential cautery is used. It is more beneficial than the potential cautery; and, were the application rendered less severe to the feelings of the patient, notwithstanding its formidable appearance, I am satisfied that it would be very generally adopted. The Actual Cauterants most frequently employed are — 1. *Moxa:* 2. *the white-hot Iron.*

1. Moxa is a remedy of Chinese origin, and consists of small masses of combustible materials, which are burnt in contact with the skin, so as to form an eschar, more or less deep as circumstances may require. The Moxa employed by the Chinese is a cottony substance obtained from the leaves of a plant of the

natural order Compositæ, the Artemisia *Sinensis*, a perennial under shrub, a native of China and Siberia. The leaves are about an inch long; the lower ones wedge-shaped and three-lobed, the superior lanceolate and obtuse, and all are tomentose. The flowers, which are borne on the summits of the twigs, are closely compacted in a simple roundish or ovate raceme; the calyx is lax and woolly. The plant is inodorous, and has a bitter, aromatic taste. For the purposes of preparing Moxa, it is cut in June, early in the morning, whilst it is yet wet with dew: it is then hung up to dry in the free air, in a shady place. The *Moxa* is prepared by beating the dried tops and leaves of the plant in a mortar, until they resemble coarse tow: they are then, in this state, rubbed between the hands till all the fibrous and membranous parts of the leaves and stalks are separated; and what remains resembles very fine cotton, which is rolled up in the form of little cones or pastiles. The Artemisia *Indica* and A. *vulgaris* are also prepared in a similar manner and for the same purposes in Japan and Java; and the Laplanders make Moxas of a fungous plant which grows in the fissures of old birch trees. As these *Moxas* cannot be readily procured in Europe, other materials have been employed for forming them, particularly by the French, who have used them more than almost any other nation. Baron Percy suggested to M. Robinet a method of forming them from the pith of the common Sunflower, Helianthus *annuus*, a substance which burns like touch-wood; and the majority of the French Moxas are formed of a cylinder of this substance rolled in a piece of cotton. They are made of various sizes, according to the fancy of the surgeon who is to use them. Some are hollow cones, and burn more rapidly and intensely than the solid cones: they are, therefore, employed when a deeper issue than usual is required. In this country, Moxas are most commonly formed of cotton which has been soaked in nitre; sometimes of lint or fine linen which has been soaked in a filtered solution of chlorate of potassa, as recommended by Mr. Wallace*.

When the Moxa is to be used in gout, it is placed over the seat of pain. If the disease be paralysis, it is applied first over the origin of the nerves which go to the diseased parts, and afterwards along the same nerves in different portions of their course. According to the size of the Moxa, the mode of using it, and the nature of the combustion, whether spontaneous or aided by the blow-pipe, it causes either little obvious injury of texture, or it produces vesication, or it forms an eschar. Employed with the first intention, the Moxa is not placed on the skin, but held in the forceps as close to the affected part as the patient can bear, and moved closely backwards and forwards

* Physiological Enquiry respecting the Action of Moxa, &c. &c.

until the combustion be finished. To produce vesication, it is held steadily as close as possible to the skin without touching it, until the skin appear white, which is the indication of the cuticle being separated and a blister raised. Neither of these methods can, strictly speaking, be regarded as cauterizing; but I have preferred mentioning them in this place rather than under the heads Rubefacients and Vesicants, to which they properly belong. To form a superficial eschar, the Moxa is placed on the skin, and allowed to remain until the spot near it appear brown, which generally occurs before the Moxa has burnt completely down to the skin. It is only for forming the deep eschar that the combustion is allowed to be completed. The radiation of the heat, in this case, inflames the skin to some distance; and it is found red and wrinkled around a black spot produced by the combustion of the Moxa. The eschar thus formed is deep; but it does not rapidly separate, sometimes requiring a fortnight for that purpose. The ulcer which is formed discharges pus abundantly, and, by the aid of peas, may be converted into an issue. When the intensity of heat is wished to be increased, the blow-pipe is employed, and the Moxa surrounded by a cylinder of card-paper, which both prevents it from being blown away, and also directs the current of heat downwards. If the pain after the operation be so intense as to be very uncomfortable to the patient, a few drops of ammonia, or some oil of turpentine, or alcohol, or ether, applied to the part by means of a hollow tube, will almost instantly moderate it. Baron Larry recommends this application of ammonia for allaying the pain, and remarks that it prevents inflammation—"the very effect," says Mr. Wallace, "which those who do not understand the application of Moxa are desirous of producing!" This gentleman maintains that, in the employment of Moxa, it should ever be our object to prevent inflammatory action. He conceives that the modus operandi of the Moxa is not the production of inflammation, but the application of a powerful stimulus to the capillary vessels, causing them to act with more force, to contract their diameters, and consequently to circulate their blood with more velocity, and, either by means of this action on the capillaries, or a direct influence on the lymphatics of the part, to excite the functions of the absorbent vessels. He therefore concludes "that the action of Moxa on deep-seated disease is precisely similar to that which is exerted by some of our most valuable agents on superficial disease."

Be this as it may, it is difficult to conceive upon what grounds Mr. Wallace can maintain that Moxas, under at least three forms of their application, do not produce inflammation; for we cannot conceive the application of caloric to a part of the body, for a sufficient length of time or with a sufficient intensity to produce disorganization, without inflammation being the result.

His hypothesis, however, explains the operation of Moxas when the texture of the skin is left undisturbed, by preventing the Moxa from touching the skin, and only moving it backwards and forwards over the part; but, when the disorganization of the skin is actually effected by the combustion of the Moxa, I cannot avoid referring its beneficial effects to the same law of counterirritation to which the operation of vesicants and other powerful Epispastics undoubtedly must be referred. The manner in which the caloric is communicated to the part in the burning of a Moxa causes it to penetrate deeply; thence it is well adapted to make an impression on deep-seated inflammation; but, on this account, it should not be applied on parts where there is cartilage, tendon, or bone, or near the surface.

2. WHITE-HOT IRON.—This application instantaneously destroys the life of the part, aud forms an eschar, which is rapidly thrown off. It is regarded as a barbarous operation, and has never come into general use in this country, although this opinion is more imaginary than real; for, when it is properly applied, so as to prevent the radiation from inflaming, to a great extent, the surrounding skin, it even excites less pain than a moxa.

Three circumstances require attention for performing the operation well and effectively:—1, the vicinity of the part to be cauterized should be covered; 2, the iron should be heated to whiteness; 3, it should be applied as quickly as possible, and pressed firmly upon the spot. With respect to the first rule, it is the radiation of the caloric from the white-hot iron which causes the pain attending its application, and which frequently produces vesication of the surrounding skin; the sound skin therefore should be guarded by being covered with folds of damp cartridge paper, having a hole cut large enough to admit the bulb of the iron to reach the skin. When this is done, little or no pain is experienced; the heat of the iron instantly destroying the vitality of the part to which it is applied. With respect to the second, the hotter the iron is, the sooner the life of the part is destroyed; and, with regard to the third, the only pain is in the approach of the hot iron to the skin, and therefore the quickness of the application must modify the pain.

The actual cautery was a remedy employed in the medicine of almost every rude nation of antiquity*; various substances being used as a media for communicating the caloric; as, for ex-

* The actual cautery appears to have been in use in England and Ireland in the thirteenth century; for we are informed that, after the defeat of Peter, Bishop of Winchester, the minister of Henry the Second, he took refuge in Ireland, whence the Lord Justices were ordered to send him "dead or alive" to England. "The compliant justices," says Sir James Mackintosh, "quickly caught the import of this alternative; and, after a long series of acts of falsehood and perfidy, caused him to be most cruelly murdered by a treacherous surgeon, who, being called to heal some of his old wounds, burnt or cauterized them so fiercely as to throw him into a raging fever, of which he died in great agony."

ample, iron, the burning nut of the olive, boiling oil, boiling water, burning sulphur, and melted lead; but the medium in most frequent use was the heated iron*. The Arabians employed it to relieve pains in any part of the body. The ancients applied it to strumous tumours, and also in cases of encysted tumours. Hippocrates recommends it in polypus of the nose and chronic pains of the head which cannot be relieved by bleeding. Hippocrates, in the sixth aphorism of his eighth book, says, "what medicine will not cure, iron will cure; and what iron will not cure, fire will cure; but what cannot be cured by fire is incurable."

The salutary influence of the White-hot Iron is often experienced before it has time to operate as a counterirritant; and yet it is not easy to conceive how it can act on any other principle. It undoubtedly produces a powerful effect on the nervous system; thence its sanative influence in spasmodic and convulsive affections. In diseases of the spine, and more especially of the spinal cord, I have seen more benefit derived from its use than from any other counterirritant; and, in cases of fungous hæmatodes, the morbid growth may be kept at bay, and its progress checked by the repeated application of a small iron to the integuments over it. It has lately been more used than formerly in this country for the destruction of malignant tumours. It is better adapted for plethoric than emaciated habits; for adults, than children.

THERAPEUTICAL USE OF EPISPASTICS.

In fevers of an intermittent character, blisters have been applied to disturb the regularity of the paroxysm, and thence to cure the disease. Were it easy to calculate the period at which a blister would produce its full operation, in every state of the habit, we might be induced to rely upon its influence for restoring the balance of the circulation, which is evidently deranged, in the cold stage of ague: this, however, cannot be done; and blisters are, therefore, seldom employed for the cure of intermittents. If the effect of the blister depend solely upon the local stimulus which it induces, then those substances, such as ammonia and boiling water or steam, which raise an instantaneous blister, might be advantageously employed; but, as I am inclined to think that more is to be attributed to the general excitement of the habit than to the local stimulus, blistering by cantharides is preferable; and this is too uncertain, in the acme of its action, to be relied upon in agues. If blisters be employed, they should be applied before the commencement of the paroxysm, that their influence may be fully felt, and the train of morbid associations,

* Imbert Delonne, Nouvelles Considerations sur le Cautère Actuel. Paris, 1812.

constituting the paroxysm be broken at its commencement. How much of the benefit is to be attributed to the pain of the blister arresting the attention of the patient, I cannot pretend to determine; but, as we know that intermittents are occasionally cured by the force of mental impressions, it is not unlikely that some of the benefit is due to the painful sensation excited by the rising of the blister. Upon the whole, however, I am of opinion that, in the range of remedies adapted for checking the paroxysm of intermittents, blisters are the least to be relied upon. Their employment in continued fever has been advocated and condemned by different writers of equal celebrity. If they are applied with the view of arresting the progress of the fever, the expectation of the practitioner will be disappointed: indeed, the irritation they produce is likely to increase the evil, if they be applied in the early stages of the disease, which are those of excitement. In the later stages of continued fever, however, when coma and delirium supervene, both sinapisms and other rubefacients, and blisters, may be prescribed with the fairest prospect of advantage. The delirium in fever is of two kinds: in one there is a preternatural or morbid determination of blood to the head; in the other there is that state which has been termed collapse, the pulse is weak, and the whole system debilitated. In both cases, blisters may prove beneficial: in the first case, they act as local stimulants, producing derivation or a transference of disease; in the other, they rouse the powers of the system by their general stimulant influence. When blisters are necessary for relieving coma, they should be applied to the shaved scalp: in very low states of the habit, however, rubefacients are to be preferred to blisters, as they are less likely to cause gangrene, and are nearly as beneficial in relieving local affections. In general, when rubefacients—for instance, mustard cataplasms—are employed in typhus mitior, they are applied to the feet—a relic of the old doctrine of revulsion; but, like other local means, their utility is in proportion to their vicinity to the part affected. This is particularly to be kept in remembrance in those affections of certain organs; such, for instance, as the lungs, indicated by cough and oppressed breathing, which too frequently require the closest attention of the physician towards the close of fevers. In all cases where the abstraction of blood is necessary, the application of a blister should be delayed until after the bleeding, when the excitement has been diminished.

If we regard particular kinds of continued fevers, we find that practitioners in tropical climates recommend, strongly, the application of blisters to the pit of the stomach in yellow fever, under the idea that the stomach is the chief seat of the disease, inducing a malignant gastritis. "A prompt application of a large blister over the region of this viscus," says Dr. Chapman, "is obviously indicated, and all experience confirms its utility."

The salutary influence of blisters applied to the head in the delirium of typhus is undoubted in those cases in which there is danger of the inflammatory action terminating in effusion. When the breathing is affected, it is more useful to apply them along the course of the spine; and in this case they should be of dimensions sufficient to stretch from the third cervical to the first lumbar vertebra. The best general rules for the application of blisters in continued fever are the following. 1. In that form of continued fever which is characterized by the early stages being inflammatory, they should be employed rather towards the conclusion than at the commencement of the disease: in typhus, on the contrary, rather at the beginning than at the close. 2. The evening is the best time for applying a blister, as it generally induces sleep when it begins to rise; and, were it applied during the day, the irritation which remains is likely to increase the evening exacerbation of the fever and prevent sleep. But, although these are the general rules, yet the practitioner must be guided by circumstances: thus, great determinations to particular parts and spasmodic affections require the use of blisters in the decline of the disease; whilst the same symptoms occurring in the commencement, being commonly connected with the general state of the system, are more effectually removed by general means.

In those symptomatic fevers in which there is a local inflammatory affection, the efficacy of blisters is undeniable. With regard to the proper time of applying them, as far as my own experience extends, I accord with those who think that they ought not to be employed until the general excitement has been reduced by blood-letting and evacuants. At a proper period of the disease—that is, after the first or second bleeding—the application of a blister will often render farther venæsection unnecessary; and, certainly, when this can be effected, it is of the greatest importance, as the strength of the patient, which is rapidly reduced by repeated venæsections, is kept up, and the period of convalescence consequently shortened.

It was the custom of Huxham, and others prior to him, to apply blisters at a distance from the affected part—a practice founded on the theory of revulsion: but subsequent experience has demonstrated that they should be applied as near to the seat of pain as possible. When the inflammation is superficial, it is preferable not to apply the blister directly over the inflamed part; for two reasons—first, because local bleeding may be requisite after the blister has been applied, and therefore the affected part should be left free; and, secondly, because it has been ascertained that a large blister, applied at a small distance, has the same effect as a smaller one applied nearer to or directly upon the inflamed spot.

In phrenitis, the accompanying delirium rises to an exalted

state: all stimulants become insupportable—light to the eyes, and sound to the ears. Tremors of the limbs, convulsions, coma, a sinking pulse, difficult deglutition and hiccup, occur, which are the forerunners of death. After the excitement has been reduced, it is usual to apply a blister over the shaved scalp. Now, although I would not attempt to impeach the propriety of this practice after due evacuation, yet it is necessary to repeat what I have already stated, that cantharides are not the proper vesicants in phrenitis. If a counterirritant be requisite, a mustard cataplasm, applied over the shoulders, or a suppurative, such as the tartar emetic ointment, or the actual cautery, when it can be applied, on the nape of the neck, or on the biceps humeri, will be found more advantageous than blistering by cantharides. To use the words of Dr. Burrows, speaking of the use of the tartarized antimony in mania—"'This application might judiciously supersede cantharides, since it produces all their good, and none of their bad effects."

In pneumonia, blisters are applied; and they are found not only to diminish the cough, pain, and difficulty of breathing, but, by a transference of the inflammatory action to the surface, to promote the expectoration. The period proper for the application of blisters in this disease must be carefully attended to: the hardness of the pulse should be reduced, as well as the other symptoms, indicative of actual inflammation, diminished, before they can be safely applied. Physicians of equal celebrity have differed as to the precise time for their application: Sir John Pringle generally ordered a blister to be applied after the first bleeding; this was also the practice of Cullen; but Heberden and later practitioners have delayed the application of the blister until after a second, sometimes even a third bleeding. At whatever period it is applied, it should be large, and placed exactly over the seat of pain. There is no necessity for allowing the blistering plaster to remain longer applied than is requisite for raising the blister; on the contrary, if cantharides be employed, disadvantages arise from the absorption of the cantharidine. The application of blisters in pneumonic affections may be repeated as long as the symptoms of the disease continue; but, when these are obstinate, and time is thus obtained, the action of suppuratives, such as tartarized antimony, is preferable to that of blistering. Some individuals, owing to a peculiar state of habit or idiosyncracy, cannot support the action of blisters of cantharides under any circumstances: in these the nitrate of silver is an excellent vesicant; or sinapisms and other rubefacients may be used. On these principles, our practice, as far as regards the employment of blisters in inflammatory affections of the chest, the fauces, the stomach, the alimentary canal, the liver, and the great intestines, should be regulated.

In ophthalmia, blisters are advantageously used after topical

blood-letting. They are usually applied either on the temples or behind the ears. In the chronic form of the disease, I know of no class of remedies so serviceable as issues in the nape of the neck, kept freely discharging until the inflammatory affection has completely subsided, and the eyes have remained apparently well for some weeks. Aristotle informs us that the physicians of his time cauterized those afflicted with ophthalmia on the temples. I feel strongly disposed to recommend cauterization behind the ears, or on the nape of the neck: for the radiation from the hot iron, when it is applied so near the eye as the temple, is, in my opinion, likely to injure that delicate organ.

In gout and rheumatism, the application of Epispastics, whether vesicants or rubefacients, is more problematical. "Blistering," Dr. Cullen remarks, "is a very effectual means of relieving and discussing a paroxysm of the gout, but has also frequently had the effect of rendering it retrocedent." I have little experience of the truth of this observation in gout, having scarcely ever ordered the application of Epispastics; but, in acute rheumatism, I have so frequently seen the most alarming translation of the inflammation to vital organs, that I cannot too strongly denounce their employment in this disease.

The use of Moxa was introduced into Europe as a local application in gout by the writings of Van Swieten; and to English practitioners more particularly by those of Sir William Temple, who had experienced the benefit of it in his own case. Free caloric, or the actual cautery, applied by the hot iron, was in common use among the Arabians for removing pains in various parts of the body. The Chinese, Japanese, and many Asiatic nations, also employed free caloric as a remedial agent; but the hot iron was never used among these people, if we credit Kœmpfer. It was with them that the use of Moxa originated; and, according to Kœmpfer, it was so freely employed that sometimes the whole course of the spine was excoriated. The inhabitants of Lapland and Sweden apply Moxas in all internal pains, without external inflammation. I confess my doubts are considerable as to the beneficial effects of Moxas in gout, notwithstanding the authority of Hippocrates, who ordered them to be applied on the node of the joint of the finger. I should be cautious of the employment of free caloric in gout, however extricated, on the same principle which induces caution in the application of blisters. If Moxas, however, be at all advisable in gout, they should be employed according to the first method—that is, moving them over the pained part, at a certain distance from the skin, so as to exert their stimulant action only on the capillary vessels and on the lymphatics of the inflamed part. There is no rule, however, without exceptions; and, in atonic gout, a blister, and even Moxas, suited to produce a slight eschar, instead of repelling the inflammatory part of the disease from

the extremities, tends to fix it there; and, consequently, becomes not only highly serviceable, but even indispensably necessary. In the same manner, blisters are admirably adapted for aiding the cure of chronic rheumatism: and in sciatica, which so frequently resists every other remedy, Moxas have been found of the most decisive benefit. This is, indeed, the usual method of treating this form of rheumatism in many parts of the Continent, particularly in Russia. The Moxas, however, are required to be so often repeated, that I have been induced to apply the actual cautery, and have found that it is followed by the most permanent relief. Dr. Paillard has used phosphorus instead of Moxa, both in chronic inflammation of the joints and in inflammation of the abdominal viscera. He places a piece, half the size of a small pea, on the skin, and applies a hot wire to it. It acts rapidly and effectually. Dr. Paillard has applied thirty at once on the ham in neuralgia.

From the effects of the absorption of the acrid principle of cantharides, on the bladder and urethra, we should, a priori, be disposed to avoid the employment of blisters, raised by their means, in nephritis, or inflammation of the kidneys; yet, experience has fully demonstrated that such fears are fallacious, and that blistering plasters of cantharides may be safely and efficaciously employed in this complaint. In strangury, indeed, the irritation seems to be confined to the bladder and the urethra: it is only when the pelvis of the kidney contains a calculus, or very coarse crystals of uric acid, that pain is felt in it. In one affection of the kidneys, that enlargement of the organ which is often the consequence of inflammation, Epispastics are of the utmost service. Upon the whole, blisters and other Epispastics are valuable remedies in the phlegmasiæ, with the exceptions which I have pointed out: but, at the same time, it must be admitted that symptoms in many cases may contraindicate their employment.

In eruptive fevers, blisters are less decidedly useful than in the phlegmasiæ. In distinct small-pox they are seldom required; and, except when local affections are present, nothing beneficial can be expected from them: on the contrary, when the excitement is high, they tend to increase the evil. It is after the commencement of the secondary fever that their aid may be required to recruit the strength and determine to the surface; and, when this is the case, or if local affections, such as cough, or pain in the right hypochondrium or the region of the liver, demand their application, they may be applied without any regard to the pustules with which the part is covered. One of the local affections which most unequivocally demand their employment is difficulty of breathing, arising from an unusual degree of swelling in the fauces, impeding deglutition. In such

a case, a large blister, applied as near to the affected part as possible, is a remedy upon which the utmost confidence may be placed. In confluent small-pox, when there is a sinking of the pustules, and of the swelling of the face, without these symptoms being followed by swelling of the hands, some writers, particularly Dr. Brocklesby, have judiciously recommended the application of blisters to the wrists and fore arms; and the same practitioner recommends blistering the wrists, when the salivation which attends this form of the small-pox suddenly ceases without any swelling of the hands supervening. On the contrary, when the swelling of the face and the neck is excessive, applying sinapisms to the lower extremities often relieves it. In both forms of the disease, if convulsions appear during the eruptive fever, blisters are proper; and if, during the eruption, the pulse becomes feeble, blisters are useful to assist the languid powers of the constitution. The symptoms, which in small-pox most decidedly demand the employment of blisters, are great anxiety at the precordia, coma, and delirium: under such circumstances, their use is unequivocally indicated, and they are employed with the greatest advantage.

In measles, blisters have been frequently applied to recall, as it were, the eruption, when it has suddenly disappeared; but it has been correctly remarked, that this depends on a state of the disease in which blisters cannot be beneficial. They are, however, of use in relieving the cough, and particularly when pain of the chest indicates the presence of local inflammation.

In erysipelas, when it assumes the malignant character, the advantage of blisters has been established by the testimony of amplest experience; and by many writers they have been recommended on the same principle in scarlet fever, when it assumes the typhoid type. I cannot affirm that my own experience has led me to place much confidence in their utility as a general stimulant in the low state of malignant scarlatina; although, as a topical application, when the throat is much affected, I have seen them successfully employed. In hæmorrhagic affections, which, at least in their active state, resemble the phlegmasiæ, blisters have been sometimes found useful, particularly in bleeding from the nose and in vomitings of blood. In the former, they are to be applied to the nape of the neck; in the latter, to the pit of the stomach; but in both it is always requisite that blood-letting should precede the application of the blister.

In dysentery, and some other affections which consist of fever with augmented alvine excretions, the use of blisters is occasionally indicated. In leucorrhœa, the morbid augmentation of the natural mucous secretion of the vagina is much diminished by their employment; and great advantage is derived from their application on the loins, over the pubis, and on the

groins. In gleet, nearly equal advantage has resulted from their employment—an effect which might be anticipated, from their known influence on the urinary organs.

In phthisis pulmonalis, few means are so powerful as blistering, or the application of counterirritants for relieving the cough and difficulty of breathing, and rendering the expectoration free. Vesication, indeed, has always been regarded as a remedy of general application in this complaint; the excitement, even at the commencement of phthisis, being seldom so great as to contraindicate their employment. It becomes, however, a question whether it is better to apply the plaster of cantharides, or nitrate of silver, or the tartar emetic ointment? I have had little experience of the effects of nitrate of silver; but what I have observed is altogether in its favour: the influence of the tartar emetic ointment is well known. Dr. Griffiths, an American, published a case in which it produced salivation; and Dr. Jackson, another American physician, met with a similar instance. If these statements can be relied upon, they confirm the opinion of its action upon the glandular system, from a partial absorption of the remedy; but this I doubt: its utility, as a counterirritant in tubercular phthisis is well known. It has one important advantage over vesicants and issues—it does not produce any considerable diminution of the strength; a circumstance which should be never lost sight of in prescribing for the relief of this formidable disease.

In nervous diseases, Epispastics, in every form, have been generally employed. In apoplexy, it is customary immediately after full bleeding, both general and local, to apply blisters on or as near the head as possible. Cullen supposed that their utility depends "on their taking off the hæmorrhagic tendency" within the head: I would say that, after blood-letting has removed the impulse of the blood from the arteries of the brain, and this has also been aided by purging, blisters contribute to restore the healthy state of the circulation in that important organ. In applying blisters, or employing other Epispastics with this view, I have found them more beneficial when applied to the nape of the neck than upon the head; and the choice of this place is farther useful by leaving the scalp free for the application of evaporating lotions; or, what is still more suddenly beneficial, the pouring a stream of cold water upon the vertex while the patient is in a sitting posture. When the patient is old and feeble, and the strength cannot be relied upon under much venæsection, the use of blisters may occasionally preclude the necessity of a repetition of the blood-letting. In that description of paralysis which Dr. Abercromby has so ably described as connected with a state of the brain, not apoplectic but *inflammatory*, the discharge produced by vesicants and issues is likely to prove more beneficial than in the ordinary

apoplectic cases, in which an immediate and powerful counter-irritant is required.

In dyspeptic affections, blisters are seldom resorted to; but, in my own practice, I have found both blisters and other Epispastics of the utmost benefit. The application of the emplastrum calefaciens, containing rather more cantharides than usual, or the tartar emetic ointment, is preferable to the ordinary blistering plaster for such cases; and I usually order them to be applied, after the abstraction of blood from the pit of the stomach, directly over the organ, a little towards the left side, so as to confine their operation as much as possible to the fundus of the stomach. I am of opinion that the cause of the acescent state of the contents of the stomach in dyspepsia is the hasty and consequently imperfect secretion of the gastric juice, owing to the very irritable state of the viscus. Now, alkaline remedies, administered to correct the acescent state of the stomach which always attends this complaint, do not benefit solely by their chemical union with the free acid in the stomach: it is necessary, therefore, that the dose should be sufficiently large not only to neutralize the free acid, but also to leave uncombined a portion to act upon the irritability of the coats of the stomach, and, by diminishing this, to obtain a better gastric juice, more slowly and naturally secreted. That alkalies operate in this manner I was led to believe from knowing that, in irritable states of the urethra, in which a bougie cannot be carried on to the bladder, on account of the spasm induced by passing it into the irritable canal, we can, almost always, instantly effect our purpose by dipping the point of the bougie in a little liquor potassæ. It is upon this principle also that hydrocyanic acid produces its beneficial results in dyspepsia. To aid the operation of these internal remedies, an active warm plaster, applied over the pit of the stomach, after topical bleeding by cupping, proves most salutary. As soon as the pustules are fairly formed by this plaster, which occurs within forty hours after its application, the flatulence and acidity are found to be much abated; and, by continuing the application, and at the same time persisting in the use of the internal remedies, and regulating the operation of the bowels, yet, carefully avoiding purging, the disease yields more readily than to any other means. In this case, the Epispastic operates entirely by the counterirritation which it induces overcoming, by its extent and degree, the irritation of the stomach.

In spasmodic affections blisters are more or less employed. In tetanus they have generally been regarded hurtful; but, if the view of the pathology of this affection, which I have been led to take from a close observation of its symptoms, be correct, I am satisfied that, although blisters from the action of cantharides may prove prejudicial, yet, Epispastics of another kind are the remedies most to be relied upon for relieving teta-

nus. When we consider that many of the leading symptoms of this affection closely resemble those of hydrophobia; that the respiratory muscles are equally affected; and that the most distressing symptom is the spasm which affects the diaphragm and mediastinum, occasioning the violent pain always felt at the lower point of the sternum, before the general rigidity and spasms occur—there is every reason for thinking that the motor tract of the spinal marrow is the principal seat of the diseased irritation. In hydrophobia, I am of opinion that the opposite column, or that giving off the nerves of sensation, is the part affected. Now, if this opinion be correct—and post-mortem examinations of the spinal marrow, both in tetanus and in hydrophobia, confirm the opinion—it must be obvious enough that a powerful counterirritant on the surface, along the course of the spine, will afford the most rational prospect of success in any attempt to cure this disease. Dr. Chapman mentions a case of tetanus which occurred nearly half a century since, in the hands of a West Indian surgeon, a Mr. Carter, which was effectually cured by the application of a strip of blistering plaster along the whole extent of the vertebral column; "and," Dr. Chapman adds, "this practice, I have heard, has been recently imitated, and with sufficient success to claim our attention." I may also quote Celsus in support of this practice: he says, speaking of the treatment of tetanus, when it is not relieved by cupping on the neck, "eadem aut ferramentis aut sinapi adurenda." In a very severe case of tetanus, I acted upon this theory, and applied dry cupping several times a day, along the course of the spine, in conjunction with calomel, purging, and opium, and succeeded in restoring my patient to health. This is one of the cases, in my opinion, in which moxas and white-hot iron would prove highly beneficial, if applied sufficiently extensively along the spine. How far the same practice might prove useful in hydrophobia, I will not pretend to determine: the excessive sensibility of the skin, in this formidable and hitherto uncured disease, would make me pause before applying moxas; but, if the radiation from the hot iron be properly guarded against by the method I have proposed, there is much reason for thinking that a salutary effect would result from its employment. In all cases of spasm depending on or connected with internal irritation, which is not of a mere mechanical nature, Epispastics are likely to prove useful adjuncts, if they cannot be regarded as the principal remedies.

I have already noticed the impropriety of employing blisters formed of cantharides in mania; but moxas are beneficial in this disease. The ancients were in the habit of applying the actual cautery, as we learn from Celsus, who says, in treating of disorders of the head, "candentibus ferramentis, ubi dolor est, ulcera excitare;" and Reverius states that he cured

mania by applying the hot iron to the coronal suture—a practice, however, which it is hazardous to follow. Suppuratives—as, for instance, the tartar emetic ointment—have been used to cause a derivation from the meninges of the brain to the surface; and, if we reflect upon the effect of the retrocession of cutaneous eruptions and their reappearance during cerebral diseases, we can readily imagine that the artifical formation of a crop of pustules upon the scalp will be likely to be followed by the best effects. In eighteen cases treated in this manner by Dr. Jenner, five were of insanity, and three hypochondriasis closely approaching to it: of these, three recovered their intellects in a few days. Dr. Burrows states that his practice with the same suppurative has not been so successful. In one case, however, when the habit was reduced to so low a state that there was an appearance of mortification of the extremities, a warm plaster, intermixed with tartarized antimony, was placed over the shaved scalp. The patient soon recovered, without the extremities sloughing. Dr. Burrows speaks less favourably of setons and issues, and remarks that it is probable "that, where they have been reported to have effected a cure, the malady has originated in metastasis, by the retrocession of some cutaneous eruption." "Whenever any of these causes," he adds, "are suspected of having influenced the mental disorder, a seton or issue should be introduced as near the head as convenient." He further adds, "Long-established setons and issues hastily dried up have caused many cerebral affections, and insanity among them."

It only remains to mention a few of the local diseases in which Epispastics, particularly free caloric, have proved useful: these are strumous tumours, bronchocele, buboes, mammary swellings, and enlargement of the testicles. Applied behind the ears, they are useful in deafness, in painful inflammations of the membranous linings of the ear, and in toothache. In acute and chronic inflammation of the joints, and in inflamed veins, their decisive utility has been well established. The importance, also, of the actual cautery, although it is very rarely employed, in fungus hæmatodes, or soft, bleeding cancer, is undoubted. A watchman, who had been a soldier, applied for my advice respecting a cauliflower fungus which had protruded under the lower edge of the right pectoralis major. It had been, six months before, extirpated by the knife at Chatham Military Hospital; but the hæmorrhage was so excessive that he nearly sunk under the operation, and soon afterwards he was discharged as incurable. On examination, I discovered that the tumour descended from the clavicle between the two pectoral muscles, and only penetrated the integuments below the major. There was also a moveable tumour in the axilla, which I removed. The white-hot iron was then applied to the whole

surface of the large tumour, which sloughed off; and in a short time the integuments healed over the part, and the man seemed completely recovered. In three months afterwards, however, a small tumour pushed up the muscle and integuments about two inches under the clavicle: the cautery was applied, and it disappeared: it again successively appeared, and was as often removed by the cautery: but the patient, having been told that he could be cured by milder means, neglected to come to the Dispensary (the Chelsea and Brompton), the tumour again enlarged to its utmost extent, and he died. On examining the body, no internal organ appeared affected; there was merely a small warty tumour on the pleura costalis.

Upon the whole, few remedies are of more importance or of more general use in the cure of diseases than Epispastics. Much judgment, however, is required in determining the circumstances of the habit, the period of the disease, and the situation in which they ought to be applied.

PART IV.

SECOND DIVISION.—CHEMICAL AGENTS.

UNDER the term *Chemical Agents* are comprehended those substances which influence the body or its contents by their chemical properties. In prefacing our examination of these, this question presents itself—What is the nature of chemical action? It may be defined—that action which is regulated by certain laws operating upon the ultimate particles of matter, and leading to the transmutation of bodies from one state to another, which phenomena depend on the attractions and repulsions exerted between these particles. The combinations which are the results of such affinities are constant and invariable, and may be predicted with certainty when the elements are placed under the same circumstances. Thus, if 54 parts or one equivalent of nitric acid and 47.15 or one equivalent of potassa be combined together, I can confidently predicate that nitrate of potassa will be the result; or, if chlorine with sulphuretted hydrogen gas be mixed, that muriatic acid will be formed and sulphur deposited. But, when chemical agents are brought under the influence of the living principle, the affinities which produce these results are either modified or altogether resisted. Substances come into contact in the living animal system without undergoing any change, which, the moment life ceases, yield to the ordinary laws of chemical action, and decompositions and recombinations take place which could not have occurred during life. Some substances, nevertheless, have so powerful an affinity for the components of animal matter as to overcome the resisting influence of the vital principle and effect new combinations with them. Others influence the body in a less direct manner by uniting chemically with substances which are acting morbidly upon the nervous system and changing healthy into diseased action. By their chemical union with these morbid matters, they form new compounds, which are either less active or which operate as sanitary agents. These are the substances comprehended under the term *Chemical Agents*. They exert their influence in three ways:—first, they affect the body directly and form new compounds with the constituents of its tissues; secondly, they affect it indirectly, combining, not with its organized tissues, but with the contents of the stomach, changing the properties of these; thirdly, they

combine with and neutralize matters contained in the atmosphere, which might, if left unaltered, produce injurious effects upon the animal frame. Chemical agents, therefore, in reference to their operation on the living system, may be divided into those which *act on the surface;* those which *act on the contents of the cavities;* and those which *change the state of the air:* the first comprehending *Escharotics;* the second *Antacids, Antalkalies,* and *Antilithics;* the third *Disinfectants,* or *Antiseptics.*

SECTION I.

CHEMICAL AGENTS WHICH ACT ON THE SURFACE OF THE BODY.

ESCHAROTICS.—MEDICAMENTA ESCHAROTICA*.

Syn. Erodentia.

ESCHAROTICS are "Substances which destroy the vitality of the part to which they are applied, and erode or decompose the animal solid." In effecting this, they combine chemically with the animal matter, destroying its organization and forming with it a soft pulp or species of eschar; or, if they do not directly combine with the animal matter, they break the old affinities, causing the elements of the solid to enter into new combinations; whence, as Dr. Murray remarks, their cohesion is subverted and their composition is changed. In whatever manner this is effected, the life of the part is destroyed. The principal difference between the substances arranged under this order of remedies is in the intensity of their action. Those which operate most powerfully, destroying the life of the part under all circumstances, may be arranged under the head *potential Cauterants;* those which act with less energy, and are chiefly employed to destroy diseased and fungous growths, under that of *Erodents.* Both may be employed with the same object in view, as far as regards their power of generally affecting the habit as counterirritants; but it is the first only, the *potential Cauteries,* that are usually preferred for this purpose; the second are generally employed to effect the destruction of fungous growths.

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* From ἐσχάρα, an *eschar.*

TABLE OF ESCHAROTICS.

A. SUBSTANCES WHICH OPERAPE AS POTENTIAL CAUTERANTS.

a.—MINERAL ACIDS (*Oxygen with simple radicals*).

Sulphuric Acid.	*Acidum Sulphuricum.*
Nitric Acid.	*Acidum Nitricum.*
Arsenious Acid.	*Acidum Arsenosum.*

b.—ALKALIES (*Oxygen with metallic bases*).

Potassa.	*Potassa.*
Lime.	*Calx.*
Potassa with Lime.	*Potassa cum Calcè.*

c.—METALLIC SALTS.

Nitrate of Silver.	*Argenti Nitras.*
Muriate of Antimony.	*Antimonii Murias.*

B. SUBSTANCES WHICH OPERATE AS ERODENTS.

* *Organic Products.*

a.—ACETIC ACID.	*Aceticum acidum.*
b.—REFINED SUGAR.	*Saccharum album.*

* * *Inorganic Substances.*

c.—SALTS.

Burnt Alum.	*Alumen exsiccatum.*
Sulphate of Copper.	*Cupri Sulphas.*
Nitrate of Silver.	*Argenti Nitras.*

A. POTENTIAL CAUTERIES.

a. MINERAL ACIDS.

All the mineral acids, in a concentrated state, char and dissolve dead animal matter. This depends partly on their attraction for some of the components of the animal fibre; partly on the partial decomposition of the acid itself—the animal fibre having a greater attraction for oxygen than the bases of some of these acids; thence the animal tissues are oxidized and acquire new properties, forming compounds which are dissolved in the undecomposed portion of the acid.

1. SULPHURIC ACID. *Acidum Sulphuricum.* L. E. D.—This acid has a most powerful affinity for water, and chars rapidly dead animal matter which is brought in contact with it, decomposing it, and undergoing decomposition. When the strong acid is applied to the living body, the vital energy is not suffi-

cient to resist the attraction of the acid for moisture, and a soapy feeling is first experienced; but, in a very short time, as soon as the cuticle is dissolved, and the acid begins to act on the nerves, acute pain is experienced, the life of the part is destroyed, and it becomes charred in the same manner as dead animal matter. As far as the action of the acid extends, until it becomes greatly diluted by distance from the point of application, this change in the structure of the part takes place; but there is no definite limit between the dead and the living parts, as when the actual cautery is employed: an intermediate space exists, on which the action of the acid has not been sufficient to destroy vitality, but, nevertheless, has greatly weakened it; and thence a long period elapses before the slough is thrown off. This is one of the disadvantages of employing Sulphuric Acid as an Escharotic; but greater inconvenience arises from its fluidity, and the impossibility of limiting its action to a particular spot. In consequence of these disadvantages attending its action, Sulphuric Acid is very seldom employed for the purpose of establishing an issue; but it is sometimes used for touching the surface of ulcers that have taken on an unhealthy action, with the view of inducing a change, and bringing back the ulcerated surface to the condition of a healthy, simple sore.

2. NITRIC ACID. *Acidum Nitricum.*—This acid acts with more energy than the sulphuric on the dead animal fibre; it decomposes it rapidly, and is itself decomposed; nitric oxide and nitrous acid vapours being freely disengaged*. Applied to the living surface, it quickly destroys vitality; but the sphere of its action is less extensive than even that of sulphuric acid; probably, in some degree, owing to its having less affinity for water than the sulphuric acid. It is never applied as an Escharotic to form an issue; but it has been advantageously employed in sloughing, phagedenic ulcers. When it is to be used, the surface of the ulcer must be well cleaned and dried; and, after applying a thick coating of lard to protect the surrounding sound skin, the whole surface of the sore must be touched with the acid by means of a sponge, moistened with it, and pressed firmly down upon every part: in the course of a few hours the sloughs which are formed are thrown off, and the sore assumes a more healthy aspect.

3. ARSENIOUS ACID. *Acidum Arsenosum.*—This Acid has been more employed as an Escharotic than either of the two mineral acids just noticed. It was first introduced into use for the cure of cancer; and various curious methods were adopted

* When equal weights of muscle and nitric acid are heated together till the fluid boils, nitrogen and carbonic acid are evolved in a gaseous state, and the muscular fibre is partially converted into a fatty matter: and if skin, instead of muscular fibre, be employed, it is converted into fat and oxalic acid, whilst nitrogen and hydrocyanic acid are given over in a gaseous state.

to obtund the violence of its action. Thus, Bayle recommends that it should be dulcified, as he terms the process of rendering it milder, by boiling alcohol over it several times. It was also applied mixed with sulphur and the powdered leaves of meadow crowsfoot, the Ranunculus *acris*, and dog's fennel, formed into a paste with yolk of egg, which was spread over the surface of the cancerous sore, and covered with a piece of bladder; in twenty-four hours a slough formed, and, the coverings being removed and the part poulticed, this was thrown off, and suppuration promoted. It has also been applied as an Escharotic in the form of ointment and solution. In the latter form it has been frequently employed, in the proportion of ten grains to an ounce of water; which is not, correctly speaking, a solution, but rather a mixture of the minutely divided acid in water. This is applied to the surface of the sore by means of a pencil. In treating of Arsenic as a tonic, the hazard arising from its application to the surface of a sore was hinted: it is as dangerous as when it is taken into the stomach; vomiting and violent purging being induced, and fatal consequences resulting. When death has ensued, the stomach and intestines have been found extensively inflamed, demonstrating the absorption of the Arsenious Acid into the system and its peculiar determination to these viscera. Such facts are sufficient to demonstrate the impropriety of rashly applying Arsenious Acid to external wounds; and, when it is employed, the necessity for watching very closely its effects. It at all times causes violent, lancinating pains; so that no external indication of its injurious effects is afforded by that means. The moment it produces any nausea, or affects the breathing, then the external employment of it should be suspended. Notwithstanding these effects, occasionally recurring, Arsenic has been advantageously employed as an Escharotic in scirrhus and cancer. It destroys the diseased surface, and, after the sloughs are thrown off, changes the morbid action of the vessels of the part, causing them to secrete a healthy pus, and thereby promoting the healing of the wound. If poisonous effects are produced by it, the same plan of treatment must be adopted as if the remedy had been swallowed by the mouth.

b. ALKALIES.

The Alkalies are much more frequently employed as Escharotics than the Acids.

1. POTASSA. *Potassa.*—This substance is a hydrated oxide of Potassium, or a compound of Potassa and water, one equivalent of the Potassa retaining one of Water. When pure hydrate of Potassa is fused in a silver or clean iron vessel, at a heat rather below redness, and is run into cylindrical moulds, it assumes somewhat of a crystalline character on cooling, and constitutes the *Potassa fusa* of the London and Edinburgh Pharmacopœias,

the old *Lapis causticus*. When Potassa is rubbed up with dead animal matter, it immediately decomposes it; and a saponaceous compound results, whilst the alkali becomes a carbonate. On this account, Potassa was early employed to destroy fungous excrescences on the living body. It is said to be more capable of dissolving the animal solids than pure soda, and is therefore preferred to it for forming eschars for issues. It operates chemically by its powerful attraction for water, and its solvent property over albumen and gluten, forming with them new compounds, which in fact constitute the eschar. It is best applied by placing a small piece of it on where it is intended to act and covering it with two or three folds of adhesive plaster. Its first effect is the partial deliquescence of the alkali, which next powerfully stimulates the sensibility of the part, exciting much pain, until the vitality of the spot be destroyed. It has one disadvantage depending on its deliquescent property—namely, it forms an irregular ulcer, and the eschar is very long of being detached. On the other hand, its action in point of violence can be easily controuled, by moistening the part with vinegar or any diluted acid when we wish to arrest its progress.

3. LIME. *Calx.* L. E. D.—This hydrate of the oxide of Calcium acts nearly in the same manner and with equal energy as the Potassa, destroying quickly the vitality of the part and entering into chemical union with the animal matter of the spot to which it is applied. It operates chiefly by withdrawing the water which forms a component part of all animal tissues. Although it is less apt to spread and extend irregularly its sphere of action than the potassa, yet it is much less employed, except as an addition to the potassa, in the Potassa cum calce of the Pharmacopœias. The effect of Lime in dissolving dead animal matter is so well known, that it has been used, from time immemorial, in dissolving the hair and gelatinous matters on skins, to fit them for the action of tannin in the preparation of leather. As an Escharotic, it produces more pain and general excitement than the pure alkalies.

c. METALLIC SALTS.

1. NITRATE OF SILVER. *Argenti Nitras.* L. E. D.—In its fused state, this is the common caustic used by surgeons, for taking down fungous growths and occasionally for making issues: it is less adapted for the latter than pure potassa, as its sphere of action is extremely limited. It is admirably adapted for giving new action to languid ulcers; and to aid their cicatrization, which proceeds under a coating, over the denuded surface, formed by oxide of silver combined with the dead animal matter: when the coating peels off, the part is left entire.

2. MURIATE OF ANTIMONY. *Antimonii Murias.*—This is a

powerful Escharotic. It is prepared most effectually and quickly by the immediate combination of its constituents, metallic antimony and chlorine. It may also be prepared by mixing metallic antimony with two and a half times its weight of bichloride of mercury, and distilling: a sesqui-chloride comes over and condenses in the receiver, and metallic mercury remains in the retort. But the process usually adopted is the following, proposed by Göttling. Introduce into a retort a mixture of four ounces of vitreous oxide of glass of antimony in powder, sixteen ounces of muriate of soda, and twelve ounces of sulphuric acid, diluted with eight fluid ounces of water; then lute on a tubulated receiver, and distil it to dryness, with a sand heat gradually increased: twenty ounces of Muriate of Antimony are thus obtained.

Muriate of Antimony is a soft, semitransparent, yellowish-white substance, volatile at a moderate heat, very deliquescent, and decomposed by water, which converts it into a submuriate, which crystallizes in white acicular crystals. The constituents of the muriate are 2 eq. of Antimony = 125.2, + 3 eq. of Chlorine = 106.26, making the equivalent 236.46. From its consistence, it is generally called Butter of Antimony, and assumes a crystalline form on cooling. Its deliquescent character renders it a very unmanageable Escharotic: it is, therefore, seldom used.

B. ERODENTS.

These, as the name implies, eat away, as it were, extraneous growths, and are, therefore, employed for removing fungous granulations and for destroying warts and other excrescences of a similar description. They operate by their chemical properties, and form new substances with the matter of the parts which they remove. Their action is much less obvious than that of the potential cauteries.

a. ACETIC ACID. *Aceticum Acidum.* L. E. D.—This acid, in its concentrated state, inflames and vesicates the sound skin. It consists of one atom of dry acid and one of water when its sp. gr. is 1.06296, at 60° Faht. In a much weaker state, at 1.074, it instantaneously produces a blister. When still more diluted, it operates as an Erodent in removing warts and corns; but great care must be taken to prevent it from acting upon the sound skin. This vegetable acid, like the mineral acids, enters into chemical combination with the dead animal matter which forms the eschar*.

b. REFINED SUGAR. *Saccharum purissimum.* L. E. D.—Sprinkled upon spongy irregular granulations, white Sugar

* Its was formerly imagined that Erodents, as well as potential cauteries, operated by means of sharp particles, which entered into the parts to which they were applied, and destroyed them.

operates as an Erodent; but there are so many better Erodents, that it is seldom employed for this purpose.

c. SALTS.

1. ALUM. *Bisulphas Aluminis et Potassæ. Alumen.* L. E. D.—Alum does not display escharotic properties until it has been deprived of the water of crystallization, and has become the *Alumen exsiccatum* of the Pharmacopœias. It is not improbable that, in this state of Alum, some part of its escharotic influence is to be attributed to its attraction for the moisture of the animal tissue, and favouring the coagulation of the albumen. It is not much used, although it is well adapted for destroying granulations and for giving a salutary impulse to languid and irritable ulcers.

2. SULPHATE OF COPPER. *Cupri Sulphas.* L. E. D.—This salt operates as an astringent on dead animal matter, and as an Erodent on the living body. It is more employed, however, as a powerful stimulant in giving energy to flabby languid ulcers than as an Erodent.

3. NITRATE OF SILVER. *Argenti Nitras.*—The influence of this preparation, as a potential cauterant, has already been noticed: in a diminished degree of strength, or by applying it in a slighter manner, it acts as an Erodent. The use of the Nitrate has been greatly extended lately by the experiments and observations of Mr. Higginbotham of Nottingham. This gentleman found, that when the Nitrate of Silver is applied to a wound or an ulcer, by extending the application to a certain length beyond the edges of the sore over the sound skin, it aids the rapid cicatrization of the sore. He also applied it in phlegmonous, erysipelous inflammation of the absorbents, and many other similar affections. In these cases, it is probable that much of the benefit depends on the formation, as he terms it, of the *adherent eschar*, which it forms of the cuticle or surface on which it acts. In ulcerations, there can be no doubt of the benefit likely to result from the formation of an artificial covering of the nature of this pellicle in protecting the irritable sore from the action of the air; and, by the gentle stimulus to the part, a more healthy action is promoted, and the cicatrization is thus promoted.

All the Escharotics operate by their chemical influence in destroying the vitality of the part to which they are applied: but they have also a counterirritant influence. The precautions requisite in using them refer—

1. To the chance of absorption; which, for example, may occur with arsenious acid, this being, under certain circumstances, poisonous when applied to ulcers.

2. To the nature of the places on which they are to be ap-

plied, as it is absolutely necessary to avoid nerves, tendons, and the larger blood-vessels.

The older physicians employed the Potential Cautery and Erodents very freely as counterirritants : Aetius extols their efficacy in asthma ; Boerhaave and many others laud them in dropsies : it may indeed be said, generally, that they prove useful in all affections in which counterirritation is indicated, and where an immediate impression is not demanded. As a local Erodent, Boerhaave ordered the Potential Cautery to scirrhous glands — a practice which Heister properly condemns ; and which is not devoid of danger when the arsenious acid is employed. With more propriety, Etmuller advised the Potential Cautery for removing polypi of the nose : but modern surgeons generally use the forceps for separating these parasitic tumours.

SECTION II.

ANTACIDS.—MEDICAMENTA ANTACIDA.

THESE require a very brief consideration. They are medicines which are said to obviate acidity in the stomach, by combining chemically with any superabundant acid there and neutralizing it. In this point of view, they can be regarded as palliatives only, carrying off the acid already formed, but not preventing the formation of more : their utility, however, is not confined to their chemical action. I have had several opportunities of mentioning my opinions respecting the beneficial effects of alkaline substances in allaying the irritability of the stomach ; and it is to this influence of Antacids that we are to ascribe much of the benefit derived from their employment in acidity of the primæ viæ. Their beneficial influence is not confined to their action on the stomach. The generation of much acid in that organ indicates a general diminished state of tone, with augmented irritability, and a condition of the system under which the formation of renal calculi is favoured and gout shews itself : by allaying this state, Antacids may be regarded as remedies of general influence, not only in these diseases, but in many others connected with an irritable and a dyspeptic condition of the stomach. The greater number of them are carried into the circulation, and it is consequently difficult to decide whether the beneficial influence, which they evidently exert, is to be ascribed to their chemical properties, or to their excitant influence on the glandular and capillary systems.

TABLE OF ANTACIDS.

a.—HYDRATES OF OXIDES.

Lime Water.	*Calcis Aqua.*
Magnesia.	*Magnesia.*
Potassa.	*Potassa.*

b.—SALTS.

Carbonate of Soda.	*Sodæ Carbonas.*
Carbonate of Potassa.	*Potassæ Carbonas.*
Solution of Ammonia.	*Ammoniæ Liquor.*
Carbonate of Ammonia.	*Ammoniæ Carbonas.*
Carbonate of Magnesia.	*Magnesiæ Carbonas.*
Chalk.	*Calcis Carbonas.*

A. SUBSTANCES WHICH OPERATE AS ANTACIDS.

a. HYDRATES OF OXIDES.

1. LIME WATER. *Calcis Aqua.* L. E. D.—This is an aqueous solution of Hydrate of Lime, or oxide of calcium. In the direction of the London and Dublin Colleges for preparing it, boiling water is ordered to be employed; and the whole of the water to be poured upon the Lime at once: both of these parts of the process are improper. In the directions of the Edinburgh College, the lime is properly ordered to be first slacked by sprinkling over it a small quantity of water, which converts it into an hydrate, which is afterwards partially dissolved in the water poured over it, one grain only being taken up by 778 grains of the water at 60° Faht. When a large quantity of hot water is poured over Lime, it forms a paste, which defends the interior from the action of the water: this fluid, also, at 212°, requires 1270 parts to dissolve one grain of hydrate of Lime, whereas, at 60°, only 778 grains are required. If the Lime Water be not used immediately after it is made, it ought to be kept in well-stopped bottles, to protect it from the air, which affords it carbonic acid, and converts the lime into an insoluble carbonate.

When Lime Water is employed as an Antacid, if we were to rely merely on its neutralizing property, the quantity required would be much greater than could be conveniently administered. It is said, by Dr. Murray, to restore the tone of the stomach and to operate also as an astringent; but although it corrugates the muscular fibre, and on that account is regarded

as astringent and tonic, yet neither of these properties is very obvious in Lime Water; and, therefore, we must refer the benefit it produces in cases of acidity to its alkaline property of diminishing irritability and favouring the secretion of a healthy gastric juice. It is frequently administered in milk, which covers its taste; but the propriety of employing this vehicle is objectionable, because much of the lime is taken up in forming a saponaceous compound with the cream of the milk, by which its influence on the stomach is greatly lessened. The medium dose is from two to four ounces—quantities equivalent to one grain and a quarter and two grains and a half of the lime.

The soft *Carbonate of Lime*, or chalk, when mixed with or suspended in water, is a more powerful Antacid; but it does not allay the irritability of the stomach so effectually as lime water: it is, however, more serviceable when diarrhœa attends an acescent state of the stomach. It is apt to form concretions in the intestinal canal.

2. Magnesia. *Magnesia.* L. E. D.—This hydrate has the advantage of lime water, from its forming a soluble and purgative salt with acid present in the stomach; but, whilst it does so, and thus carries off much of the already-existing acid, it does not allay the irritability of the stomach so effectually as lime water, unless it be combined with an aromatic. Such an union greatly augments the influence of Magnesia; and, in cases of violent vomitings, I have seen a teaspoonful or two of Magnesia, administered in a glass of sherry wine, produce a more immediate sedative influence than any other means that I have ever seen employed. The *Carbonate of Magnesia* is also administered as an Antacid in the diseases of children; but, although the extrication of the carbonic acid which it contains, when much acid is present in the stomach, is an objection to its employment, yet, in an adult, this is rather useful, as the gaseous acid stimulates the nerves of the stomach and acts as a tonic. The dose of pure Magnesia should not exceed half a drachm; that of the carbonate two drachms.

3. Solution of Potassa. *Potassæ Liquor.* L. E. D.—This solution produces its effects as an Antacid both by neutralizing the existing acid and by its powerful influence in allaying the morbid irritability of the viscus. Keeping these facts in view, there is little doubt that, in order to obtain all the advantages which the medicine can afford, it ought to be given in much larger doses than are usually prescribed. It is true that the pure alkalies are powerfully excitant to the living system, and this in proportion to their concentration: but although a large dose of the Liquor Potassæ, taken into the stomach, even when much acid is present, if the habit be unaccustomed to the medicine, would undoubtedly prove injurious, yet the system rapidly accommodates itself to very large doses of this

medicine; and its beneficial effects are rarely evident until full doses can be administered. I have carried the dose of Liquor Potassæ to the extent of 120 minims, administered three times in twenty-four hours, with the most decided benefit, in obstinate cases of psoriasis, and in anomalous tumours in the abdomen. It is necessary to mention that the medicine cannot be carried rapidly to this dose. When acid is present, its first effect is to neutralize it, much of the Potassa is thus rendered merely purgative; and it is that portion only which is over and above what is required for this purpose that can be said to exert its specific influence on the coats of the stomach. Potassa, however, at least as an Antacid, may be safely brought to the dose that I have mentioned; and, as it then enters the circulation and stimulates the whole glandular system, it not only acts as a palliative by its chemical properties, but also tends to correct the disposition to acescency. The best vehicle for administering it is the almond emulsion, unless we wish to combine it with a bitter, in which case the infusion of gentian, or that of orange-peel or cascarilla, will answer every indication that we can desire it to fulfil; or, what is better than any of these, it may be given in beer. The dose at first is from fifteen to twenty minims; this should be augmented, five minims at intervals of two or three days, until the full dose can be taken.

In weak stomachs, it is advisable to employ the carbonate of the alkali before using the pure alkali, as its action is not only milder, but, from the extrication of the carbonic acid, some advantage is obtained from its tonic influence, when applied to the sensitive nerves of the stomach, in the manner which must take place when this viscus is distended by it.

b. SALTS.

Some of these have been already noticed under the head of their alkaline bases: two only remain to be considered in this place.

1. CARBONATE OF SODA. *Sodæ Carbonas.* L. E. D.—This salt, as well as the bicarbonate, operates nearly in the same manner as the Carbonate of Potassa; but it appears to be more readily taken into the habit than that salt. After a person has taken either of these carbonates for a short time, all the secretions, even the cutaneous perspiration, become very perceptibly alkaline. Its influence on the urinary secretion will be noticed under Antilithics. As an Antacid, its properties resemble those of the carbonate of potassa: it may be given in the same doses and in the same vehicles.

2. CARBONATE OF POTASSA. *Potassæ Carbonas.* L. E. D.—The manner in which this salt operates, when taken into the stomach, has been already noticed under the head of the solution of the pure alkali. The Carbonate, owing to its deliquescent property, cannot be administered in substance. The dose of

saturated solution is from m. xx to f℥i; it may be taken in any bland demulcent fluid.

3. Solution of Ammonia. *Liquor Ammoniæ.* L. E. D —Ammonia operates in the same manner as the other alkalies; but it communicates a powerful stimulus to the nerves of the stomach; and, from its volatility, readily acts on the acidity of the elastic vapour that frequently distends the stomach in dyspeptic affections. From fifteen to thirty minims of the Liquor Ammoniæ may be given in fifteen fluid drachms of any bland fluid that can cover the acrimony of the medicine whilst it is passing the gullet. The decoction of Iceland liverwort, Cetraria *Islandica*, deprived of a portion of its bitter, has answered every purpose as a vehicle for the administration of Ammonia.

From what has been said, it must be evident that this class of medicines is of very limited application.

SECTION III.

ANTALKALIES.—MEDICAMENTA ANTALKALINA.

Free alkalies are rarely present in the stomach; but that there exists what may be termed an alkaline state of habit is well known. It is demonstrated in the chemical quality of the urine, accompanied with a pale countenance, lassitude, irregular bowels, sometimes costive, sometimes too relaxed, and a tendency to hysteria in females. Mental as well as corporeal causes; diseases affecting the spinal cord, whether in the loins, back, or neck, or whether paralysis be present or absent, produce an alkaline state of habit which is displayed in the urine. The *acids*, undoubtedly, are indicated in such cases: the best is the nitric acid; and much benefit is derived from its employment.

SECTION IV.

ANTILITHICS*.—MEDICAMENTA ANTILITHICA.

Syn.—*Lithontriptics.*

The appellation Lithontriptics, generally applied to this class of medicines, is calculated to mislead, as it implies substances

* From ἀντι, against, and λιθος, a stone.

which dissolve urinary calculi; and, therefore, as I regard the substances in this class rather as *preventives* of the formation of calculous concretions than as *Lithontriptics*, or destroyers of concretions already existing in the kidney or in the bladder, I have chosen the term *Antilithics* as the name of the class. Antilithics may be defined—"Substances which counteract the predisposition to the formation of calculous concretions in the urinary organs."

I am of opinion that it has been too much the custom to regard the formation of calculi in the pelvis of the kidneys and in the urinary bladder as mere chemical processes, and, consequently, to conduct the treatment too exclusively upon chemical principles, losing sight of the general effects of disease upon so important a secretion as the urine. Dr. Marcet and Dr. Prout, to whose talents and industry the profession is more indebted than to any others for the lights which they have thrown upon this important subject, admit the truth of this remark. "The only benefit," says Dr. Marcet, "which we may with any confidence expect from medicine in this disease is either to prevent the increase of calculi already formed, or, what is still more important, to guard the constitution of those who are subject to the disorder against the prevalence of the particular diathesis from which it arises*." In accordance with the same views, Dr. Prout quotes an observation of Berzelius, that, in a case in which the phosphoric acid was indicated and was largely given, no effect was produced until it proved laxative, when "the urine became acid and deposited uric acid, which continued as long as the laxative effect continued, and no longer, although the dose remained unaltered†." My own experience has amply confirmed this observation; and, also, another remark of Dr. Marcet, that alkaline remedies "often allay the irritation of the bladder and promote the flow of urine, even when, from the chemical composition of the concretions, they can be of no service as solvents." A remarkable instance of the beneficial effects of general remedies—those which have no influence whatever on the calculus which excites the irritation—occurred to me some years since, and is a powerful illustration of the point under consideration. An elderly man, the master of the workhouse of the parish of Chelsea, placed himself under my care on account of a violent pain which he had experienced for several years, across the loins, and which was accompanied with urine of a coffee colour and scanty in quantity. There was little difficulty in discovering the cause of these symptoms, and that the pain proceeded from irritation in the pelvis of the kidney from the presence of a calculus. To combat the symptoms, and

* Marcet's Essays on Calculous Disorders, 8vo. 1817, p. 143.

† Prout's Inquiry into the Nature and Treatment of Gravel, Calculus, &c.

under the supposition that at least the irregular surface of the calculus, which I suspected to be the chief source of irritation, might be smoothed by such chemical agents as were likely to pass to the kidneys unaltered, both acids and alkalies were alternately administered without any advantage, although carried to full doses; and, after some months, symptoms of dropsy supervened. With the view of relieving the dropsical disease, diuretics—foxglove and mercurials—were administered until the mouth became affected. As soon as salivation supervened, the pain of the kidney abated, the urine remained clear, and every symptom of irritation disappeared and continued absent as long as it was requisite to keep up the mercurial action on the habit. On leaving off mercury, as soon as the mouth became well, the pain of the loins recurred, and, in a short time, the urine again became loaded with broken-down blood or the coffee-coloured sediment. For three years, circumstances required that the mercurials should be occasionally employed; and, in every instance, the beneficial effects were such as I have described. At length, during my absence in Scotland, my patient again lost ground: and, on my return, I found him in the last stage of dropsy, of which he died a few days afterwards. The post-mortem investigation of the body confirmed my opinion of the disease: the pelvis of the right kidney was filled with an irregular calculus, which had assumed its form and its branching infundibula, and completely filled them, so as almost to prevent the passage of any urine into the ureter on that side. I mention this case as a fair illustration of the effects of remedies, not operating on chemical principles, in allaying pain and clearing the urine, in a case all the symptoms of which so decidedly arose from the irritation of a calculus. Indeed, when we reflect upon the changes which disease effects on the urinary secretion, we shall be more and more convinced that the object of the *chemical* practitioner is, as Dr. Prout has expressed himself, "at best but of a secondary description; namely, to prevent the effects of disease rather than to remove it." In order to understand the manner in which Antilithics operate, it is necessary to enquire into some peculiarities connected with the secretion of the urine. Some of the saline matters contained in human urine are more liable than others to form deposits, owing to their comparatively little solubility; namely, the phosphates and the uric acid. The former are held in solution by the phosphoric and lactic acids, which are always in excess in healthy urine; for when these are saturated by a few drops of ammonia, the phosphates are precipitated: on the contrary, when any acid, in small quantity, is added to recent healthy urine, uric acid, in small reddish crystals, is thrown down. Diseases operate nearly in the same manner in producing urinary deposits. Thus, in inflammatory diseases, we find the urine high-coloured, peculiarly acrid, and throwing

down no deposit until the state of excitement begin to yield, when it lets fall a copious, pink-coloured sediment, consisting of the *rosacic* and *uric* acid, with a little phosphate of lime. The urine of those persons who labour under a gouty diathesis—that is, who are predisposed to gout—contains much less phosphoric acid than that of healthy individuals; and even although the quantity of this acid is increased during the actual presence of the gouty paroxysm, yet much less, at this time, than is usual in healthy urine. This is also the case in rheumatism; and, as in other inflammatory and irritable diseases, in the decline of the paroxysms of which there is a copious deposition of pink sediment, which Dr. Prout regards as urate of ammonia coloured by purpurate of ammonia: but the idea of the colouring matter being purpuric acid is denied by Messrs. Brett and Bird*. In healthy urine, the phosphates are in small quantity; but, in derangements of the chylopoetic viscera and in low states of the habit, it is from the abundance of these compounds that calculi, both in the bladder and in the kidneys, are formed.

In dropsy, the urine is loaded with albumen and becomes milky, coagulating when acids are added to it; but, if the dropsy be connected with diseased liver, the urine is scanty, high-coloured, and entirely free from albumen. It is probable that the nitrogen, which exists in albumen to the amount of fifteen per cent. is exhausted in the formation of the lithic acid in these diseases; this acid requiring nitrogen as one of its components: and thence the necessity of a vegetable diet in such cases.

Urea, which, in its pure state, is transparent, colourless, and in four-sided, pearly prisms, soluble in their own weight of water at 60°, is a principle peculiar to urine, depending probably, as Dr. Prout has suggested, upon the action of the kidneys on the albuminous matter of the blood: its ultimate constituents are—4 eq. of hydrogen = 1, + 2 of carbon = 12, + 2 of oxygen = 16, + 2 of nitrogen = 28; making the equivalent of the salt 60.

Lithic or *uric acid* is a compound of the same constituents, but in different proportions; namely 2 eq. of hydrogen, + 5 of carbon, + 3 of oxygen, + 2 of nitrogen; making the equivalent 84: but, if this contains 2 parts of water, as has been asserted, the equivalent of the anhydrous acid is 66. Dr. Prout is of opinion that it is always in combination with ammonia, as a lithate or urate, in urine. Pure uric acid is white, inodorous, tasteless: it is sparingly soluble in water and wholly so in alcohol. It forms salts with alkalies. Nitric acid gives it a purple colour. Urine contains other acids, namely, the Purpuric and the Rosacic. In *hysteria*, the urine is in large quantity, limpid, colourless, and containing scarcely any urea; and, in *chronic hepatitis*, it is totally devoid of it: in gout, the concretions are chiefly urate of

* Med. Gazette, 23rd August, 1834.

soda; in *rickets*, the urine is loaded with phosphate of lime; in *diabetes*, with saccharine matter; and, in *dyspepsia*, it contains so much gelatin that it yields a copious precipitate with tannin.

The conclusion to which these observations lead is this—that, when the urine displays such variations of chemical character from the effects of disease, and when these chemical changes are removed, not by any agents directed to effect chemical action on the secretion itself, but by general remedies directed to fulfil the indications which these states of disease present—there is every reason for not confining our attention, in the treatment of calculous diseases, too exclusively either to the chemical constitution of the urine, or that of the calculous concretions deposited from it. In making these remarks, it is not my intention to take too limited a view of what may be termed the calculous diathesis and its treatment: nor is there any occasion to detract from the great advantages which have been derived from chemistry in this branch of therapeutics. Without a clear understanding of the chemical nature of urinary calculi, we should be but ill fitted for affording relief, even in taking a simple pathological view of the cases that, daily, are brought under our notice.

In treating of diuretics, I noticed the components of urine, as obtained by the analysis of Berzelius; it is therefore now only necessary to mention that its chief components are, besides water, *urea*, *lithic acid*, *free lactic acids*, and *lactates*, *sulphates of potassa* and *soda*, *phosphates of soda* and *ammonia*, *muriates of soda* and *ammonia*, some earthy *phosphates*, *fluate of lime* and *silicious earth*. In stomachic diseases, the more or less assimilating quality of the food, and the nature of the food, favours the production of these compound salts, and calculi are the result. The following is the nature of the four kinds of calculi, under which all the others may be arranged:

1. The *Lithic Calculus* is of flattish-oval figure, brownish or fawn-coloured, surface smooth, has the texture laminated: is inodorous; soluble in the pure alkalies, but not in their carbonates; sparingly in water; insoluble in sulphuric and muriatic acids; but soluble in the nitric, and, on evaporating the solution to dryness, a bright pink residue is left, purpurate of ammonia, which disappears on adding either an acid or an alkali. The Lithic Calculus evaporates before the blow-pipe, leaving a white alkaline ash. A variety of this species is the urate of Ammonia calculus; it is distinguished by its solubility in boiling water; and the disengagement of Ammonia during its solution in pure potassa.

2. *Mulberry*. Colour dark-brown, surface tuberculated, substance hard. It consists chiefly of oxalate of lime. In fine powder, it is soluble in muriatic and nitric acids; but not in the pure alkalies. When Mulberry Calculi are exposed to heat, the

oxalic acid is volatilized, and quick lime remains. Some have no tuberculated surface, but are smooth, as illustrated in what is called the hemp-seed calculus.

3. *Phosphate of Lime.* Colour pale-brown; surface smooth, as if polished; texture laminated, so as to separate into concentric crusts. In fine powder, it dissolves in nitric and muriatic acid: but it is insoluble in potassa. It is fused in an intense heat.

4. *Ammoniaco-Magnesian Phosphate.* Bright-white, little compact, surface studded with crystals. Before the blowpipe it gives out an ammoniacal odour, and then fuses. The crystals are sparingly soluble in water, but readily in the acids, even the acetic. Pure potassa disengages ammonia from them; but does not dissolve them.

5. *Fusible Calculus.* The whitish and most friable of all, soiling the fingers like chalk: when the texture is laminated, the layers are often studded with crystals of the triple phosphates. Fusible calculi often acquire a great size: they consist of a mixture of the triple phosphate and phosphate of lime.

There are, besides these, others, which are termed *cystic*, *alternating*, and *compound calculi;* but they are very rare.

In treating of the class of medicines supposed to act on these calculi, we must regard those articles contained in it in two points of view:—1st. As fitted for removing the symptoms that indicate the first formation of calculous deposits in the habit; and these I would regard as *Antilithics*, or preventives of stone. 2dly. As fitted to act upon calculi already existing in the kidney or in the urinary bladder; and, by wearing down or smoothing their asperities, to diminish their irritating powers, if they cannot altogether dissolve them; and these I would denominate *Lithontriptics*, or solvents of calculi. There can be no doubt that the first part of our enquiry is the most important, and that likely to prove practically useful. It has been said that it is in this state of the complaint that solvent medicines, or Lithontriptics, prove serviceable: I would say, that it is in this stage of the disease that the accumulation of calculous matter is likely to be prevented; and that the plan of treatment should be begun so early after the first symptoms display themselves, that the gravel or calculous matter deposited shall be readily washed out by the urine. This question then presents itself—what are these symptoms? and it is followed by another—what are the *Antilithics*, and in what manner do they operate to effect the changes which are desired?

There are three substances which principally form the gravel and calculous matter deposited in the urine; *uric acid*, *phosphate of lime*, and *phosphate of ammonia* and *magnesia:* and it is of great importance to be aware of the first indications of these in the urine, in quantity sufficient to afford deposits.

Whatever generates free acid in the stomach favours the deposition of *lithic* or *uric acid*, the existence of which is well known by the name of red gravel; it is the disease, therefore, of dyspeptics, especially those of a gouty diathesis, when this is attended with a dry state of skin; this acid being, in a healthy condition of the habit, freely thrown off by the cutaneous exhalants. Two thirds of the calculi generated in the kidney consist of this acid. The opposite state of the system, when there is a deficiency of acid in the urine, favours the deposition of the phosphates: the stomach is generally deranged; and when the bladder has lost any of its muscular energy, as in cases of disease of the prostate, in affections of the spine, and in very old people, the urine is so long retained in the bladder as to undergo a partial decomposition, ammonia is generated, and a deposition of the ammoniaco-magnesian phosphates takes place. This is also the case when the alkalies are administered in this state of the habit; and a disposition to stone of the bladder is favoured. It thus appears that these two deposits at least are wholly influenced by the general health. But whatever may be the cause of urinary deposits, the knowledge of their nature teaches us the necessity of varying our means according as they are of an acid, an alkaline, or a mixed character.

TABLE OF ANTILITHICS.

A.——— when an Acid is indicated.

a.—Mineral Acids.
- Sulphuric Acid,
- Muriatic Acid.

b.—Vegetable Acids.
- Tartaric Acid,
- Citric Acid,
- Carbonic Acid.

B.——— when an Alkali is indicated.

c.—Oxides.
- Solution of Potassa,
- Magnesia,
- Lime Water.

d.—Salts.
- Carbonate of Potassa,
- Carbonate of Soda.

C.——— when Tonics are indicated.

e.—Vegetable Bitters.

f.—Vegetable Astringents.

D.——— when local Lithontriptics are indicated.

g.—ACIDS.
h.—ALKALIES.

SUBSTANCES WHICH OPERATE AS ANTILITHICS.

a. ACIDS.

Before entering upon the consideration of the efficacy of particular acids as Antilithics, this question presents itself for consideration—Are acids carried to the urinary organs through the circulation? The free acid generally present in the urine renders it difficult to satisfy the mind upon this point. It has been ascertained that sulphuric acid enters the circulation; for, in the case of a pregnant female who was poisoned with it, and gave birth to a child in the expiring throes of life, sulphuric acid was detected both in the body of the infant and in the liquor amnii. The experiments of Mr. Brande* also render it at least probable that carbonic acid reaches the bladder.

Whenever the quantity of the natural acids of urine is diminished below a certain point, we find that white sand is deposited. The cause of this deposit is generally some disordered state of the digestive organs; and the occasional appearance of it is of little consequence, if it occur only after irregularities in diet; but, if it appear daily, and after our ordinary meals, and particularly if it be voidable in a visible state in the urine, and do not simply appear as a deposit, on the cooling of the fluid, then it ought to obtain our serious attention. It more easily collects and forms into calculus than deposits; and this is peculiarly favoured, if, from stricture of the urethra, or any other cause, the bladder be not completely evacuated when the urine is passed. Remedies, in this case, ought to be immediately resorted to; and, as this *white* sand consists of the phospates, ACIDS are indicated.

1. MINERAL ACIDS.—All of these have been employed in cases depositing white sand: the *nitric* has been supposed to disagree with some stomachs, exciting flatulency and eructations, and therefore is seldom used; but this objection is not valid: I have given it in large doses; and Mr. Brodie has carried it to the extent of ʒi in the day without inconvenience; at all events, this objection cannot be brought against the *sulphuric* and *muriatic*, either of which may be employed for adults. The muriatic acid acts more upon the bowels; and, as an open state of these always tends to relieve the condition of the habit which encourages the deposition of the phosphates, it

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* Philosophical Transactions, 1808, p. 242.

is to be preferred to either of the others. When it agrees with the stomach, the *muriatic acid* diminishes this deposit; or, more correctly speaking, prevents its further formation. Many persons who suffer from acidity of stomach can take muriatic acid with impunity. The dose of the acid is from ten minims to twenty, or even fifty, in any mucilaginous fluid; but, after its influence is experienced, the dose should be diminished; and, if any uric acid appear, the use of the mineral acid should be altogether intermitted. These remarks apply particularly to adults; for, in the cases of children, the vegetable acids are always to be preferred.

2. VEGETABLE ACIDS.—It is probable that the Vegetable Acids undergo decomposition during the process of assimilation, or, as it is termed, in transitu; and, as in this state new compounds are formed, it is difficult to predicate whether these are likely to prove salutary or prejudicial. The *tartaric acid* has not been much employed; but, if we regard it simply as an Antilithic, operating on the stomach, it is as likely as any other to prove beneficial. An excellent method of administering it to children, is in the form of imperial, made with the bitartrate of potassa, which has also the advantage of keeping the bowels in a soluble state. But it must be recollected that the bitartrate of potassa is one of those salts which, when taken for some time, is supposed by Dr. Paris to be decomposed in the stomach, and to afford its alkaline principle only to the kidneys. When treating of this salt as a diuretic, I pointed out the probable fallacy of this opinion; as, the moment its superabundant acid is consumed by the digestive process, the tartrate thus formed will act on the bowels, and carry itself out of the habit; and I have no doubt that the purgative effect of the bitartrate is probably, on every occasion, owing to this change.

Mr. Brande, in his observations "On the Medico-Chemical Treatment of Calculous Diseases," states his preference for the *Citric Acid*, which may be given in doses of from gr. v to ʒss; and it has the advantage of being highly relished by children.

It is extremely probable that much of the benefit arising from these acids proceeds from their action on the digestive organs, correcting irregularities of these organs, and particularly of the liver, in those persons who pass the *ammoniaco-magnesian phosphates;* but it is also probable that they partly find their way to the kidneys and bladder, as they have proved useful in relieving those cases of elderly persons, who, from some affection of the urethra, or from the disability of completely evacuating the bladder, have a tendency to the accumulation of the phosphates in that viscus. This idea of the penetration of acids to the bladder was particularly believed in reference to carbonic acid, before the nature of urinary calculi

was understood: thence any reasoning upon its action must necessarily be very imperfect; and, from the experiments of Dr. Marcet*, the passage of carbonic acid from the stomach into the urine is very improbable. On the other hand, we know that the tonic influence of carbonic acid when applied to the nerves of the stomach, independent of any chemical agency, is great, and therefore its influence as an Antilithic may depend on this property.

b. ALKALIES.

The *Alkalies*, it is almost unnecessary to remark, are to be employed in the opposite condition of the system from that indicating the use of acids; that is, when there are deposits demonstrating the presence of *uric* acid. In the management of these Antilithics, many obstacles were at one time thrown in the way, from a fallacious opinion that the caustic or pure Alkalies are likely to injure the stomach, and could not be taken to an extent sufficient to reach the kidney, without being neutralized by the acids in the urinary secretion. Now, although this might be an argument of some weight, were it correct, against the employment of the pure Alkalies as Lithontriptics, yet it is certainly none against their use in Antilithics; for, in those instances in which the lithic acid diathesis prevails, this is more connected with the state of the digestive organs than in those cases in which the phosphates are deposited. The first effect of pure Alkalies upon the stomach is to allay irritation, and thence to lessen that hasty secretion of the gastric juice which favours acidity. Indeed, in almost all cases, I am disposed to describe the advantages derived from Alkalies, in correcting acidity of the stomach, less to their neutralizing the acid already existing in the organ, than to their sedative power, and the taking off that state of irritability which, by affecting the secretion of a hasty and imperfect gastric juice, favours the production of acid. With regard to the injury arising from large doses of pure Alkalies, these may have arisen from the indiscretion of too rapidly bringing up the dose; but, when this is done with caution, the *pure potassa*, in the solution ordered by the London College, may be given to the extent of even m. cxx, thee times a day, with evident advantage to the habit in every respect.

The question presents itself—are Alkalies conveyed into the bladder? There is no difficulty in determining our reply in the affirmative: they certainly reach the urinary organs, and operate in not only checking the prevailing diathesis, but in bringing on a calculous deposit, depending on an opposite condition of the habit, when they are given in excess and have

* Marcet on Calculous Disorders, 8vo. p. 160.

been too long continued. This must be carefully avoided; and, as soon as the urine changes paper of litmus which has been reddened, to blue, or turmeric paper to brown, the use of the Alkalies must be discontinued. Sometimes, however, they may be long used with the greatest advantage. A very satisfactory case, illustrative of this fact, has been recorded by Dr. Marcet. The patient was a clergyman; he persevered in the use of an alkaline lixivium for ten years, and during that time passed many calculi, all of which had their angles rounded, "and their edges blunted in a manner which could hardly be explained except from the long-continued effect of the alkaline medicine*."

The *carbonates* are mild forms of exhibiting the Alkalies; and, if the results which are recorded of their beneficial effects be correct, they are, in many instances, preferable to the pure Alkalies. The carbonate of soda, either in soda water, or in the form of the bicarbonate, is usually preferred; but, from whatever cause it may arise, experience has decided that *potassa* has a much more powerful antilithic effect than *soda*, whether uncombined or as a carbonate. One excellent reason for preferring potassa or its carbonate, is the fact ascertained by Dr. Prout, that the lithate of potassa is a soluble salt, whereas the lithate of soda is insoluble. The dose of the bicarbonate of soda is from gr. x to ʒi, and it may be taken two or three times a day. In this case the carbonate is decomposed in the habit, and the Alkali only is carried to the kidney. With regard to *ammonia* and its carbonate, it is probable that the whole of its effects are due to its influence on the stomach: and indeed it is upon this principle that it appears to act so favourably in those cases of the gouty diathesis in which the deposition of red gravel, as it is termed, from the urine, alternates with fits of gout, or in which the disease appears to affect the joints and the kidneys alternately. In this condition of the habit, the use of *magnesia* as an antilithic remedy was brought before the notice of the profession in a paper, by Mr. Brande, published in the Philosophical Transactions for 1810, and in an essay which is printed in the 6th vol. of the Journal of Science and the Arts. The observations of Mr. Brande have in a great degree been confirmed by subsequent experience; and magnesia is now much employed as an Antilithic. It is very evident that this substance can only exert its influence in the stomach; and, when it is combined with bitter vegetable tonics, and precautions are taken to prevent its accumulation in the bowels, by the occasional use of purgatives, individuals liable to the constant formation of red sand have been effectually relieved. But, if Magnesia or even Alkalies be depended upon, without proper

* Loco citato, p. 151.

attention to improve the tone and general state of the digestive organs, disappointment will follow the employment of the best Antilithics. The dose of magnesia is from gr. x to gr. xxx of the calcined, and from ℈i to ʒi of the subcarbonate. When there is reason for thinking that the alternating calculi are forming, then, it is said, that the acids and the Alkalies should be alternately administered. But this recommendation involves too chemical a view of the subject; the alternate depositions of lithic acid and of the phosphates do not so much indicate a state of stomach at one time acescent and at another alkalescent, as it indicates a continued state of indigestion, varying from accidental circumstances, and only requiring to be removed to prevent the future deposition of either kind of calculous matter*. The only mode of relieving stone already existing in the bladder is by the aid of surgery. This is not the place to notice improvements in surgery; but, if I may be permitted to offer an opinion as a member of the profession, I should say that no operation in my time has advanced so greatly this branch of surgery as that now practised by Baron Harteloup, M. Civiale and his pupil Mr. Costello; namely, the attrition of the calculus in the bladder.

c. TONICS OPERATING AS ANTILITHICS.

If the opinions which have been delivered respecting the connection between the state of the stomach and the urinary secretion be correct, it will be readily perceived that the importance of obviating any irregular action of the digestive organs should be the first attempt to cure the disposition to the formation of calculus. This part of our subject involves a long and interesting inquiry into the nature of dyspeptic affections, which would be out of place in this work. I will, therefore, confine my remarks to the influence of *Tonics* and *Astringents*, as Antilithics.

The *Tonics* generally employed in cases of a disposition to calculi are the vegetable bitters; and when the indigestion depends on simple deficiency of tone in the stomach, preventing the secretion of a due quantity of gastric juice, these are undoubtedly serviceable; but, in a few cases, indeed, as far as my experience has enabled me to form a judgment, does the dyspepsia that produces calculi depend on this cause. If we eflect on the fact, that it is in the gouty diathesis and in

* Besides the Essays of Mr. Brande, already noticed, much information on this subject will be found in the work of Dr. Marcet on "the Chemical History and Medical Treatment of Calculous Disorders;" in the masterly volume of Dr. Prout, entitled "An Inquiry into the Nature and Treatment of Gravel, Calculus, and other Diseases connected with a deranged Operation of the Urinary Organs;" Dr. Woollaston's papers in the Phil. Trans.; and a paper by Dr. W. Phillips, in the 6th vol. of the Medical Transactions.

similar states of the habit that calculi most frequently occur, in states of the stomach arising from over-excitement and excessive indulgence and indolence, we have no difficulty in satisfying our minds that the irregular secretions of the stomach in such cases depend, as I have already stated, rather on a subacute inflammation of the viscus than on simple debility. This is the condition of the organ in particular, in which there exists a superabundant acid, and in which deposits of lithic acid are noted. In these instances, therefore, any expectations of benefit from bitters will undoubtedly be disappointed. It is in the opposite state of the stomach, such as occurs from the course of years, when the debility is direct, and the deposits are of an ammoniacal nature, that bitters are really serviceable; and the choice of the substances is of little moment, provided they are of a kind to pass partly into the circulation, and to give a moderate degree of stimulus to the kidneys. For this reason, those bitter vegetables which at the same time contain an astringent principle are more serviceable than simple bitters. This indirect influence of astringents on the urinary organs has been well known from a very early period, although their efficacy was erroneously ascribed to their exercising an expulsory power—an opinion that prevailed until it was corrected by Dr. Cullen, who first pointed out the influence of tonics and astringents in relieving the symptoms of calculus, independent of any chemical or solvent properties which they were formerly conceived to possess. The only tonics which demand particular attention as suited for antilithic purposes are the Diosma *crenata*, a plant the leaves of which have found a place in the last edition of the Dublin Pharmacopœia, and the Pareira Brava.

1. Diosmæ crenatæ Folia. *Buchu Leaves.* D.—This plant is a native of the Cape of Good Hope: it belongs to the natural order Diosmeæ*. The name of Buchu is derived from the word *bocchae*, which is given to the plant by the Hottentots. To an inexperienced eye, the leaves of this species of Diosma very much resemble those of Senna; but, when the two are examined together, the difference is very obvious: they vary in length from half an inch to one inch, in breadth from half an inch to five-eighths of an inch; the base is equal and attenuated, with a short, channelled footstalk; the apex is obtuse; and the margin beautifully crenated; whence the name of the species. The upper disc is smooth and shining, of a yellowish-olive hue, and dotted, caused by innumerable glands; the under is rugose, with few but comparatively larger glands than on the upper disc. The leaves are generally mingled with the stalks, which appear notched, owing to the minute petioles of leaves which have fallen. The stalks are of a reddish brown hue, mottled with

* Woodville's Med. Bot. 3rd edition, vol. v, p. 51.

bright yellow. The leaves of Buchu, when recent, exhale a powerful, not unpleasant, aromatic odour, and taste bitterish, with a coolness somewhat like peppermint, leaving a pungent impression and a degree of sweetness on the tongue. These properties are imparted to water and also to proof spirit, and seem to depend on volatile oil and extractive. According to the analysis of Cadet de Gassicourt, these leaves contain volatile oil, gum, extractive, resin, and chlorophyle. The infusion is precipitated by infusion of galls and acetate of lead: the persulphate of iron produces a green colour in it.

The medicinal properties of Buchu leaves are such as render them admirably adapted for calculous complaints, as, at the same time that they afford tone to the digestive organs, they are sudorific or diuretic according to the condition in which the surface is maintained. Thus, if the deposit be lithic acid, owing to the state of the surface, the Buchu leaves, by their sudorific influence, counteract this state, whilst, at the same moment, they are giving tone to the constitution, and, thereby, promoting in both ways that condition of the habit which is least favourable for the formation of red gravel*. The Dublin College have ordered both an infusion and a tincture of these leaves, either of which may be advantageously administered in all cases of the calculous diathesis in which tonics are indicated. The preparations of Diosma *crenata* have long been a favourite remedy with the Dutch in diseases of the urethra, prostate gland, and bladder of urine.

2. PAREIRA BRAVA. *Cissampelos Pareira:—Radix*†.—This species of Cissampelos, the Abuta *amara* of Aublet, is a native of South America and the West Indies, belonging to the natural order Menispermeæ. The root, which is the part employed, is long, thick, woody, and covered with a furrowed brown bark. According to the analysis of M. Feneulle, it contains a soft resin, a yellow colouring matter, a brown principle, fecula, an azotized matter, acidulous malate of lime, nitrate of potassa, and some mineral salts. This analysis throws little light upon the medicinal principle of the roots of Pareira Brava, which was known to the Brazilians as an excellent remedy in all obstructions of the urinary organs long before its introduction into Europe. The root is nearly inodorous: its taste is sweetish, with some degree of bitterness and slight acerbity. It yields these properties to both water and alcohol; but its best menstruum is proof spirit. Helvetius was among the first of the European physicians who investigated its influence in nephritic and calculous

* A spirit, distilled from the leaves of the Diosma in the leys of wine, is regarded by the natives of the Cape of Good Hope as a sovereign remedy in chronic affections of the bladder.

† Woodville's Med. Bot. 3rd edition, p. 168, pl. 65. Richard, Hist. Nat. Med. t. ii, p. 614.

cases: he ascribed its efficacy to lithontriptic powers; and Geoffroy to its solution of the mucus to which the sabulous matter adheres in calculous diseases: but it is more probable that its effects are due to its tonic influence on the bladder. Mr. Brodie extols its powers in chronic inflammation of the bladder: it diminishes the irritability of the organ, and lessens the secretion of the ropy, alkaline mucus. The decoction is prepared by simmering four ounces of the root in three pints of water, until the fluid is reduced to two pints, and then straining. From six to twelve fluid-ounces of this decoction may be taken in twenty-four hours. Mr. Brodie adds to it the tincture of Henbane; and, where there is any deposit of the triple phosphates, indicated by milky urine, with an irridescent pellicle on the surface, he adds muriatic or nitric acid.

D. LOCAL LITHONTRIPTICS.

These consist of alkalies and acids, properly diluted, injected into the bladder; but it has been ascertained that the bladder cannot bear the degree of strength of an alkaline injection sufficient to dissolve a lithic calculus. Some experiments of Mr. Brodie, however, have demonstrated that loose concretions of the phosphates and of carbonate of lime can be acted upon by a weak solution of nitric acid, and thus gradually removed from the bladder. The strength of the solution used by Mr. Brodie was two minims and a half to each fluid ounce of distilled water. No suffering attended the injection, which was effected through a double cannula of pure gold; but the patients experienced relief from all their symptoms, the adhesive mucus from the coats of the bladder was lessened, and the frequent desire to empty the bladder much abated. By testing the fluid which had been employed and passed through the bladder with a concentrated solution of ammonia, the phosphates were abundantly precipitated, proving that the calculi in the bladder had been acted upon.

In concluding this brief sketch of this class of medicines, I have only to remark that it is on *Antilithics*, as preventives of calculi, that we can place any reliance; and these we find in acids and alkalies, as circumstances may demand; but not less in whatever promotes the healthy functions of the digestive organs and those of the skin—that temperance, exercise within due limits, a regular and somewhat open state of the bowels, and restoring the tone of the system when it fails, constitute the best aids to the influence of Antilithics.

SECTION V.

DISINFECTANTS.—MEDICAMENTA ANTIPESTIFERA.

Syn.—*Antiseptics.*

BEFORE examining the substances which act as disinfectants, it may be proper to acquire some correct ideas of the nature of infection and contagion. Both produce diseases in those who are in contact with or near the sick, without the influence of the imagination. It is unnecessary to enquire into the causes that influence the production of the same symptoms when a contagious disease is communicated, whatever may be the state of the system of the person receiving the contagion. The matter, whether it be introduced into the blood, as in inoculation of syphilis, small-pox, or cow-pox, or be conveyed through the medium of the air, as in the case of infection, is the true fomes of the disease, and can communicate a disease only of the exact nature of that which generated it. But this virus, whatever may be its nature, can be received in certain states of the living system only; and it is probable that the causes which are suspected of originating a contagious fever, or disease of any kind, are often those which bring the body into that state which is best fitted to receive the impression of the exciting causes of the disease, however these may be produced. Thus, in a crowded, ill-ventilated apartment, such as the black hole of Calcutta, or the crowded births of transport vessels, or ill-ventilated jails, the effluvia arising from the bodies of many individuals becoming, as it were, stagnant, are capable of so lowering the vitality of the habit as either to produce disease itself or to render the body more susceptible of diseased impressions. Whichever of these opinions is correct is of little importance for our purpose: it is sufficient to know that diseases often arise from certain impregnations of the atmosphere. These are of several distinct kinds:—1, the proportion of carbonic acid in a limited portion of air may greatly exceed that which can be borne by the living system with impunity: 2, hydrogen and its compound gases may superabound, constituting malaria or miasmata: 3, there may be a large proportion of gaseous matters, the products of putrefying animal substances, and of an *alkaline nature:* 4, the air may be tainted with matter emanating from the bodies of persons labouring under contagious diseases. All of these effluvia, when largely diluted with atmospherical air, exert little influence on the body; but, in a concentrated state, they produce the most deleterious effects. They are supposed to operate either by an immediate impression on the nerves or by being taken into the system through the lungs or the stomach, into the latter of which they are supposed to be carried by the saliva It is difficult to

decide which of these opinions is correct: in my opinion, an impression on the nerves is all that is required; and this may be made upon the surface generally or upon the mucous membrane of the lungs: in either case, there exists a sufficiently widely extended sensitive membrane on which the infectious atoms may operate.

It has always been supposed that the matter of infection can be destroyed by decomposition; and, for this purpose, means the most opposite have been, at different times, adopted, such as large fires, concussions given to the air by firing gunpowder, and the sprinkling of water. For a long time also it was supposed that all substances which aid in retarding the progress of the putrefactive process, in dead animal matter, would also destroy the matter of infection; and thence camphor, resins, bitumens, benzoin, and aromatics, were employed, as well as vinegar, in the apartments of the sick and in hospitals; and, indeed, it was not until the close of the eighteenth century that the inadequacy of these means was acknowledged. It is unnecessary to notice the numerous schemes for disinfecting which have been proposed: three only deserve attention—the employment of *muriatic acid*, *nitric acid*, and of *chlorine gas*.

a. ACIDS.

1. *Muriatic Acid.*—Morveau conceived that the nature of infection could be determined by chemical tests; but, in forming this opinion, he was mistaken. He ascertained, however, that some gaseous agents can destroy certain noxious effluvia; and he imagined that the power of gases to effect this was in the ratio of their facility in parting with their oxygen: but, after many experiments with a variety of substances, he at length discovered that Muriatic Acid, in the gaseous state, was the best adapted of those substances which he had tried for effecting this purpose.

In 1773, Morveau was employed to disinfect the Cathedral of Dijon, which had been rendered unfit for religious service by the emanations from the vaults beneath it. He effected its purification by diffusing through it the vapour extricated from six pounds of common salt, on which were poured two pounds of concentrated sulphuric acid. In this case, Muriatic Acid was evolved, which so completely neutralized or destroyed the noxious effluvia, that worship was performed in the church four days afterwards. In the same manner he disinfected the prison of the same city, into which the infection of a most malignant fever had been carried from other jails. The success of Morveau brought Muriatic Acid into general use; and its powers must still be acknowledged, although more powerful means have been, since that time, employed.

Some inconvenience arises from using the proportions of salt

and acid employed by Morveau; instead of which, the proportions now adopted are twelve parts of acid to fifteen of muriate of soda, which should be moistened before the acid is poured on it. No heat is required: the ingredients may be mixed in flat earthen dishes, and left to exhale the gaseous acid formed by the decomposition of the muriate.

2. *Nitric Acid.*—In 1780, Dr. Carmichael Smythe suggested the employment of nitric acid fumigations; and received a Parliamentary grant of £10,000 for his invention. His experiments were made in the depôt of Spanish prisoners at Winchester, during the progress of a fever, of a most destructive character, which carried off a large proportion of those unfortunate men. The *Nitric Acid Fumes* were extricated by mixing together equal parts of nitre and of strong sulphuric acid. It is not easy to account for the efficacy of this acid, unless we suppose that it combines with the ammonia, in the same manner as the muriatic acid fumes, and forms nitrate of ammonia, which precipitates the acrid fœtid oil, supposed to constitute the infectious agent. But I am disposed to think that the influence of this gas is exerted rather on the body of the patient who is exhaling the infectious effluvia, than on the atmosphere. The influence of Nitric Acid, when largely diluted and taken into the stomach, is that of a powerful tonic; and this is well demonstrated in very low states of the habit, such as occur in purpura, in which the blood is poured out from the capillary vessels, producing spots on the skin, and there is a general solution of continuity, approaching almost to a state of putrefaction: nothing, in such a condition of the system, so rapidly brings up the tone of the habit, and, as it were, rouses the vital energies, as Nitric Acid. Now, in crowded ships and hospitals, where infectious fevers exist, the atmosphere, it is true, is loaded with the fomes of contagion and with noxious effluvia; but, if the powers of life can be sustained, the body withstands its baneful influence; and, at the same time, a smaller quantity of fresh effluvia must necessarily be thrown off by the patients, if they are in a state of less debility, than before. In this manner, I am of opinion, Nitric Acid fumes operate in hospitals and prison ships; whilst they act in purifying the atmosphere only to a certain extent, by destroying the ammonia which is the vehicle of the fœtid effluvia, whatever these may be. Be this as it may, Nitric Acid is less useful than muriatic acid, and especially in purifying infected houses and clothes; but it has one advantage over muriatic acid—it is less inconvenient to the individuals who are in the apartments during their fumigation; and therefore may be used in situations whence the sick cannot be removed*.

* The Nitric Acid was first used by Dr. Johnston of Kidderminster; but the most decisive proofs of its efficacy were displayed on a large scale in the depôt of Spanish prisoners at Winchester, and in the Russian fleet, by Dr. Carmichael Smythe.

In using the ingredients for extricating the Nitric Acid, it should be recollected that half an ounce of each is sufficient for disinfecting an apartment containing a thousand cubic feet of air. In large apartments, it is better to multiply the vessels containing the ingredients than to use them in a large quantity in one vessel.

b. CHLORINE.

Chlorine gas, for the purposes of disinfecting, is extricated from a mixture consisting of equal parts of dry sea-salt, chloride of sodium, and of peroxide of manganese, acted upon by two parts of sulphuric acid mixed with one part of water. The salt should be intimately mingled with the peroxide of manganese in powder, and the diluted acid be allowed to cool before it is used. The ingredients may be put in common earthenware pans.

Chlorine was first suggested as a disinfecting agent by Fourcroy, in 1791 : it was afterwards adopted by Morveau, in preference to muriatic acid ; and has been since very generally employed. As I have stated, Morveau imagined that miasmata depended, in a great degree, on the extrication of ammonia, combined with, or holding in solution, an acrid, fœtid oil. Whether this opinion be critically correct, it is true that ammonia is largely formed in putrefying animal matter, probably by the union of nitrogen and hydrogen, both of which are abundantly given out during the process of putrefaction. Now, the same effluvia are obviously emanated in very crowded apartments, and, wherever circumstances occur to lower the powers of vitality. As far as the ammonia is concerned, we can readily conceive how the muriatic acid gas operates, as, the union of the ammonia and the acid gas forming muriate of ammonia, this substance is incapable of holding the fœtid, acrid oil in solution : it is precipitated and rendered inert. But muriatic acid vapour has little effect on some of the other deleterious gases—such, for example, as carburetted and sulphuretted hydrogen ; it is, therefore, now seldom used, Chlorine being extricated with equal facility ; and, besides answering the same purpose as the muriatic acid gas, decomposing readily both the above-mentioned gases. The Chlorine also decomposes the ammonia, and forms muriatic acid by combining with its hydrogen. The other gases generated in the process of putrefaction, detrimental to life, are sulphuretted hydrogen, phosphuretted hydrogen, and carburetted hydrogen. Chlorine combines with one or other of the principles of all these ; and, by decomposing them, destroys their sedative influence on the living system, and thereby renders them innocuous.

In considering the process adopted by Mr. Faraday for disinfecting the Penitentiary at Milbank, it would appear that half

a pound of dry chloride of sodium, the same quantity of peroxide of manganese, and one pound of sulphuric acid, would be sufficient for fumigating a building containing 288,714 cubic feet of air*. In applying this gas, some inconvenience arises from its irritant influence on the lungs, and therefore it has been thought to be inapplicable for inhabited apartments: but there is more speciousness than truth in this opinion; and daily experience of its use in the apartments of phthisical patients has completely disproved it. In the belief of this supposition, however, Morveau invented his disinfecting bottle, in which the chlorine is slowly disengaged, and the quantity admitted to escape under the regulation of the attendants in sick apartments. It consists of a strong glass jar, to which a flat ground-glass lid is accurately fitted. The jar is enclosed in wood, and the lid acted upon by a screw, so as to be kept firmly closed, or to be opened at pleasure. The jar is charged with a mixture of four parts of peroxide of manganese finely powdered and sifted, ten parts of nitric acid of sp. gr. 1.40, and ten parts of muriatic acid of sp. gr. 1.134: the chlorine is slowly extricated from this mixture; and, being confined in the upper part of the jar by the power of the screw, it acquires an increase of elasticity, and readily issues on the smallest relaxation of the pressure on the lid of the jar. A moderate sized jar of this kind, properly arranged, retains its disinfecting power for many months.

Chlorine may also be employed as a disinfecting agent, as it is spontaneously extricated from solutions of the chloride of lime or of soda. The former of these solutions is the ordinary bleaching liquid, and may be prepared by passing a stream of chlorine through water containing slacked lime suspended in it; the latter, by either passing a stream of chlorine through a solution of carbonate of soda, or by decomposing chloride of lime with carbonate of soda†. The best quantities of the ingredients proper for preparing the sodiac solution are 2800 grains of crystallized carbonate of soda dissolved in 128 pints of water, through which, in Woulfe's apparatus, is transmitted the chlorine extricated from a mixture of 967 grains of dry sea-salt and 750 of peroxide of manganese, acted on by 967 grains of sulphuric acid diluted with 750 grains of water. The gas, before reaching the soda, should pass through a saturated solution of chlorine in water, so as to remove any muriatic acid which may come over. This chlorio-sodiac solution has a pale yellow colour, a slight odour of chlorine, and a sharp saline taste, which leaves an acrid sensation on the tongue. In both of these solu-

* Journ. of Sciences and the Arts, vol. xviii.

† See method proposed by M. Payen, Quart. Journ. of Science, New Series, vol. i, p. 236.

tions the chlorine is retained by a feeble affinity: so that, when exposed to the air, it is evolved, and the lime and the soda converted into carbonates; a process which proceeds more rapidly when the air is loaded with putrid effluvia, owing to the great quantity of carbonic acid produced during the putrefactive process. That the evolution of the chlorine depends on the decomposition of the chloride by the attraction of carbonic acid from the air is easily demonstrated by passing a stream of carbonic acid through the solution of the chloride of lime: the chlorine is extricated, and the lime precipitated in the form of a carbonate.

The Chloride of Lime was first used as a Disinfectant in 1809, by M. Masuyer of Strasburg; but little attention was attracted by the experiments of that chemist, and the chloride remained neglected until 1822, when M. Labarraque introduced it to the notice of the profession. The dry Chloride of Lime may be used with equal advantage as the solution, by exposing it in shallow pans in the places to be disinfected. Under every form, it is the Chlorine which is the active agent; and although some individuals complain greatly of the odour of this gas, yet this is a trivial inconvenience when compared with the pernicious property of the effluvia which it is so admirably calculated to remove.

Employed in limited spaces, as in rooms of houses or the wards of hospitals, both the nitric and muriatic acid gases and Chlorine possess an undoubted power for destroying the infectious matter of typhus and other fevers: they correct also fœtid odours, and check the putrefactive process. Their employment, however, should not supersede the necessity of white-washing walls, washing clothes, ventilation, and other means, all which, although they do not neutralize the virus as the gases are supposed to do, yet aid greatly in weakening its force on the system.

c. Caloric.

Although the influence of large fires, in checking the spreading of infectious diseases, had been occasionally experienced, yet the scientific examination of the influence of Caloric was not entered upon until Dr. Henry, of Manchester, made his experiments. By these he proved that substances, impregnated with the fomites of different contagious diseases, exposed to elevated temperatures, namely, from 200° to 204°, for a considerable length of time, where rendered incapable of communicating the diseases, even when they were clothes worn during the whole period of the infectious diseases. He enclosed the substances to be disinfected in air-tight canisters, and exposed them to dry heat for the specified time; and he regards this process as superior to the influence of gases, inasmuch as these

may be arrested by compressed materials, while no opposition can prevent the transmission of Caloric. The agent which he employs for conveying the Caloric is steam; and this is passed between the walls of a tinned copper box and an outer case of the same material. The most delicate goods cannot be injured by the application of the degree of heat extricated by this means.

Although the use of acid fumigations—at least those of sulphurous acids produced by burning sulphur, and acetic acid—have been known since the days of Hippocrates, and many favourable effects have resulted from their employment and that of chlorine, yet it is proper, before dismissing the subject, to notice some of the disappointments and disadvantages that have occasionally followed their employment. Thus, at Torgau, Dr. Graefe, Sugeon-general to the Prussian army, tried both the muriatic and nitric acid vapours, and also chlorine, in wards of the military hospital containing forty beds each. The fumigations were repeated with closed windows, every two hours, for six weeks. In one ward, two of the attendants were infected, and six patients died; in each of the other two wards, three attendants were infected and seven patients died; and a young man, whose sole business it was to diffuse the nitric acid vapour, was infected, and fell a victim to the fever.

When the lungs are inflamed during fever, these gases cannot be employed; for, although chlorine, in a highly diluted state, has been found beneficial when inhaled in the latter stages of phthisis, yet, in the commencement of the disease, when active inflammation exists, it proves injurious by the irritation which it excites; and the same is the case in all pulmonary affections of an inflammatory character*.

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* Much information on this important subject may be obtained from "The Reports of a Society for bettering the Condition of the Poor," vol. i, iii :—Lind on Fever and Infection :—Haygarth's Letter to Dr. Percival :—and Labarraque "De l'Emploi des Chlorures de Chaux et de Sodium."

PART V.

MECHANICAL AGENTS.

It is difficult to offer a correct definition of this division of the Materia Medica, because, although the substances comprehended in it are said to exert no influence on the vital principle, yet we can form no idea of any substance which can be applied to the living body without exciting some sensation in it; consequently, no substance can be strictly termed mechanical which in any degree influences the vital principle. If a quantity of gum or fecula be swallowed, no local effect is perceived in the organ, the gum is in part digested imperceptibly, in part it is taken into the circulation, and, lessening the acrimony of the secretions, produces a salutary effect on the system. Still this substance is not a vital agent.

The term mechanical is intended to express that the articles contained in this division do not produce their effects as remedial agents by any influence which they exert on the vital principle, but by means which closely resemble the agency of active matter on dead or inert bodies. The division contains two classes of medicines only, *Demulcents* and *Diluents*.

SECTION I.

DEMULCENTS.—MEDICAMENTA DEMULCENTIA.

Syn.—*Emollients, Relaxants.*

The usual definition of a Demulcent is the following—"*a* substance which diminishes the vital tension of tissues, and lessens acrimony, by lubricating, softening, and rendering more flexible the solid part of the body." There is no difficulty in comprehending how these effects are produced in bodies devoid of vitality: thus, caloric, within a certain limit, combined with water; or oil, applied by friction, enters the interstices of the solid, diminishing the force of cohesion: the entire density of the part is lessened, and the whole becomes more flexible. But, when we reflect that one of the effects of vitality is the preservation of the continuity of the body, in opposition to the

efforts of those extraneous matters which constantly tend to its solution, we pause before admitting the same explanation of the influence of Demulcents on the living body. It is, nevertheless, true that warm water, of a temperature not exceeding 98° Faht., and friction with oily and bland fatty substances, render parts flexible which are morbidly rigid, and enable them to be more easily removed by the influence of the will. How is this to be explained? Does it admit of no explanation, if we refuse to adopt that which has reference to dead or inert matter? or are we to attribute it to the relaxing effect of the substances upon the extreme vessels of the surface, and the propagation of this by *sympathy* to the rest of the body? In reference to the living body, there can be no hesitation in adopting the latter opinion; for, not only is this effect produced by warmth and moisture, but it is a fact well established, by the use of oily friction in the commencement of the plague, that oil, by relaxing the skin, promotes the excretion of perspiration, in the same manner as the application of warmth and moisture. It is true that the first effect, in both instances, is purely mechanical; for the cuticle possesses little or no vitality, and is composed of scales which are separated from one an other, either by the application of warmth and moisture, or by friction with oily matter; but the subsequent effect must result from the matter, thus admitted to the true skin, being applied to the sentient extremities of the cutaneous nerves, and, by diminishing their sensibility, decreasing the contractile force of the muscles; and, as I have already stated, propagating this state of relaxation by sympathy to the rest of the body. When the rigidity has been of long standing, and the organization of the part is in some degree changed, then Demulcents, if they act at all, produce their effects in the same manner as upon inert bodies.

But substances also, which are taken into the stomach, produce a demulcent effect, and apparently act upon distant organs. A question arises, suggested by the nature of the substances—what effects has digestion upon them? Undoubtedly a large portion of almost every Demulcent taken into the stomach is digested; but a part of some of them, at least, escapes this process and is carried into the system. In whatever manner they operate, they are to be regarded merely as auxiliaries, calculated to do no more than palliate certain symptoms, or to afford nutriment to the body. Almost all of them are inodorous and have a mawkish taste. Their long-continued use by persons of delicate habits, in whom the digestive organ in particular is in a weakened or atonic state, increases the paleness, flabbiness, and languor of such persons; but, in those of vigorous habits, or in ordinary health, they produce no visible effect:

we must, therefore, judge of their internal power by their external effects.

Demulcents may be divided into two sections; the *first* comprehending those which are supposed to act medicinally, the *second* those which are used dietetically. Substances which produce demulcent effects upon the body are all obtained from the animal and the vegetable kingdoms of nature. The Animal Demulcents may be arranged under three general species—*gelatine*, *cetine*, and *wax*: the Vegetable under seven—*gum*, *mucus*, *cerasin*, *sarcocoll*, *fixed oil*, and *fecula*. The remarks upon each of them may be brief.

TABLE OF DEMULCENTS.

A. DEMULCENTS MEDICINALLY EMPLOYED.

* *Animal.*

a.—GELATINE—procured from			
Horns—Cervus *Elephas.*	1.	7.	Ruminantia.
Sounds—Acipenser *Sturio.*	4.	2.	Sturienes.
b.—CETINE—from			
Physeter *Macrocephalus.*	1.	8.	Cetacea.
c.—WAX—produced by			
Apis *Mellifica.*	4.	12.	Hemenoptera.
d.—FIXED OIL.			
Fat—Ovis *aries.*	1.	7.	Ruminatia.
Sus *scrofu.*	1.	6.	Pachydermata.

* * *Vegetable.*

e.—GUM—exuded by			
Acacia *Vera.*	23.	1.	Leguminosæ.
——— *Senegalensis.*	—	—	———
f.—MUCUS—procured from			
Roots—Althæa *officinalis.*	16.	8.	Malvaceæ.
Malva *sylvestris.*	—	—	———
Seeds—Linum *usitatissimum.*	5.	5.	Lineæ.
Pyrus *Cydonia.*	11.	5.	Rosaceæ.
g.—CERASIN—exuded by			
Astragalus *Gummifer.*	17.	4.	Leguminosæ.
Prunus *cerasus.*	12.	1.	Myrtaceæ.
h.—SARCOCOLL—in			
Roots—Glycyrrhiza *glabra.*	17.	4.	Leguminosæ.
Fruits—Amygdalus *communis.*	12.	1.	Amygdaleæ.
Oleæ *Europeæ.*	2.	1.	Oleaceæ.
Coccus *Buteracea.*	1.	1.	Palmæ.

B. DEMULCENT SUBSTANCES DIETETICALLY EMPLOYED.

a.—FECULA—from

Roots—Maranta *Arundinacea.*	1.	1.	Marantaceæ.
Plant—Cetraria *Islandica.*	24.	3.	Lichenes.
Bulbs—Orchis *Mascula.*	20.	2.	Orchideæ.
Pith — Sagus *farinifera.*	1.	1.	Palmæ.
Cycas *circinalis.*	1.	1.	———
Seeds—Triticum *hybernum.*	3.	1.	Gramineæ.
Avena *sativa.*	—	—	———
Hordeum *distichon.*	—	—	———

A. MEDICINAL DEMULCENTS.

* *Animal Productions.*

a. GELATINE.

Gelatine is found in the skin, membranes, tendons, cartilages, and bones of land animals, and the sound or swimming-bladder of fishes; but not in any healthy animal fluid*. It is a semi-transparent, brittle substance: it dissolves in cold water; but more readily in hot water; and, on cooling, assumes a semi-diaphonous, tremulous appearance. If in this state it be agitated with cold water, a complete solution takes place.

Gelatine, when freed from water by evaporation, so as to become brittle, is not susceptible of change, and may be kept for any length of time. For medicinal use, it should, therefore, always be kept in the dry state. But, when it is united with so much water as to render it tremulous, it soon undergoes decomposition, first becoming acid, then exhaling a fœtid odour; and putrefaction takes place. Exposure to the air is not necessary to effect this change in Gelatine. When exposed to a high temperature, Gelatine first whitens, then shrivels, and is carbonized: tremulous Gelatine first melts before it undergoes these changes. When tincture of galls or any astringent vegetable solution is dropped into Gelatine in solution, an insoluble precipitate takes place; this is a compound of the Gelatine and tannin: and it is this combination that produces leather. Gelatine, like gum, renders oils miscible with water, forming emulsions.

Alcohol and ether do not dissolve Gelatine, but separate it from the water of its solution: in a thin solution, however, neither alcohol nor ether produces any obvious change. All the concentrated acids decompose Gelatine, but diluted acid

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* Berzelius—Bostock.

dissolves it unchanged. When chlorine gas is mixed with a solution of Gelatine, a white solid matter, in filaments, is separated, which Bouillon la Grange has named oxygenized Gelatine; but the nature of this change is unknown. The alkalies, assisted by heat, dissolve gelatine, but do not produce soaps. None of the earthy salts, with the exception of baryta, precipitate its solution; phosphate of soda, however, causes a slight milkiness in it. Among the metallic salts, nitrate of silver only precipitates the solution of pure Gelatine.

According to the analysis of Gay-Lussac and Thenard, the components of Gelatine are—carbon 47.881, + oxygen 27.207, + hydrogen 7.914, + azote 16.998, = 100.000. Such are the chemical characters of Gelatine; but these differ in some particulars, according to the nature of the substances which yield it.

HARTSHORN SHAVINGS. *Cornu.* L. E. D.—The horns as well as the hoofs of the greater number of animals consist of albumen; but those of the stag closely resemble bone, and yield a considerable quantity of gelatine.

The Stag, Cervus *Elaphas*, is a native of the whole northern parts of our hemisphere. The male acquires horns at two years old; they are shed annually, about the end of February; and are reproduced during the summer, in a soft, tender state, full of blood-vessels, and covered with a downy cuticle, which they lose by degrees as they increase in size, until they become hard, compact, and bony. It is supposed that the number of the points of the horns indicates the age of the animal; but, after the eighth year, this is very uncertain*. Pure Hartshorn Shavings, which are formed by planing down the internal white part of the horn, yield to water, by decoction, twenty-seven parts of gelatine in every hundredth part of the horn: it is inodorous and insipid, and has all the chemical properties of pure gelatine. As sold for medicinal use, these shavings are mixed with bone shavings, which may be distinguished by their greater degree of brittleness: but the adulteration is of too little consequence to merit attention. The retention of Hartshorn in the list of the Materia Medica is the relic of a period of inert practice: it yields a light and sufficiently nutritious article of diet for the sick and the convalescent; but this very quality renders it useless as a medicine.

ISINGLASS. *Ichthyocolla.*—The sounds of the Perch, some species of the Cod, and a few other fishes found in the waters of this island and upon its coasts, afford isinglass. The Sturgeons,

* A curious fact attending the growth of the Stag's horns is worthy of notice, in a physiological point of view. When the animal is castrated, if this is performed at a very early age, the horns do not grow; if at a later period of life, the horns do not alter nor fall off during the life of the animal. I have a pair of horns in my museum, presented by my friend, Sir F. Shukburgh, Bart., which were produced on a castrated deer on his own estate.

Acipenser *Sturio*, *Ruthenus*, and *huso*, from which the best is prepared, are caught in the rivers of Russia, in the Nile, and in the Caspian Sea, and occasionally in those of this country.

The Isinglass is the prepared sound or swimming-bladder. It is taken from the fish, slit open, well washed, and freed from the thin membrane which covers it; then beaten, exposed to stiffen a little in the air, rolled, and fixed in a peculiar shape by means of wooden pegs, or folded into leaves like a book, or simply dried without any care. The best Isinglass is generally that which is rolled up and called *staple;* the next best kind is the *book Isinglass:* there are inferior kinds, which are chiefly used to adulterate the better kinds. Good Isinglass should be dry, whitish, semi-pellucid, and inodorous. One hundred grains of it should afford ninety-eight of matter soluble in water, and scarcely two parts of solid, insoluble matter, which consist of phosphate of soda and phosphate of lime. The same objections apply to Isinglass as to gelatine, as a therapeutical agent; and we can only wonder that, while this gelatine is expunged from the last edition of the London Pharmacopœia, that of the hartshorn is suffered to remain. It was formerly regarded as an antacrid, lubricating, and incrassating remedy; but the experience of modern medicine has demonstrated it to be worthless as a remedy.

As a nutrient, a solution of Isinglass, acidulated with lemon juice, and, when it is admissible, flavoured with wine, is a very proper and agreeable food for the convalescent; but it is much less nutritive than the muscular parts of animals, and also less easily digested. In animal broths, gelatine is combined with oil; and if we can regard it at all in the light of a remedy, it is in this form; in which it is ordered as an enema in the tenesmus of dysentery, and in ulcerations or abrasions of the lower portion of the intestinal canal.

b. CETINE.

This name was given by Chevreul to the white crystalline scales deposited from alcohol boiled on Spermaceti.

Spermaceti is an inflammable substance, occurring in white, pearly, crystalline plates, brittle, soft, and unctuous: at 210° Faht. it softens and melts; but crystallizes again when cooled. It is insoluble in water, but soluble in 13 parts of boiling alcohol, from which, as the solution cools, it is deposited in brilliant, talc-like scales. It is also soluble in ether and fixed and volatile oils; but it separates from the latter as it cools. When distilled repeatedly, it is partially decomposed, and becomes liquid, like oil; and, by a farther repetition of this process, a brown acid liquid is produced. It forms a soap with the pure alkalies: the acids have scarcely any action upon it. In the head of the Phyceter *Macrocephalus*, or white whale, the Spermaceti is

contained in two principal cavities, and some small ones, which are covered with several teguments: namely, the skin; a layer of fat; and a black membrane containing large nerves. The larger cavities are subdivided into smaller chambers, each of which is again subdivided by vertical membranes resembling the lining pellicle of an egg. The lowest cavity contains the purest Spermaceti, which is always fluid during the life of the animal. The Spermaceti is also distributed all over the animal by a peculiar system of tubes, the main trunk of which is improperly termed the *spermatic* vein. Besides being thus found in the white whale, it also exists in all the other Cetaceæ; from the oil of which it is deposited in considerable quantity; and this is also the case, in a more moderate degree, in the oil of all fishes, whether breathing by lungs and mammiferous, or breathing by gills.

The quantity of crude Spermaceti which is dug out of the head of an ordinary-sized whale is seldom less than twelve large barrels-full. The oil is separated from it by dripping; and, when sent to England, it has a yellow, unctuous appearance, and a nauseous odour; and is unfit for medicinal use until it is purified.

Spermaceti, although more employed as a Demulcent, is scarcely more valuable as a remedy than gelatine. It is readily digested in the stomach in the same manner as animal fat, and is converted into chyle with equal facility as any other animal matter. From some fancied healing virtues, which it was supposed to possess, it was formerly regarded as highly beneficial in all affections of the chest, the kidneys, and the uterus; and, even in the present day, it is often prescribed as a vehicle for preparations of opium, and sedatives after child-bearing. It is not for us to perpetuate error; and, as an internal remedy, experience has decided against the claims of this substance.

c. WAX.

Wax is both an animal and a vegetable production. It was long supposed to be merely collected by the bee from the pollen of flowers, and then wrought up by the insect into the regular and beautiful hexagonal cells which characterize the honeycomb; but this is a mistake: pollen does not yield wax, and it has been ascertained that bee's wax is an animal secretion, the production of the glands termed wax-pockets, which are seated under the wings on each side of the bee. From the observations of Huber, it appears that bees, supplied with sugar only, and shut up in the hive, manufacture Wax in the same manner as those bees which enjoy their freedom, and range from flower to flower. The flower yields the honey which the bee eats; and from the sugar of this, after it undergoes animalization in the stomach of the insect, wax is produced. But Wax, as above

stated, is also a vegetable production, and is found as an abundant excretion of many plants. What is called the bloom, on some leaves and fruits, is Wax: the seeds of the Myrica *cerifera*, an American tree, is so thickly encrusted with Wax, that it is separated from them for the purposes of commerce; and the trunk of a South American palm, the Ceroxylon *Andicola*, is thickly covered with it. It is found also in some vegetable essential oils.

Wax, as it is obtained from honeycomb, is of a dark-yellow colour, owing to its admixture with some honey and what is termed bee-bread. It has an aromatic odour, owing to the same admixture; for pure Wax is inodorous and insipid. It is purified by being drawn out in ribands, and afterwards exposed to the light and air. By this process it is whitened; and is then melted and thrown into moulds, to acquire the round and disc-like shape, in which it is usually sold. By this process not only is the colour discharged; but, as purified Wax is of a less specific gravity than yellow Wax, we may conclude that something is lost during its bleaching. Chlorine bleaches it when applied to it in combination with water. Unbleached or yellow Wax is brittle, but not hard, is ductile and unctuous, and does not adhere to the fingers. When cut, it presents a peculiar surface, which is termed *waxy-lustre:* its sp. gr. is 0.96; it fuses at 150° Faht. and boils at 300°. It is insoluble in water, and only partially soluble in boiling alcohol or ether; and the greater part of the Wax is precipitated as the solutions cool: what is retained is precipitated by water. Both the fixed and the volatile oils dissolve Wax when aided by heat: with the former, it constitutes cerates and ointments. Boiled with the fixed alkalies, it forms a soap, which is a simple combination of the Wax and the alkali; for when an acid is added to the saponaceous compound, the Wax is separated in its natural state. The acids scarcely act on Wax.

According to the experiments of Dr. John, when bees-wax is treated with boiling alcohol, it is separated into two distinct substances, *cerin* and *myricin*. The former is of the consistence of Wax, of the same specific gravity as water, melts at 108° Faht. is insoluble in water and in cold alcohol, but soluble in boiling alcohol, precipitating, however, as the solution cools. *Myricin* is somewhat glutinous, of less specific gravity than water, and insoluble in water, alcohol, or ether, even when hot. The former of these substances gives the brittleness to Wax, the other its unctuosity. Dr. Ure asserts that the ultimate components of Wax are 80.4 of carbon, 11.3 of hydrogen, and 8.3 of oxygen, or 13 eq. of carbon = 78, + 11 of hydrogen = 11, + 1 of oxygen = 8, making the equivalent 97. According to this analysis, Wax contains less oxygen than the fixed oils.

Wax is often adulterated. When very brittle, and the colour

of the mass is a light grey, inclining to yellow, there is a reason to suspect that it is mixed with peas-meal; when the fracture is smooth, shining, and vitreous, it contains resin, which may be readily detected by putting a small quantity of wax into cold alcohol: the resin is dissolved, whilst the Wax remains unacted upon. An admixture of *tallow* is detected by the exhalation of a disagreeable, suffocating smell when the Wax is melted.

Wax, combined with soap and mucilaginous solutions, is employed as a Demulcent in the tenesmus of dysentery; but it possesses little demulcent virtue. The best formula for prescribing it is that of Dr. Monro. He orders three drachms of *bees'-wax*, one drachm of Castile soap, and one fluid ounce of water, to be melted together over the fire in a tin vessel, stirring the mixture until the ingredients are perfectly mixed. The whole is then to be poured into a mortar, and gradually incorporated with a pint and a half of water, and two ounces of syrup of marsh mallows. The dose of this compound is two or three table-spoonfuls, repeated at the intervals of three or four hours. It has been recommended in diarrhœas; but, if these are passive or depend on simple debility of the viscus, such a composition as this is must increase the evil: if they arise from inflammation or any other active cause, it is not easy to see how such a remedy can prove beneficial, although it is not difficult to conjecture that it would prove hurtful if it passed unaltered to the diseased surface.

** VEGETABLE SUBSTANCES USED AS DEMULCENTS.

a. GUM.

Gum is one of the earliest of the vegetable secretions, being the first change of the sap into a distinct substance. It exudes from the bark of certain species of trees, and almost all of them have astringent barks. The general characters of Gum in the dry state, that in which we are most familiar with it, are semi-transparency, brittleness, insipidity, inodorousness, and solubility in water. When very pure, it is nearly colourless; but some of the varieties are yellowish. Its specific gravity is greater than that of water, being 1.355. It does not undergo any change when kept in a dry place; but, when moist, it becomes mouldy. Exposure to the light blanches it. Heat softens and swells it, but it does not melt; on the contrary, it is charred, emits a bluish flame, and a light charcoal remains in the retort: in a high temperature, it is consumed, leaving a white ash, which consists chiefly of carbonates of lime and of potassa. The solution in water does not undergo any material change; for, when the water is evaporated, the Gum is obtained unaltered. When it is long kept in this state, if the mucilage it forms be

not too thin, it will keep unaltered for years; but, if thin, it acquires an acetic odour and taste, and becomes mouldy on the surface. Its solution precipitates and decomposes some of the metallic salts: thus, with subacetate of lead, it forms a copious coagulum, which consists of 38.25 parts of oxide of lead and 61.75 of Gum; the acetic acid being left in the water. It unites readily, without any obvious change, with all the alkalies when unaided by heat; but, when liquid pure potassa is employed and the mixture heated, it converts the Gum into albumen; and, when the watery part is evaporated, the residue has all the characters of albumen treated with heat, and is equally insoluble. M. Raspail, who first remarked this result of the alkali on Gum, asserts that the alkali actually converts the Gum into true albumen, which he conceives to be a compound of Gum and potassa, even when it is the product of animals. It certainly resembles animal albumen in the following property: — when exposed to a high temperature, it is incinerated with difficulty, whereas, nothing is so easily carbonized as Gum: but, according to Raspail, it is the alkali which, both in the albumen and the alkalized Gum, resists the incineration. This is certainly a very remarkable fact, and demonstrates the existence of an affinity between vegetable and animal products.

The mineral acids act powerfully upon Gum; the sulphuric decomposes it, resolving it into charcoal, tannin, water, and acetic acid; the muriatic produces a brown solution, which lets fall a charry matter, and the Gum approaches to sugar in its properties; but the most remarkable effects are produced by nitric acid. If this acid and Gum be slightly heated until a solution is formed, and a little nitrous gas be evolved, the solution on cooling deposites mucic acid; and malic acid is formed at the same time. If a greater quantity of acid be used and the heat longer continued, the Gum is changed into oxalic acid. When alcohol is poured into a solution of Gum, it precipitates the Gum, by attracting the water of solution; at least, this is the explanation of the phenomenon given by the chemists. Gum is insoluble in oils; but, when triturated with them, they are rendered miscible with water—a fact which is very useful in prescribing these unctuous bodies.

When Gum is exposed for a long time to a temperature of 212°, it loses, according to Dr. Prout, all the water not essential for its composition; but, even in this state, it consists of carbon 41.4, and water 58.6, in 100 parts. According to the analysis of Gay-Lussac and Thenard, 100 parts of Gum consist of 50.84 of oxygen, 42.23 of carbon, and 6.93 of hydrogen. If these analyses be correct, we may with much probability suppose that Gum is the consequence of the decomposition of water in the vegetable system, and the union of its components with the carbon taken in with the fluid of the soil in a state of solution.

Gum is the production of a great variety of plants.

GUM ARABIC. *Acaciæ veræ Gummi.* L. E. D.—The Acacia yielding this gum grows on the Atlas mountains, and at Bled-eljerrede. It belongs to the natural order Leguminosæ. This plant was formerly named *Sant* by the Egyptians. It is a low tree, of a hard, withered aspect, with a stem covered with a grey bark, from which the gum exudes in a soft, semifluid state, and hardens in the atmosphere without losing its transparency. When first collected, which is about the middle of December, the gum has a faint smell; and, after being stowed in the warehouses, cracks spontaneously. The best Gum Arabic exported from Morocco is procured from the province of Sase and that of Abda. It is often mixed with gum senegal, which is the production of the Acacia *Senegalensis*. Good Gum Arabic has a very pale straw colour, breaks with a vitreous fracture, is transparent, inodorous, insipid, and feels viscid in the mouth. It is, in general, in small, round, irregular pieces. When dissolved in water, a small portion of insoluble matter is left, which contains nitrogen. According to Gnerin, the solution contains bimalate and muriate of lime, and muriate and acetate of potassa.

Besides the general components of Gum, this species contains a small portion of gluten, which is detected by rubbing the Gum with a spirituous solution of guaiac, which evolves a blue colour. The change is gradual, first to a pale green and ultimately to a deep cerulean blue. This is perhaps the most perfect test of the distinction between gum and mucus; next to this is the precipitate caused by subacetate of lead; then that by silicated potassa; and, lastly, that by alcohol, which precipitates Gum in white opaque flakes, and merely coagulates mucus. Such are the distinguishing features of Gum and mucus. Gum Arabic is often mixed with the Gum of another species of Acacia, a native of Hindostan, Ceylon, and also of Arabia, the Acacia *Arabica* of Roxburgh. This Gum is collected in the dry season, and is used as an article of diet by the poor Hindoos, mixed with the seeds of the sesamum, after the oil is expressed from them. Another species of Gum, which resembles that of the Acacia *vera* in its properties, is obtained from the Feronia *Elephantum*, or wood apple tree of Roxburgh; a tree belonging to the natural order Aurantiaceæ, and a native of the woods and mountainous parts of India, and of Ceylon, near Colomba. The Gum exudes from wounds made in the bark; and is so pure and transparent that Roxburgh says "Mr. Smart, the miniature painter, told him it exceeded every thing he had ever seen for mixing with his colours*." This Gum is employed for medicinal purposes all over India: for it is never brought to England as an article of commerce.

* Plants of the Coast of Coromandel, fol. vol. ii, p. 20.

The demulcent properties of Gum were very early known. Dioscorides mentions that it obtunds the acrimony of medicines with which it is mixed. If we enter into the examination of the effects of the digestive powers of the stomach on Gum, we shall find that, unless it be combined with a bitter, it is seldom digested, and not unfrequently passes through the stomach and bowels unaltered. This, in a great measure, secures its power as a Demulcent. In opposition to this opinion, may be stated the fact mentioned in Hasselquist's Voyages, that a large caravan of Abyssinians would have starved if they had not discovered a stock of Gum Arabic amongst their merchandize—on which alone 1000 persons subsisted for two months. Whole towns of negroes in Africa, also, subsist upon Gum in seasons of scarcity; and the Arabs who collect the Gum subsist upon it during the period in which they are thus employed*. Yet dogs, as an experiment of M. Majendie proved, soon perish if fed only on Gum. The animals quickly lose flesh; they become dull, retain no relish for food in the second and third week, and generally die about the 32nd or 33rd day of the experiment†: but it should be recollected that the dog is a carnivorous animal.

The effects of Gum as a Demulcent is well confirmed; it is useful in the inflammatory stage of gonorrhœa; in strangury from the absorbtion of cantharides and other acrid matters which pass into the circulation and are excreted by the kidneys; in catarrh, to sheath the fauces; and as an enema, combined with milk or other animal juices, in tenesmus. In whatever form Gum is administered, it ought to be thick, so as to admit of dilution in the juices of the stomach, if we are to expect any benefit from its employment as a demulcent.

e. MUCUS (*vegetable*).

This principle is more generally extended over the vegetable kingdom than Gum. It is found in the roots, leaves, and seeds of many plants; and, in its purest state, greatly resembles a solution of Gum in its physical properties. Dr. Bostock first pointed out two of the distinctions which mark the difference between Gum and Mucus. I have already mentioned another, guaiacum.

Mucus varies according as it is procured from different plants; and parts of plants.

* ROOTS.

1. THE ROOTS OF MARSH MALLOW. *Althææ officinalis radix.* L. E. D.—This plant, which belongs to the natural order Malvaceæ, is indigenous; the root is perennial, and the

* Lind on the Diseases of Hot Climates. † Majendie's Elemens de Physiologie, &c.

herbaceous part annual. It is cultivated both in Germany and in France, for medicinal purposes, and is imported into this country. The root is fusiform, white in the interior, and covered with an ash-brown epidermis. Every part of the plant abounds with mucus; but it is most plentiful in the roots. When these are steeped in cold water, the mucus alone is extracted; but, when they are boiled, the mucus is mixed with fecula. According to the analysis of M. Bacon, of Caen, Marsh Mallow roots contain—gum or mucus; sugar; fat oil; starch; a peculiar crystalline matter which he named *altheine*, resembling asparagine or glycyrrhizine; malic acid; albumen; several salts; and lignine*. The officinal preparations of this root are decoction and syrup. On the Continent, a Demulcent lozenge is prepared with it, named *Pâte de Guimauve*.

** LEAVES AND FLOWERS.

1. THE LEAVES AND FLOWERS OF COMMON MALLOW. *Malvæ Sylvestris folia et flores.* L. E.—This plant is found in almost every quarter of the globe; it is a common weed on the sides of roads and around fields in this country. All the parts of the plant yield mucus; and, when boiled, tincture of iodine demonstrates the presence of starch in the decoction. The flowers being delicate tests of the presence of alkalies and acids, any addition of these substances to the decoction gives it a green or a red colour, as the one or the other is used. The decoction is employed as a fomentation in abrasions, and as a glyster in dysentery.

2. An East Indian plant, Gmelina *parviflora*, contains so much mucus, that a thick viscid mucilage, which may be used as gum, is obtained by steeping a few of the leaves in cold water for eight or ten hours.

*** SEEDS.

1. LINSEED. *Lini Ussitatissimi Semina.* L. E. D.—The Lint plant, belonging to the natural order Lineæ, of which it is the type, is generally cultivated in Britain; but it originally came from the banks of the Nile. The seeds used in this country are imported chiefly from the Baltic. The plant is readily distinguished by its slender, smooth, round stem, seldom exceeding two feet in height; its small, sessile lanceolate, narrow, alternate leaves; its loose panicle of blue-streaked flowers; and its globular capsule terminated with a spine, containing, in five cells, many flat, elliptical, mahogany-brown shining seeds, with white oily cotyledons.

The mucilage resides in the testa of the seeds, one ounce of which, infused in ten fluid ounces of water, forms a colourless,

* Journ. de Chim. Med. t. ii, p. 551.

viscid mucus, which is coagulated by alcohol, subacetate of lead, and permuriate of tin; but produces no effect on silicated potassa, nor the salts of iron, nor the decoction of galls. This mucus soon gets ropy and spoils. M. Vauquelin examined it, and found that it consists of gum, combined with an azotized matter, acetic acid, acetates of potassa and lime, sulphate and muriate of potassa, some phosphates, and silex.

2. QUINCE SEED. *Pyri Cydonis Semina.* L.—This plant, which belongs to the natural order Pomaceæ, is a native of Crete. The testa of the seeds abound with mucus, which is readily abstracted by boiling water, an ounce of them being sufficient to render a pint of water viscid. When the seeds are boiled, the decoction contains, besides the mucus, malic acid and fecula; on which account the mucilage rapidly ferments. Acids and metallic salts coagulate the mucus of Quince Seed; consequently, they are incompatible in prescriptions with it. The decoction is the officinal preparation.

All the varieties of mucilage which have been described, with the exception of that procured from the leaves of the Gmelina *parviflora*, were well known to the ancients. The mucilage of the linseed, in particular, on account of its cheapness, has always been in common use. In preparing it, the custom is to boil the seeds in water; but this is not only unnecessary, but is improper, as some of the fixed oil contained in the cotyledons is extracted, and gives a nauseous taste to the mucus. In all visceral inflammations, particularly in those of the kidney or the bladder, in gonorrhœa, ardor urinæ, and tenesmus, the mucilage of linseed has been found very useful, whether administered by the mouth or as an enema. Dioscorides particularly notices the mucus of the marsh mallow in affections of the urinary bladder: it is procured by slicing the root transversely, and boiling it in water, in the proportion of two ounces of the root to a pint of water. Both the leaves of the Althæa and those of Malva, when well boiled, form excellent emollient cataplasms in abrasions, and in some cutaneous eruptions in which a sharp ichorous discharge takes place. They form excellent vehicles for the hydrocyanic acid, as an external application, when there is much irritation in impetigo. The mucus of the quince is employed in aphthous states of the mouth, and in inflammation of the eye, when the lachrymal discharge is sharp and acrid, and as an enema in tenesmus and chronic diarrhœa. These mucilages, as internal remedies, are less useful than the mucilage of gum arabic, inasmuch as they are more digestible, and therefore less likely to pass into the system undecomposed; this is especially the case with the quince mucilage, which contains a bitter principle that aids the influence of the stomach upon the mucus.

f. CERASIN.

Cerasin derives its name from *Cerasus*, the specific name of the Prunus, the botanical genus which yields the plum and the cherry. It exudes from the bark of the cherry-tree, in small quantity and very impure: the greater part of that which is used in medicine and in the arts is brought from Persia.

Cerasin is sometimes in pieces, resembling gum, but more frequently in vermicular fragments, less transparent than gum and not so easily pulverized, but equally insipid and inodorous. It is nearly insoluble in cold water; but imbibes the water, swells, and forms a thick, gelatinous mixture: if the cold water, however, be acidulated with any of the mineral acids, a portion of the Cerasin is dissolved. In boiling water, the gelatinous mixture of the Cerasin and water is dissolved; but, as the liquid cools, the gelatinous part is again precipitated: if the acidulous mixture, however, be heated, nearly the whole is permanently dissolved. According to Bucholz, a German chemist, Cerasin consists of 57 parts of a matter resembling gum, and 43 parts of a peculiar matter, insoluble in cold water, although it imbibes that fluid and swells like a sponge; but it is soluble in boiling water, in which it forms a permanent mucilage. According to the analysis of Guibourt, the portion dissolved in cold water differs from gum in collecting into an opaque mucous mass, when it is precipitated by alcohol, which is not the case with gum; whilst the insoluble portion, he says, has some affinity to starch in striking a blue colour with tincture of iodine. This latter portion has been named Bassorine, from being found abundantly in *Bassorah* gum. From what I have said of the effect of alcohol, the acids, and iodine, it is probable that Cerasin is a compound of mucus and fecula; the former constituting the portion soluble in simple water, the latter that which requires the aid of acids for its solution. If a solution of gum arabic be poured into a solution of Cerasin, no union takes place; on the contrary, the Cerasin separates sooner from the water than it would otherwise have done. A homogeneous mucilage may be formed by triturating Cerasin with pure water in a mortar. This solution is precipitated by subacetate of lead: so far it accords in its characters with gum; but muriate of tin, which does not affect a solution of gum, produces a copious precipitate in a solution of Cerasin, in which respect it accords with fecula. Silicated potassa, which precipitates a solution of gum, does not affect the watery mixture of Cerasin; demonstrating that the soluble part is mucus. Nitrate of mercury throws down a slight reddish precipitate. Such are the chemical properties of Cerasin, confirming my opinion of its character, that it is a mixture of mucus and fecula. There are three known varieties of Cerasin.

1. TRAGACANTH. *Tragacantha.* L. E. D.—This is almost pure Cerasin. It is the production of a species of Astragalus, which is supposed to be the A. *Creticus*, a plant which grows abundantly on Mount Olympus and in Iona and Crete, belonging to the natural order Leguminosæ. Tournefort describes the plant which he saw on Mount Ida, and details the manner in which the Tragacanth is collected; but, notwithstanding the time that has since elapsed, there is still doubt respecting the species of Astragalus which yields this gum-like exudation. The Astragalus *Tragantha* and *Gummifer* of Labillardiere are supposed to be the plants; whilst some refer it to the Astragalus *verus* of Olivier: perhaps, all of them yield Tragacanth. It is gathered in autumn: its exudation, which occurs in summer, is more or less abundant according to the heat of the weather; it exudes in tortuous filaments or ribands. That which is collected in Persia is sent to Bagdad, Bassorah, and Russia: that which comes to this country is exported from Aleppo.

The qualities of Tragacanth which distinguish it as being good, are, whiteness, semitransparency, brittleness, insipidity, and inodorousness. It displays all the chemical properties of pure Cerasin. Although brittle, yet it is not easily pulverized, unless during frosty weather and in a heated mortar. The London College orders a compound powder which contains starch—a useless ingredient, as it is not soluble in cold water. Mucilages of Tragacanth are ordered by all the British Pharmacopœias. A drachm of Tragacanth thickens a pound of water as much as an ounce of gum; but the best proportions for internal use are a drachm of Tragacanth to eight fluid ounces of water.

2. CHERRY-TREE GUM. *Pruni Cerasi Gummi.*—Besides being procured from the cherry-tree, this species of Cerasin exudes from the bark of the Apricot and the Plum-tree. It is too well known to require any particular description. As it exudes from the bark, it is variously coloured by the other secretions of the bark: thence, Cherry-tree Gum, were it even obtained in sufficient quantity for medicinal and other purposes, is too impure to supply the place of tragacanth. It consists chiefly of Cerasin; and, from the circumstance of Dr. John having discovered this product in Cherry-tree Gum, the whole received from him the name of Cerasin. It displays all the chemical characters of tragacanth, with the addition of a little tannin.

3. THE GUM OF BASSORAH. *Gummi Bassoræ.*—This is the production of an unknown plant. M. Virey, in a paper which he published in the Journal de Pharmacie, has conjectured that it is a species of Mesembryanthemum; but upon what foundation does not appear. It is brought from the neighbourhood of the city of Bassorah; whence its name: but it is, occa-

sionally, found mingled with the gum arabic of the Coast of Barbary. It is in irregular masses, of a yellowish hue, less transparent than gum arabic, but more so than tragacanth. It is insipid, and does not produce so thick a mucilage as tragacanth. It swells like tragacanth when put into water; but it does not form a cohesive mucilage, as it appears to be composed of a vesicular matter, which, after it swells in water, separates like little granules, and does not appear to be susceptible of cohesion. This vesicular matter, which is insoluble in water, is not coloured blue by iodine; it is soluble in water acidulated with nitric acid. Treated with potassa, ammonia is disengaged. If the Gum of Bassorah be treated with water, alcohol, and ether, it leaves this substance, which is *Bassorine*, in a state of purity. Vauquelin, who has particularly examined this substance, found it in the Gum of Bassorah, and named it; Pelletier has found it in *assa-fœtida*, *euphorbium*, *bdellium*, and *sagapenum;* Braconnot in the *bean of St. Ignatius;* and Caventou in *opium*.

Such are the three varieties of Cerasin which have been employed as Demulcents. The Tragacanth is the only one generally used in medicine. As it forms a thicker mucilage than gum arabic, it has acquired the character of being a better Demulcent; but, from its approximation to fecula, I am disposed to think that it is more digestible than gum, and therefore is less demulcent when it is taken into the stomach. As a local Demulcent, it is preferable to mucilage of gum; but, upon the whole, all the purposes of a Demulcent, whether general or local, are obtained from Gum Arabic; consequently, it is unnecessary to load the list of Materia Medica with other vegetable gums for this purpose.

g. SARCOCOLL.

This is the concrete juice of the Penæa sarcocolla, a plant which is a native of Africa. Sarcocoll was known to Dioscorides, who states that it is the tears of a tree which is a native of Persia; that it resembles the farina of frankincense, is reddish, yellow, and is bitter to the taste; and that it is often adulterated with gum. It is generally in small yellowish grains, and has a peculiar odour not unlike that of anise-seed. The pure Sarcocoll which the samples of this vegetable matter generally contain does not exceed eight parts in ten; the other two parts are impurities of various kinds, but chiefly cerasin. Sarcocoll has a sweet taste, which changes to a bitter. The watery solution is viscid. Its solution is precipitated by infusion and tincture of galls. Nitric acid causes a slight effervescence, and throws down a white precipitate. Silicated potass causes no precipitate, but colours the solution green, as do all the alkalies. Sulphate of iron slowly forms a precipitate, and subacetate of lead an immediate and copious one. The circumstance of being

precipitated by tincture of galls distinguishes Sarcocoll from gum and mucus, and approximates it to starch, which yields a gallo-tannate when treated with hot infusion of galls and allowed to cool.

The extract of liquorice, or Spanish juice, as it is termed, owes its taste and peculiar properties to Sarcocoll. It is obtained from the roots of the Glycyrrhiza *glabra*, a plant belonging to the natural order Leguminosæ. This plant is a native of Syria, cultivated abundantly in Spain and in this country. When the plant is three years old, the roots are supposed to be at their perfection; they are then dug up for use. Dr. Russel, in his History of Aleppo, informs us that a decoction of the roots of the liquorice plant is drunk cold in summer, in the manner of sherbet. By decoction, these roots yield the well-known extract, *liquorice*, or *Spanish juice*, which is chiefly prepared in Spain, whence it is imported in rolls covered with laurel leaves. It is afterwards refined, and formed into small cylinders, which are glossy, brittle, and break with a vitreous fracture. It consists of mucus, Sarcocoll, sugar, and charcoal, which is converted into artificial tannin when the liquorice is dissolved in nitric acid; and when dissolved in sulphuric acid, the charcoal left amounts to one quarter of the weight of the liquorice employed. The saccharine matter of liquorice may be procured in the form of a yellow, transparent, brittle mass, which, when heated, swells, burns with a clear flame, and gives out smoke. The solution of this saccharine matter in water is precipitated by all the acids; but none of the acids appear in the precipitates. Robiquet, who first separated this saccharine matter from liquorice, has named it *Glycyrrhisine*.

As a Demulcent, extract of liquorice is useful for smearing the fauces and allaying the tickling cough which often accompanies catarrh. It is also useful, although in an inferior degree, when taken into the stomach, as it involves there acids and many things that are detrimental to the healthy stomach. In heart-burn, a piece of liquorice often affords very considerable relief.

h. FIXED OILS.

As an article both of diet and of medicine, one of these oils, that of the olive, has been known from the earliest periods to which the history of our species can be traced. As Demulcents, the Fixed Oils are rarely given in an uncombined state, although the followers of the doctrines of Broussais, in France, have lately exhibited them in those affections of the viscera which they term gastro-enteric; and it is undoubted that, in their unmixed state, the Fixed Oils are not readily digested, but continue separate from the other contents of the stomach, and thence are well adapted to act as Demulcents. When taken into the stomach in a combined state, such as occurs in the productions

of nature—in the emulsive seeds, for instance—they are wholly converted into chyme, and of course do not pass the pylorus as oils; so that they cannot exert any demulcent effect; but when they are not blended with other substances, this is not the case, and they become useful medicinal agents. Much, however, depends on the manner, and even on the dose, in which they are given; for oil which, in small doses, acts as a Demulcent, in large doses proves either emetic or purgative. When given as Demulcents, they are generally combined with other substances, either by the hand of nature or by art: it is in this latter state that we have now to examine them.

When artificially prepared as Demulcents, fixed oils are generally combined with water, either by means of mucilage of gum or of alkalies. When the first is used, the oil is simply diffused through the fluid in a state of minute division, and the mixture is easily decomposed; with the other, a soap is formed, which is more permanent. In the first state, the oil is more easily digested as it approaches to the condition of natural emulsions, or those formed by triturating demulsive seeds with water. In the saponaceous compound, on the other hand, oil is a useful Demulcent; and, although I cannot exactly explain the manner in which it produces its effects, experience has sufficiently confirmed its utility to authorize its recommendation. The only seed employed for forming emulsions is the almond, the produce of the Amygdalus *communis*.

As imported into this country, the almond is sometimes freed from its shell. The best is brought from Malaga, under the title of *Jordan* almonds. The bitter almond, which does not differ much in appearance from the sweet almond, is generally considered as the produce of a distinct variety of the Amygdalus *communis*. Both yield, when expressed, a considerable quantity of bland, insipid, inodorous oil, which, in the cotyledons of the almond, is united with mucus and fecula. This fecula, however, differs from starch, as it is not capable of striking a blue colour with iodine, and is supposed to have properties closely resembling albumen. According to the experiments of M. Boullay, 100 parts of almonds contain 54 parts of a fat oil, 24 parts of albumen, 6 parts of sugar, or rather a saccharine principle, and 3 parts of gum. The albumen which the almond contains is supposed to approximate to the white of egg; but it differs very considerably from that animal substance. A very small proportion of white of egg diluted in water is immediately precipitated by a few drops of the solution of corrosive sublimate, whereas the same substance contributes to the permanence of the almond emulsion. Besides these components of the sweet almond, the bitter almond contains an essential oil, on which its flavour and odour depend: hydrocyanic acid is evolved when it is treated with water. The emulsion of the sweet

almond cannot be regarded as a Demulcent, the quantity either of the oil or the gum being too small; but it is an useful and agreeable vehicle for other medicines. The emulsion of the bitter almond may be employed in the same manner as that of the sweet almond; and the hydrocyanic acid, instead of being a disadvantage, from the sedative effect which it produces on the nervous system, renders it more useful, in catarrh and similar complaints, than the emulsion of the sweet almond. It must, however, be kept in view that many people suffer from eating bitter almonds, owing to the volatile oil acting on a peculiar idiosyncracy: the skin is rendered highly irritable, and an eruption closely resembling nettle-rash appears.

The best known of all the bland vegetable oils is that of the olive, *Olea Europœa*, a plant which is a native of the north of Africa, and belongs to the natural order Oleaceæ. The value of the oil obtained from the fruit of this plant and the mode of procuring it were very early known; and it was so much prized, that the plant became the emblem of Peace. The oil is obtained from the ripe fruit, gathered in November, and bruised in a mill, which does not crush the nut. The pulp is then pressed in bags made of rushes; the best oil flows first, and is termed *virgin oil;* the marc is then broken, moistened with warm water, and again pressed, and an inferior oil is obtained; and, lastly, the marc is again broken down, moistened, fermented, and pressed, or it is boiled to an extract, to obtain from it all the oil which it contains. It is necessary to leave the newly-drawn oil at rest for some time, to enable it to deposite a fibrous albuminous matter, which is expressed with the oil.

The oil of olives imported into this country comes chiefly from Lucca and the vicinity of Florence; but the best oil is made in Provence, owing to the great care bestowed in cleaning and garbling the olives. This oil, when pure, has the common characters of the fixed oils; it is the lightest of the fixed oils, its specific gravity being 0.913; whereas that of almonds and of linseed is 0.932, and that of the poppy 0.929. The purer the oil, the lighter it is, and the thinner. Olive oil concretes in a temperature of 10° of Faht.; almond oil remains fluid at a lower temperature; and poppy oil still lower; which differences in the point of concretion enable the adulteration of the oil of olives with poppy oil to be readily detected, by exposing the suspected oil to a freezing mixture, which congeals the oil of olives, but does not affect the oil of poppies. The adulteration may also be detected by mixing the suspected oil with pernitrate of mercury. If the oil be pure, it will become totally consolidated in a few hours; whereas, if it be adulterated, this coagulation will not take place. The admixture of the poppy oil with the oil of olives hastens the rancidity of the latter. Oil of almonds, which is obtained by macerating almonds and then expressing them

without heat is of a paler straw colour than the oil of olives. When first expressed, it is turbid; but it is cleared by filtration through coarse, spongy paper, in a room kept at a rather high temperature.

The oils expressed from the seeds of plants are called *fat oils*. They are all insoluble in water; but form emulsions when triturated with yolk of egg or with gum and water; and it is owing to the presence of mucilage in the cotyledons of the seeds, which yield oil, that they form emulsions when triturated with water. When a thin layer of oil is long exposed to the air, it forms a varnish; and this change occurs rapidly when the layer of oil is exposed upon water in close vessels to the action of oxygen gas: thence we conclude that this change in the oil exposed to the air arises from the absorption of its oxygenous part. But some oils, under these circumstances, do not lose their transparency; and on this account are used in the art of painting under the term *drying oils*. When the fat oils become rancid, they thicken, acquire a brown colour, and a disagreeable smell; carbonic acid and hydrogen are evolved, with some carbonic oxide. They acquire, also, acid properties, converting the vegetable blues into red; sebacic acid and water being evolved. This state has been supposed to depend, in a great degree, on the mucilaginous matter which is pressed out with the oil, and does not separate from it.

The only concrete fixed oil used as a Demulcent is that obtained from the kernel of the fruit of the Makaw tree, the Cocos *butyracea*. It is termed an oil, *palm oil;* but it is, in fact, a vegetable butter. It is used for external purposes only; and in this respect, however, it is not superior to lard and other animal fats, except that it has an agreeable odour.

The demulcent properties of the fat or fixed oils were very early known. They were chiefly employed with the aid of friction; and both Galen and Celsus have left many precepts for their application. The local emollient properties of the fixed oils are much augmented by the addition of caloric in quantity sufficient to produce a temperature between 65° and 98°. In this respect, the action of the fixed oil cannot be regarded in any other light than as a mechanical agent acting on rigid surfaces without reference to vitality. To its emollient properties we ought to ascribe its effects in promoting the flow of the urine in ischuria or retention of urine, by rubbing it upon the lower part of the abdomen. We cannot account for this in any other manner than by supposing that the relaxing effect which the warm oil produces on the part to which it is applied is communicated by sympathy to the sphincter muscles of the bladder, which, in this case, are spasmodically constricted. Cullen ascribes the benefit chiefly to the friction; but friction alone does not produce the effect which

follows friction with warm oil. In noticing this emollient effect of caloric, combined with fixed oil, in ischuria, it is necessary to be careful that the stoppage of urine does not depend upon paralysis of the bladder; as, in that case, the application of warm oil as an emollient would be productive of injurious consequences, by adding to the degree of relaxation which is the cause of the stoppage.

B. DEMULCENTS EMPLOYED DIETETICALLY.

Dietetical Demulcents are all varieties of fecula or starch, combined with gluten, albumen, and other vegetable principles. *Starch* is readily distinguished from gum and sugar in its raw state by its opacity, its insolubility in cold water, and its forming a gelatinous mucus when it is boiled with water. Its solution in water soon loses its consistency, acquires an acid taste, and becomes mouldy; it should, therefore, never be kept in this state. It is insoluble in alcohol, which precipitates it from its solution; and it is also precipitated by tincture of galls, subacetate of lead, and barytic water; but the greater part of the metallic salts and silicated potassa do not act on starch. The most delicate test of its presence is iodine; but this acts only in a low temperature, heat decomposing the compound of iodine and fecula, or Iodide of Amidine, and destroying the colour. The varieties of fecula arranged in the table of Demulcents may be indiscriminately employed for supporting the strength in all diseases of increased action; and in convalescences from acute diseases. Among these varieties, the fecula of barley is the least, that of *salep* the most nutritious, owing probably to its containing a large proportion of saccharine matter.

SECTION II.

DILUENTS.—MEDICAMENTA DILUENTIA.

DILUENTS constitute an order of medicines of great practical importance; for, as they are beneficial in all febrile affections, and as fever is a general accompaniment of almost every disease, there is scarcely any deviation from health in the treatment of which they are not required. The name of the class refers to the simple fact, that the substances contained in it are intended for diluting the fluids of the body. Were this the only result of their administration, very few remarks, indeed, would be necessary for explaining their effects; but their operation involves many enquiries of great interest, some of which have long divided the opinions of physiologists. On this account, in

treating of Diluents, I shall enter more into details than might, on a cursory view of the subject, be expected.

The animal body is a compound of solids and fluids; consequently there must be maintained a certain relative proportion of these to constitute that state of system which is denominated *health*. In a full-grown adult, the solid matter of the body, under which term we comprehend all that substantial part of the frame which is not in constant motion in the vessels, does not amount to more than one-fifth of the weight of the body: Richerand makes it one-sixth, and Chaussier only one-ninth: it must be recollected that there is a quantity of fluid combined with the solids in so intimate a manner as almost to constitute a part of their substance. The diminution of the fluid part of the body, whether as regards the circulating mass or the solids, is the cause of an uneasy sensation, indicating the necessity of repairing the waste of fluids, which we familiarly term *thirst*. This is a sensation connected with some natural state of the corporeal functions, and altogether independent of the occasional excitement of foreign bodies, although it may be induced by these. In enquiring into the cause of thirst, as far as is necessary for our subject, we must distinguish *true* or *spontaneous thirst* from that demand for a certain supply of liquid which is the result of repletion of the stomach, and the cause of our drinking at our ordinary meals. It is not this *alimentary thirst*, if we may so term it, that is to occupy us at this time. True thirst occurs when we have been some time without taking drink; when the system has been greatly excited, whether by corporeal or mental causes; when acrid substances, particularly saline bodies, have been taken into the stomach; and in every condition of the system, from whatever circumstance it may proceed, which favours the excretion of fluids—as, for example, perspiration, diarrhœa, and diuresis. The immediate cause of thirst appears to be a dry state of the mouth and fauces; owing to the mucus which covers these parts becoming thick and viscid. This may arise from the absorption of the fluid parts of the saliva; for it appears to be necessary, for the due performance of the functions of the palate and the tongue, that the mucus should possess a certain degree of liquidity. It is proper to observe, however, that some physiologists regard the sensation of thirst as altogether independent of any dryness in these parts, and contend that it is sympathetic of an uneasy state of the stomach. However this may be, the sensation is indicative of the necessity of a supply of fluid to the system generally; for although thirst may be momentarily assuaged by wetting the mouth or holding a thin fluid in it, yet it can only be effectually and permanently relieved by conveying into the stomach a quantity of fluid sufficient to supply the deficiency. This supply is termed *dilution*, from an idea that the liquid passes into

the blood and renders it thin; thence the fluids themselves, which are taken under these circumstances and with this view into the stomach, are termed *Diluents*. Thirst is not always indicative of a deficiency of fluids in the circulating mass; and the tongue and fauces are found to be occasionally dry and harsh, whilst the sensation of thirst is absent. Some individuals never experience the sensation of thirst. Sauvage mentions a member of the Academy of Toulouse who never thirsted, and passed whole months of the hottest weather without drinking. It is well known that many warm-blooded animals—namely, mice, quails, and parrots—drink very little*. In general, however, thirst is indicative of diminished fluidity of the blood; and, when it is not assuaged by taking liquids into the stomach, or by moistening the mouth with them, or by applying them to the surface, the torment which it induces occasionally amounts almost to phrenzy: on every occasion it is borne with less patience and greater difficulty than hunger. Sometimes inflammation of the mouth and throat and intense fever supervene. Various circumstances connected with the ordinary condition of the body influence the sensation of thirst. Thus, it is greater in infancy and childhood than in adult age, and less in old age; it is greater in women than in men; it is varied by constitution and temperament; by climate; season; the nature of the diet; exercise; passions of mind, and even by imagination.

A certain relative proportion of the fluid to the solid parts of the body is, as we have already said, essential to health; it is only in a diseased state of the habit that the balance of that proportion is broken, and either an increase or a diminution in the fluids can occur. Thus, in health, if thirst induce a person to drink freely of any bland fluid, the excretory powers of the skin and the kidneys are augmented so as to throw off the superabundance in the form of urine and perspiration: and even in disease, when the thirst is augmented to an inordinate degree, as in *polydypsia*, in which patients have been known to drink sixty or seventy pints of fluids in twenty-four hours, the skin and the kidneys still maintain the relative proportion between the solids and the fluids. Indeed, it is not until the body is greatly weakened, that this balance is overcome; and then, the exhalation into the cellular membrane not being reabsorbed, one kind of dropsy is produced. It is necessary, however, so far to modify the above statement as to admit that a temporary inequality may exist during health. When the fluids are deficient, drink is desired and taken, so that the balance is

* The defect of the sensation of thirst in these animals is supposed to depend on their having very large salivary glands, and a larger pancreas in proportion to the magnitude of their bodies, than is found in animals who require drink.

quickly restored: on the other hand, the kidneys and the skin rapidly restore the balance when the fluidity of the circulating mass is too much increased. Taking all these considerations into account, we may define Diluents to be—"Remedies which, rendering more liquid the contents of the stomach and the bowels, and, subsequently, the general mass of the circulating fluids, lessen the morbific effects of certain matters contained either in the intestinal canal or in the blood on sensible and irritable parts with which they come in contact." We are fully aware that the idea of acrimony in the blood is problematical: but as cantharidine, turpentine, iodine, and many volatile oils are taken into the circulation, it is not improbable that other acrid matters are also received into it. We can readily comprehend that, when the stomach and bowels are disordered by acrid matters, Diluents may prevent or diminish their bad effects by increasing the proportion of the fluid contents of these viscera. And it is very possible that, in disease, the natural constituent parts of the blood may be so altered as to produce a morbid impression on the vessels containing it, and thereby increase their general force or the frequency of their action: whilst the secretions formed from it are either in a diminished quantity, or have acrid and stimulating qualities, which they do not possess in a healthy condition of the body. Diluents, therefore, in this state of the blood, by augmenting, even for a short period of time, the quantity of water in the circulating mass, may render both it and the secretions more bland, and thus allay general increased excitement.

From these effects of Diluents, it will be understood that they are indicated in acrimonious states of the contents of the first passages, and in all cases of increased excitement. They are, therefore, advantageously administered in fevers, in which, besides answering the above-mentioned intentions, they remove another very considerable cause of irritation, the sensation of thirst. They are indicated in irritable states of the intestines, arising from bile and diseased secretions; in dyspepsia, proceeding from causes producing a very irritable condition of the coats of the stomach; in dysentery; in cholera morbus, particularly when occasioned by too great or too hurried a secretion of bile; and in diarrhœa kept up by acrid secretions from the intestines themselves. They are, also, useful in many diseases of the urinary organs. When taken in large quantity, they cause the urine to flow abundantly, pale, and little stimulating: thus, when the concreted animal acid, which forms the sand-like matter collected in the pelvis of the kidney, in gravel, abounds, Diluents, by washing out that receptacle, assist in curing the disease. In local inflammations of the urethra, they are also useful, both by abating the acrimony of the urine, and carrying off the virus lodged in the urethra. There are, indeed, few

diseases in which Diluents are not useful auxiliaries, by aiding the influence of other remedies—as, for example, that of cathartics, emetics, diuretics, and diaphoretics.

All the substances usually employed as Diluents owe their properties, as such, to the water they contain: this fluid, therefore, is the only Diluent in the strict sense of the term. Several vegetable and animal infusions and decoctions are used as Diluents: but the substances in solution increase in no degree the diluent power of the water. Some of these infusions, however, are often useful in abating nausea, and in cleansing the mouth and fauces of viscid mucus; others convey small quantities of nutriment in the most favourable form into the system. But all the advantages which can be expected from them may be obtained from simple water.

Under this view of the subject, our attention should be directed to water in the different states in which it can be employed as a Diluent; the extent of its diluting powers; and its real value as a remedial agent in the treatment of diseases.

TABLE OF DILUENTS.

* NATURAL FLUIDS OPERATING AS DILUENTS.

a.—RAIN WATER. *Aqua pluvia.*

Var. 1. Ice Water.
2. Snow Water.
3. Spring Water.
4. River Water.
5. Lake Water.

b.—WELL WATER.

* * ARTIFICIAL FLUIDS OPERATING AS DILUENTS.

a.—DISTILLED WATER. *Aqua distillata.*

b.—TOAST WATER. *Aqua Tosti Panis.*

c.—BARLEY WATER. *Decoctum Hordei.*

WATER.

The ancients regarded water as one of those bodies which they believed to be the elements of all other bodies; and the

belief of its elementary nature, modified by some experiments of Van Helmont and of Mr. Boyle, which apparently demonstrated that it could be changed into all vegetable substances and into earth, prevailed until past the middle of the eighteenth century; when Macquer having fired some inflammable gas in a glass vessel, drops of a clear fluid were condensed upon the sides of the vessel, which appeared to him to be pure water. But it was not until the year 1781, that the experiments of Mr. Cavendish unequivocally demonstrated that water is a compound of *hydrogen* and *oxygen*.

Water is almost universally diffused over the surface of the globe, yet it is not found perfectly pure in any place; even the rain and the snow that descend from the clouds, the condensation, as it were, of a natural distillation, are slightly tainted by traces of saline matters; which circumstance can only arise from the great solvent power of water enabling it to take up a portion of most substances with which it comes into contact in its natural condition. In many lakes, and in the ocean, the quantity of saline matter is so great as to render it unfit for diluent purposes; but, when sea water freezes, the saline impregnations are deposited; and the ice affords fresh water. In the state in which water can be used as a diluent, its impregnations are in small quantity, and not sufficient in general either to dim its transparency, or to give it colour, or smell, or taste, and consequently to render it unfit for the ordinary purposes of life. Water which is transparent, colourless, inodorous, and tasteless, is therefore *good* and *pure:* but it is not necessary that it should be in this pure state for common use; although it ought not to contain so much matter in solution as to affect the nerves of the stomach more than distilled water, containing the same quantity of atmospherical air which good spring water contains; nor should it contain soluble salts in sufficient quantity to stimulate the bowels to increased action. Its diluent properties are counteracted by obvious quantities of such impregnations.

Water fitted to answer the intention of a Diluent must be one or other of the following kinds:—

1. *Rain water*, which includes *ice* and *snow water*, *spring* and *river water*, and *lake water:* 2. *well water:* 3. *distilled water*. Let us examine each in the order in which they are named.

a. RAIN WATER *(Aqua Pluvia)* is the purest kind of natural water. It is either an actual distillation from the water on the surface of the earth taken up by the solvent power of the air and again precipitated; or it is produced, in the higher regions of the atmosphere, from the immediate combination of its principles by the influence of the electrical fluid. In whichever of these ways it is formed, *Rain Water*, if collected at some distance from a town or from houses, and not at the commencement

of a shower, is good water, aud as free from foreign matters as any natural water can be. In specific gravity it scarcely differs from distilled water. It, nevertheless, generally holds in solution common air, carbonic acid, carbonate of lime, and a trace of nitric acid. If it be collected from the roofs of houses, after it has rained for some time, it contains a sulphate of lime and occasionally carbonate of lead. The quantity of common air in Rain Water does not exceed 3½ cubic inches in 100 cubic inches of water; it is more oxygenous than atmospherical air; the same quantity of Rain Water contains one inch of carbonic acid gas. These combinations, in the small quantities in which they exist, in no degree injure the diluent properties of Rain Water. It is indeed to the presence of the two elastic gases that Rain Water owes the taste which renders it palatable to animals and useful to vegetables. Ice melted into water, being destitute of these gases, are extremely vapid: fish cannot live in it; and it does not seem either to quench thirst or to be so complete a solvent in the stomach as Rain Water. To purify Rain Water and render it useful, even for the delicate purposes of chemical experiment, Morveau recommends dropping into it a little barytic water, and then exposing it for some time to the atmospheric air. This combines with the carbonic acid, which being the solvent of the carbonate of lime, both it and the carbonate of baryta are precipitated as insoluble salts. Instead of exposing it to the atmosphere, it may be poured from one vessel to another; by which means not only the minute portion of barytic water is dispersed through the Rain water and brought into contact with the carbonic acid, but it involves a great portion of air in its substance, which improves both the taste and the utility of the fluid.

Var. 1. 2. *Ice and Snow Waters* differ from rain water only in not containing so much air*; and, therefore, they should be exposed for some time to the atmosphere, or poured from one vessel into another, alternately, for some time before they are used as Diluents. The opinion that *Snow* Water causes bronchocele is erroneous.

Var. 3. *Spring Water.* (*Aqua Fontana.*)—Rain Water, when it falls on high grounds, enters the soil and filtrates through it, until it is stopped by some natural obstacle, when it pushes upwards, and, welling out upon the surface, forms *springs:* the water is, therefore, merely a modification of Rain Water. It is rare that the stratum is so purely siliceous or flinty, that it does not meet with some soluble matter in its passage; and, consequently, it is less pure than distilled water. The purest spring

* This air is, nevertheless, richer in oxygen than even that obtained from rain water: it contains 34.8 per cent. of that principle; whereas the air from rain water contains only 32 per cent.

water generally contains a little carbonate of lime, chloride of sodium, and the usual proportions of air and carbonic acid gas. The presence of these are detected by subacetate of lead, which displays the smallest portion of carbonic acid or a carbonate, and nitrate of silver, which detects the muriates by the formation of muriate of silver.

The water of the well called St. Winifrede's, in the town of Holywell, in Flintshire, is, perhaps, the purest in this kingdom. It rises, with effervescence, out of the crevices of a solid limestone rock; is as transparent as crystal, pure, and well tasted; and at one time it acquired much celebrity in the cure of cutaneous affections and painful diseases of the kidneys and bladder; but its celebrity is now much lowered. The Malvern spring, which possess similar properties, is now more resorted to than those of Holywell. The water is clear and pellucid, and retains this state on standing. The most correct chemical analysis has detected scarcely any foreign matter, except some carbonic acid, in the Malvern water; and consequently the benefit which it produces is to be attributed to its great purity augmenting its diuretic and diluent effects. In all cases, it improves the appetite, increases the flow of urine, and elevates the animal spirits—effects likely to result from the improvement which the water effects on the secretions. Malvern water is resorted to chiefly by those who are labouring under scrofulous and cutaneous diseases. According to Dr. Percival's account, it has the property also of dissolving the little sabulous calculi which are often voided in nephritic affections. It is more than probable, however, that the benefit arises altogether from the diluent properties of these waters.

Matlock, in Derbyshire, possesses springs of very pure water, arising out of a compact limestone rock. All of the springs issuing from this rock possess the characters of pure water, being beautifully limpid, and having the taste of good water; but it is singular that all those which rise from fifteen to thirty yards above the Derwent are tepid, whilst those both above and below this limit are cold springs. The tepid is the lowest in temperature of any thermal water in Great Britain, not exceeding 66° of Faht.: it exhales no vapour, except in very cold weather. It contains a small quantity of bicarbonate of lime when it first rises, and therefore curdles soap; but this soon disappears: and in all its other properties it resembles the best spring water.

Var. 4. *River Water.* (*Aqua Fluviatilis.*)—This is merely spring water, which, from exposure to the air, has deposited much of its earthy salts, and has consequently become softer than as it welled from the spring. Mountain rills, as they generally issue from siliceous rocks, and run over stony or pebbly beds, are remarkably pure and soft. The river water in

Wales, Scotland, Switzerland, and all mountainous districts, is of this description. The water of the Thames, although loaded with mud almost from its source, yet, is soft, and, when filtered, is as good and fit for diluent purposes as that of the purest mountain rill.

In rivers, the exposure of the water, and the course which it runs from the springs whence it arises, soften it; therefore, River Water, in general, contains less calcareous matter than spring water; the specific gravity is less, and the taste more vapid. The water of rivers, however, is tainted with the nature of the soil over which their course extends; consequently, some which are pure and excellent at their sources lose these properties before they mingle with the sea. The water of the Thames, which is naturally very soft and excellent, becomes so loaded with animal and vegetable matter, from the towns and villages on its banks, that, after being kept a month or two in a closed cask, on opening it, a quantity of sulphuretted hydrogen gas, of the most offensive odour, escapes, and the water is so black and nauseous as to be unfit for use. But on racking it off, it clears, depositing a quantity of slimy mud, and becomes remarkably clear, sweet, and palatable. In truth, the matters deposited in the Thames, the Seine, and all rivers traversing great towns, are merely mingled with the body of water, which is too large and too changing to admit of any permanent taint from solution; consequently filtration, or the natural deposition of the ingredients, fits them for every domestic and medicinal purpose.

Var. 5. *Lake Water*, including that of ponds, owing to the vegetation generally going on at the bottom when the sheet of water is shallow, or owing to its stagnant state when it is deep, is generally vapid; but it is soft, and, when filtered, is as good and wholesome as any other description of soft water.

b. WELL WATER.—This is, in fact, spring water, rising deep within the bowels of the earth, when an opening is made so as to enable the underground stream to rise towards the surface. It is characterized from spring water, which wells out spontaneously upon the surface; also, by its hardness, depending upon earthy salts, a large proportion of air, and a greater specific gravity than other spring waters. It does not break soap, as the term is; that is, instead of making with it a pure opaline solution, it curdles soap when agitated in it, owing to the lime of the calcareous salts which it contains forming an insoluble compound with the margaric and oleic acids of the soap. Although this property of Well Water renders it unfit for many operations, yet it is perfectly well adapted for the general purposes of dilution. When, however, the earthy salt is a sulphate of lime, it causes a sensation of weight in that condition of the stomach which exists in dyspepsia. The abundance of this earthy salt in the water of Paris and in the waters of many parts of Swit-

zerland produces uncomfortable feelings to strangers who first visit these places. It is also said to produce calculous complaints in the inhabitants—a result which, however, cannot be attributed to any earthy deposit in the kidneys, but to the low solvent power of the water not being sufficient to carry off the animal acid, which concretes in the kidneys to form calculi. Well Water can be easily freed from these earthy salts: boiling precipitates the carbonate of lime by driving off the carbonic acid which holds it in solution; and the addition of a little carbonate of soda precipitates the lime, if it really exist in the water.

If it have filtered through granite or quartz rocks, Well Water is very pure; but, in general, it contains various matters, according to the nature of the strata through which it has flowed. When the contents are in notable quantity, either to the smell or taste, it is unfit for use as a Diluent. *Hard Water* generally contains calcareous carbonates, sulphates, and muriates, besides muriate of soda; *Soft* Spring Water differs from Hard Water chiefly in containing none of the calcareous salts. Hard Spring Water, unless previously boiled, cannot be always employed as a Diluent; in weak and irritable stomachs, it causes an uneasy sensation of weight at the stomach; and, when long used as daily beverage, produces a degree of dyspepsia, to which we must attribute the calculous deposits, which Dr. Percival and others have observed to be common in places where hard Water is drunk.

* * WATER ARTIFICIALLY PURIFIED.

a. DISTILLED WATER. (*Aqua Distillata.*)—Water which contains no volatile matter, when passed through the still, is the purest state of this important fluid. It is beautifully transparent, colourless, perfectly void of taste and smell, and lighter than any other water; for even the admixture of carbonic acid and other gases in common water renders this specifically heavier than distilled water. It feels also softer to the touch, and the fingers are instantly wetted with it. Another singular property of Distilled Water, is that it produces a greater sound when poured from one vessel to another. It dissolves soap into a pure opaline mixture; and may be added to a solution of soap in spirit of wine without causing any opacity. Lime water, barytic water, solution of nitrate of silver, and oxalates, produce no effect on it. If kept free from the access of matters floating in the air, time produces no change on Distilled Water: it freezes exactly at 32° Fahr. and boils at 212° under a pressure of the atmosphere of $29\frac{8}{10}$ inches. The purest Distilled Water is obtained from Rain Water, once distilled, rejecting the first and last products. When the water to be distilled contains car-

bonic acid, if the temperature be low, this gaseous fluid passes over with it; and, therefore, the first part of the product precipitates the subacetate of lead.

Distilled Water is the best solvent of all soluble animal and vegetable matter without decomposing them; on which account, could it be more easily procured, it would be the best and most wholesome beverage for common use that can be employed, and might be rendered sufficiently palatable by agitating it mechanically with the air, which it rapidly imbibes. As a medicinal agent, it not only answers every indication required from a Diluent, but washes out the pelvis of the kidneys in a manner which has led to the supposition that it is a solvent of urinary calculi.

Distilled Water is the most perfect of all Diluents, liquifying without changing the properties of both animal and vegetable substances with which it is united. It has been recommended as a solvent of concretions in the kidneys*, and in gout, scrofula, phthisis and cancerous affections†; but although we are of opinion that in none of these diseases much confidence is to be reposed on its solvent powers, yet it cannot be denied that as a Diluent it is more likely to pervade the minutest vessels than waters containing foreign ingredients, either gaseous or solid; and, therefore, could it be easily and cheaply procured, it ought always to be preferred when simple dilution is required in the treatment of diseases.

b. TOAST WATER. *Aqua Tosti Panis.*—This form of administering water has been long in use. It is made by pouring, on a piece of well-toasted bread, water which has been boiled and allowed to cool; a small piece of lemon-peel is sometimes added. The toast communicates taste and colour to the water; but its diluent properties are not different from those of pure water.

c. BARLEY WATER. *Decoctum Hordei.*—The decoctions of Barley, carefully prepared, according to the direction of the Pharmacopœias, are well adapted for diluting in fever, phthisis, gonorrhœa, and many other acute diseases; and, however trifling they may appear, they contribute much to the efficacy of the treatment in these affections. Hippocrates wrote an entire book concerning their use, and that of boiled barley, in acute diseases. Besides diluting, they afford some degree of nutriment to the body; and the simple decoction, when mixed with an equal quantity of milk and a small portion of refined sugar, is a good substitute for the breast milk, for infants who are unfortunately brought up with the spoon.

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* See a paper, by Dr. Heberden, in the Medical Transactions, vol. i.

† See Dr. Lambe's Medical and Experimental Inquiry into the Origin, Symptoms, and Cure of Constitutional Diseases, &c. 8vo. 1805.

Use of Water as Aliment.

The use of water as an aliment may be said to be universal in organized nature. In the members of the vegetable race, every portion of the nutriment which they derive from the soil or from the atmosphere must be in a fluid state before it can be taken into their system and assimilated to their substance; and as the lacteals, which may be regarded as the animal roots, cannot admit gross matters, it is evident that a considerable degree of fluidity is also necessary for the food of animals. Although the division of the substances which water liquifies is required to be less minute to enter the animal than the vegetable vessels, yet it is requisite that they also should be held in solution, or at least suspended in a fluid medium, before they can be regularly conveyed into the animal system. But water, besides performing this office, is itself an alimentary substance, without the presence of which, in a certain definite proportion to solid matter, life could not be maintained. It is evident, therefore, that the presence of a certain quantity of fluid is essential in the process of digestion to enable the gastric juice to exert its solvent powers regularly upon the contents of the stomach; but it is also equally evident that, in a vigorous and healthy state of this organ, the presence of more water than is required to give a due solubility to the food must retard digestion. Too much will so greatly weaken the activity of the gastric fluid as to permit the food to pass into the same fermentative process which it would do were it placed for a given time in a common vessel, at the temperature of the stomach. In the healthy stomach, this chemical action is generally overcome by the vital powers of the organ; but these languish, if the secretion which it supplies for the formation of chyme be too dilute. Hence the impropriety of the over-supply of fluid in which it is too common to indulge in at meals. It is not my intention, however, to imply that no more drink should be taken than is absolutely necessary for the moderate solution of the solid part of our food; for, were the chyle diluted only to this extent, it is probable that its rapid animalization would afford that state of over-tonicity, if we may employ such a term, to the solid fibre, which would tend to the production of inflammation and all its subsequent train of evils. On the contrary, if the spontaneous chemical changes which the food, mixed with water at a certain temperature, would undergo out of the body be permitted to occur in that organ by over-diluting the gastric juice, the consequences must be acidity, heartburn, eructations, and the whole train of symptoms that characterize dyspepsia.

In the duodenum, the bile and the pancreatic juice combine with the chyme; and here the presence of a certain quantity of fluid is as essential as in the stomach; nor is it less so during the passage of the chyme through the intestines; at least, until

it enters the large intestines, which, from the structure of their villous coat, are evidently not naturally intended to absorb it, and in which the insoluble portion of the food, becoming less and less fluid, is carried forward and ejected from the body. It is unnecessary to trace the influence of water in carrying forward the chyle through the lacteal vessels until it reaches the left subclavian vein to be mingled with the blood. But the importance of a due supply of water to the system does not terminate here: it is essential to the preservation of the proper balance between secretion and excretion—so necessary to the healthy state of the system.

The first change to which the chyle is subjected, after it is mingled with the circulating mass, is its exposure, with the venous blood returned from every part of the body, to the action of the air in the lungs. Here the carbonaceous part, which is necessary to be thrown off, is carried out of the lungs in combination with a large portion of aqueous vapour. A similar removal of noxious or useless matters takes place in the excretion of the skin and the kidneys; and this removal, which is as necessary for preserving the health as the daily supply of food, is greatly favoured by dilution. Were it necessary to prove, by any other arguments, the utility of water as an aliment, and as favouring every salutary process connected with the support of vitality, we might mention some of the many well-authenticated cases of persons having lived on water alone, under circumstances which precluded them from obtaining any supply of solid aliment. But, after all, the salutary or noxious influence of water as a Diluent must necessarily depend on the nature of the food, and the condition of the stomach to prepare that food into proper chyme, adapted to afford healthy chyle, and support for the body. If the food be naturally watery or bland in its quality, little dilution is requisite: among the lower animals, those that live upon succulent herbage require little or no drink: on the contrary, a flesh diet requires to be accompanied with more dilution, not only on account of its ready assimilation, but on account, also, of its liability to undergo changes which are in some degree noxious, and require to be obviated.

These circumstances, in a healthy state of the stomach, modify the necessity of dilution: but the powers of the stomach itself, or its digestive faculty, may be defective from causes not originating in the organ; and in either case the regulation of the fluid aliment of the individual becomes an object of primary importance.

No water which contains so much foreign matter as to place it within the class of mineral waters can be employed as an ordinary Diluent; and even hard or well water, as we have already stated, when daily used, proves injurious. This fact is

well known to horse jockeys, who, when they are desirous to sell a horse to advantage, give him either spring water, or water which has been boiled, for drink; well knowing that the use of hard water makes his coat rough.

Remedial Use of Water.

The influence of water on the diseased body is modified by three circumstances connected with the state of the fluid—1, the caloric with which it is combined: 2, its bulk: 3, its solvent power.

1. With regard to temperature, water answers the double intention of diminishing the heat of the mouth, the fauces, the stomach, and, by sympathy, that of the whole body, and of fulfilling the purposes of Dilution. But, in admitting this, it is proper to remark, that the degree of cold which can be safely borne must be carefully ascertained. In a debilitated frame, water at a temperature under 45° is apt to prove injurious; for, when the reaction which the application of cold, whether to the surface of the body or to the stomach, should induce, is too languid, the stomach becomes oppressed, and general sinking may occur. In this case the temperature of the Diluent should be between 60° and 70°; and this fact should be borne in mind—that water at 60° merely dilutes; whereas, water under 60° and above 45° proves either tonic to the stomach or causes an injurious sensation of cold in it, which is transmitted to the general frame. One standard by which, however, the temperature of water, used as a Diluent, may be safely measured, is to be found in the degree of the animal temperature at the time, keeping in view the vigour of the frame and the character of the disease.

Looking at this part of our subject in the most general point of view, we may lay it down as an axiom, that water, to operate as a simple Diluent, is most effective the nearer it approaches in temperature to that of the body. It is undoubtedly less grateful to the palate at this temperature than between 45° and 60°; but this is the most useful temperature. It is a common opinion, that warm water, habitually employed, has a debilitating effect on the stomach: I apprehend that this opinion is unfounded; at least, my experience leads me to regard it as a mistake. On the contrary, water between 65° and 70° improves both the appetite and the general health.

In fever, when the habit is vigorous, and the reaction of the stomach strong, as low a temperature as fluid water can admit of may be employed. The immediate effect upon the stomach will be rapidly communicated to the skin, and the same result be obtained as if the whole body had been immersed in the fluid; the pungent heat will be diminished, and a copious perspiration follow; at least, such is the general result. The

period of the febrile paroxysm must also be taken into account; for if water at this temperature be drunk in the cold stage, it augments the sensation of cold at the surface, oppresses the præcordia, and renders the pulse feeble, and at the same time more frequent: if given during the flow of perspiration, it may check this salutary excretion; and, in either case, the patient must suffer. The Diluent, in the different stages of a fever, should be first of a temperature above 70° when the rigors are present; then cold, as the hot stage proceeds; and, lastly, tepid, when the perspiration flows freely.

Independent of the effect of water in fever, it is essential to attend to its temperature when it is used as a general Diluent. Those who have irritable stomachs cannot bear a draught of very cold water with impunity; and a temperature approaching to 70° is demanded. In the dyspeptic, there is frequently a distressing and gnawing pain, arising from the acrimony of the undigested food, combined with heartburn. Nothing relieves this state so suddenly as a draught of water, taken as hot as it can be drunk.

2. With respect to the influence which the *bulk* of the liquid exerts in modifying its diluent effect, we may merely observe, that although much of the benefit to be derived from the diluting properties of water depends on the regulation of the quantity thrown into the system, yet there is no standard by which this can be easily determined. Much depends on the condition of the excretory organs at the time; namely, the skin, the lungs, and the kidneys. But, under every condition of these organs, a large quantity of water, taken into the stomach, oppresses from its bulk, in the same manner as any other distending cause. It is possible, also, that the arterial system may be overloaded, not so much from the bulk of the water taken as from a diminished action of the cutaneous exhalants and other excretories. Much water, in this condition of the system, if taken into the stomach, may cause tension and fulness; and is not unlikely to produce a sudden determination to the head, which, in languid habits, may cause apoplexy—a disease not unfrequent in the worn-out invalids who resort to watering places and incautiously take large draughts of water; and this sometimes occurs when no fever is present.

3. But the most important circumstance modifying the influence of *Water* as a *Diluent* is the degree of *solvent* power which it exerts. This necessarily will depend much upon the temperature, and the nature of the contents of the stomach which it is intended to act upon. If the latter be of easy solution, we must enquire how they will operate in this state, and be regulated by the result, in fixing the extent of dilution. Thus, if a poison be taken into the stomach, which requires to be

in a state of complete liquidity before it can operate, it would be dangerous to throw in water or any other fluid, until the greater part of the offending substance be removed, either by vomiting or by other means; but, this being accomplished, then the most ample dilution will so weaken what remains as to render it inert, and aid greatly in carrying it out of the body.

Such are the general effects of water as a diluent on the animal system, both in the state of health and that of disease: it now remains only to examine briefly its practical utility as a remedy.

If we look into the history of our profession, we shall find that water was the chief remedy employed by Hippocrates in the treatment of fever; sometimes in its pure state, sometimes mixed with vinegar. He varied the temperature of the fluid according to the seasons of the year: in winter, recommending it to be used in a tepid state; in summer, as cold as it could be procured. Galen concurred in this excellent practice; but with some, not injudicious, restrictions respecting the quantity, the condition of the patient, and the period of the disease. Among the ancients, however, the use of water, even in fevers, was condemned; particularly by Asclepiades: even the judicious Celsus concurs in the propriety of his practice. Among the moderns, Stahl (whose theory was useful, inasmuch as it led men back to Nature) first introduced the liberal use of water in fevers. Hoffman, who followed Stahl in many things, restricts its use in these diseases; yet he was a great supporter of its efficacy as a general remedy, and wrote a work expressly to prove its value.

In Spain, where medicine has not arrived at the same degree of perfection as in this country, cold water is still, as it has long been, the principal remedy in fever; and, in what is termed the *dieta aquæa*, from five to ten pints are ordered to be taken daily. But this is nothing to the extent to which this diet was formerly carried; and which was the occasion of the well-known satire of Le Sage, in the excellent novel of Gil Blas, in which this part of the practice of the Spanish physicians is very happily ridiculed in the person of Dr. Sangrado.

In England, water was little used in fevers until the commencement of the eighteenth century, when it was introduced by Dr. Smith, an able physician, and Dr. Hancock, the author of "*Febrifugum Magnum*," a Doctor of Divinity, Rector of St. Margaret's, Lothbury. Those innovators carried some of their particular opinions, especially those respecting the use of water as a febrifuge, to an extravagant length, and brought discredit upon the practice. In the present day, a more intermediate course is pursued; the advantage of dilution in fevers is well understood and appreciated; and, at the same time, the limits

to which it may be carried are as well known. A physician does not now order water in quantities sufficient to injure as greatly by its bulk as it is calculated to benefit by its diluent properties; but he leaves the quantity to be regulated, in a degree, by the desires of the patient. This is undoubtedly the best guide; and it has been remarked by every writer on diseases, that, in acute fevers, the inclination for watery fluids is so striking as to be almost a measure of the degree of fever which rages. As simple water contains nothing in itself noxious, the attention of the physician is required to be directed only to quantity and temperature. And, with regard to both these circumstances, we have already expressed our opinion: the measure of both may, in truth, be left to the patient.

In the phlegmasiæ, particularly in those instances in which the part affected is extensive, as in inflammation of the serous membrane lining the cavity of the thorax, and in similar cases, mild and diluent drinks ought to be plentifully administered. Whether these consist of water only, or of vegetable infusions or decoctions, they should never be given cold, but moderately tepid, and in small successive portions, frequently repeated. Of all the phlegmasiæ, that one which most demands the use of Diluents is nephritis. The excretory power of the kidneys is much diminished by inflammation in the organ; and the nature of the part affected has generally been regarded as requiring that the Diluents should be of a mucilaginous kind; but tepid water answers every intention, and it may be more freely administered than is admissible in any of the other diseases of the order.

In the eruptive fevers, comprehending small-pox, chicken-pox, measles, scarlet fever, nettle-rash, and similar affections, Diluents, and particularly water, may be used ad libitum. In that form of small-pox in which the pustules are distinct, cold water may be freely administered during the whole period of the eruptive fever; in the confluent, it ought to be tepid. In measles, also, the Diluents should be tepid; but, in scarlet fever, as all catarrhal symptoms are absent, and the most distressing circumstance is the burning heat both of the skin and the viscera, the coldest water which can be procured should be administered. It answers nearly the same purpose as the cold affusion, or cold water applied to the surface during the period of excitement. In both cases, the heat is rapidly diminished, the skin becomes soft, the general irritability of the system is lessened, sleep is induced; and often the most alarming cases are converted into the most moderate and manageable.

In catarrh, the acrimony of the secretion of the mucous membrane led to the supposition that mucilaginous drinks were requisite; but experience has proved that water is capable of

answering every purpose for which dilution can be required in this disease. It is almost unnecessary to say that, whatever fluid is taken, it ought to be in a tepid state.

In no disease is copious dilution so requisite as in bilious cholera. Indeed, the chief indication in the commencement of this disease is the evacuation of the redundant bile upon which both the vomiting and purging characterizing the attack depend. No medicines are required, nor would any be effectual, until the bile is, as it were, fairly washed out: tepid water accomplishes this better than any other Diluent. The same may be affirmed respecting bilious diarrhœa.

APPENDIX.

I.—TABLE OF EQUIVALENTS OR ATOMIC WEIGHTS† OF CHEMICAL SUBSTANCES BELONGING TO THE MATERIA MEDICA‡.

C, stands for Carbon, H, Hydrogen; N, Nitrogen; O, Oxygen; Chl. Chlorine; S, Sulphur; P, Phosphorus; W, Water; A, Ammonia; Ba. Barium; L, Lead; M, Mercury; Z, Zinc; C, Carbonic Acid; Ir. Iron; Io. Iodine.

Acid Acetic, 4 C + 3 H + 3 O	51
Arsenious, 2 A + 3 O	99.4
Benzoic, 14 C + 5 H + 3 O	113
Boracic, 1 B + 3 O	32
Crys. 2 Water (2 + 9)	50
Carbonic, 1 C + 20	22
Citric, 4 C + 2 H + 4 O.	58
Crys. 2 Water (2 + 9)	76
Chloric, 1 Chl. + 80	75.45
Hydrocyanic, 1 H + 2 C, 1 N	27
Hydriodic, 1 I + H	127
Kinic, 15½ C + 12 H + 12 O	205.5
Muriatic, 1 H + 1 Chl.	36.45
Nitric, 1 N + 5 O	54
Liquid, 2 Water (gr. 1.5)	72
Oxalic, 2 C + 3 O + 3 W	63
Phosphoric, 2 P + 5 O	71.4
Succinic, 4 C + 2 H + 3 O	50
Sulphuric, 1 S + 3 O + 1 W (gr. 1.8485)	49
Tartaric, 4 C + 2 H + 5 O + 1 W	75
Acetate of Ammonia, 1 A + 1 Acid + 7 W	131
Baryta, 1 Ba. + 1 Ac. + 3 W	154.7
Copper (Neutral) 1 Ox. + 1 Acid + 1 W	99.6
—(Diacetate) 2 Ox. + 1 Acid + 6 W	184.2
—(Triacetate) 3 Ox. + 1 Acid + 1½ W	183.3
Lead (Neutral) 1 L + 1 Acid + 3 W	189.5
—(Diacetate) 2 L + 1 Acid	274
—(Triacetate) 3 Pl. + Acid	385.5
Mercury, 1 M + 1 O + 1 Ac.	259
Potassa, 1 Pot. + 1 ac.	98.15 116.15
Zinc, 1 Z. + 1 ac. + 7 W	154 5
Alcohol, 3 H + 2 C + 1 O	23
Alumina, 2 Al. + 5 O	51.4
Aluminum	13.7
Ammonia, 3 H + 1 N.	17
Amigdaline, 19 C + 28 H + 1 N +	70.192
Antimony	64 6
Oxide of, 2 An. + 3 O	153.2
Sesquichloride, 2 An. + 3 Chl	235.44
Sesquisulphuret, 2 An. + 3 Sul	177.2
Persulphuret, 2 An + 5 Sul	209.3
Bisulphuret, 2 An. + 4 Sul	193.2
Oxy. Sulph. (Glass) 1 Ox. of Ant. + 2 An. + 3 Sul	340.4
Arsenic	37.7
Iodide, 1 Ar. + 1 Iod.	163.7
Periodide, 2 Ar. 5 Iod.	706.2
Sulphuret, 1 Ar. + 1 Sul	53.7
Arsenite of Potassa	104.22
Barium	68.7
Oxide of (Baryta) 1 Ba. + 1 O	76.7
Chloride, 1 Ba. + 1 Chl.	104 15
Sulphuret, 1 Ba + 1 Sul.	84 7
Bismuth	71
Oxide of, 1 Bi. + 1 O.	79
Bisulphate of Potassa, 2 Sul. acid + 1 Potassa + 2 W	282.18
Boron	8
Brucia, 33 C + 18 H + 1 N + 6 O	278
Caffein, 8 C + 5 H + 2 N + 2 O	97
Calcium	20.5
Chloride of, 1 Cal. + 1 Chl	55.95
Oxide (lime) 1 Cal. + 1 O	28.5
Camphor, 10 C + 8 H + 1 O.	76
Carbon	6
Carbonate of Ammonia, 1 Am. + 1 Ċ	39
Bicarb. 1 Am. + 2 C.	61
Baryta, 1 Ba. + 1 Ċ.	98.7
Lime, 1 L + 1 Ċ	50.5

† In this Table, Hydrogen is taken as unity.

‡ The chemical equivalents in this Table are those which were received as correct until lately; a second Table of those lately proposed by Berzelius and others is added.

Carbonate of Iron, 1 Ox. Tr. + 1 C̈ 58
Lead, 1 Ox. L. + 1 C̈ 133.6
Magnesia, 1 Mg. + 1 C̈ 42.7
Potassa, 1 Pot. + 1 C̈ 69.15
Bicarbonate, 1 Pot. + 2 C̈ + 1 W. 100.15
Soda, 1 So. + 1 C̈ + 10 W. 143.3
Bicarbonate, 1 So. + + 2 C̈ + 1 W. . 84.3
Chlorine 35.45
Chlorate of Potassa, 1 Po. + 1 C̈hl. A 123.50
Cinchonia, 20 C + 12 H + 1 N + 1 O 154
Copper 31.6
Oxide, 1 Cop. + 1 Ox. 39.6
Cyanogen, 2 C + 1 N 26
Delphina, 26 C + 3 + H + 1 N + 3½ O 236
Ether, 4 C + 5 H + 1 O. 37
—Nitric, 1 Ether + 1 Hyp. Nit. Acid 75.15
Hydrate of Lime, 1 L + 1 W 37.5
Hydrogen 1
Sulphuretted, 1 H + 1 Sul 17
Iodine 126
Iron 28
Chloride, 1 Ir. + 1 Chl. . 63.45
Iodide, 1 Ir. + 1 Iod. 154
Perchloride, 1 Ir. + 1½ Chl. 80.7
Oxide, 1 Ir. + 1 O 36
Peroxide, 2 Ir. + 5 O . . 80
Sulphuret, 1 Ir. + 1 Sul. 44
Lead 103.5
Iodide, 1 L + 1 Io. 229.9
Oxide, 1 L + 1 Ox. . . . 111.6
Red Oxide, 3 L + 4 O . . . 342.8
Lime (Chloride of) 1 L + 1 Chl. 63.95
Magnesium 12.7
Oxide of (Magnesia) 1 Mg. + 1 O . . . 20.7
Manganese 27.7
Sesquioxide, 1 Man. + 1½ O 39.7
Binoxide, 1 Man. + 2 O 43.7
Mercury 200
Bicyanide, 1 M + 2 Cy. 252
Chloride, 1 M + 1 Chl. 235.45
Bichloride, 1 M + 2 Chl. 270.9
Iodide, 1 M + 1 Io. . 326
Biniodide, 1 M + 2 Io. 452
Oxide, 1 M + 1 O . . . 208
Binoxide, 1 M + 2 O . . 216
Sulphuret, 1 M + 1 Sul. 216
Bisulph. 1 M + 2 Sul. 232
Muriate of Ammonia, 1 Am + 1 Acid 53.45
Baryta, 1 Ba + 1 Acid 113.15
Lime, 1 Cal + 1 Acid + 6 W 118.95
Morphia, 34 C + 18 H + 1 N + 60 284
Meconine, 9 C + 9 H + 4 O . . 95
Naphtha, 5 H + 6 C 41
Nitrogen 14
Nitrate of Baryta, 1 Ba. + 1 Acid 130.7
Potassa, 1 Pot. + 1 N Acid 101.15
Silver, 1 Oxide + 1 Acid 170
Oxygen 8
Phosphorus 15.7
Phosphate of Soda, 1 So. + 1 ac. + 24 W 381.3
Potassium 39.15
Chloride, 1 Pot. + Chl. 74.60
Cyanuret, 1 Pot. + 1 Cyanog 65.15
Iodide, 1 Pot. + 1 I 91.15
Oxide (Potassa) 1 Pot. + 1 O 47.15
Sulphuret, 1 Pot. + 1 Sul 55.15
Hydrosulphuret, 1 Sulph. + 1 S. Ac. . 71.15
Quinia, 20 C + 12 H + 1 N + 2 O 162
Salicina, 2 C + 2 H + 1 O. 22
Silver 108
Cyanuret, 1 S + 1 Cyan. 134.39
Sodium 23.3
Chloride, 1 So. + 1 Chlor. 58.75
Oxide (Soda) 1 So. + 1 O 31.3
Solania, 28 C + 42 H + 1 N + 3½ 252
Sulphate of Copper, 1 Ox. Cop. + 1 S Acid 5 W. 124.6
Iron, 1 Ox. Ir. + 1 S Acid + 6 W . . 130
Magnesia, 1 Mg. + 1 S Acid 7 W . . 123.6
Bisulph. Mercury, 1 Ox. M. 2 Acid . . 296
Potassa, 1 Pot. + 1 Sul. Acid 87.15
Soda, 1 Sod. + 1 Sul. Acid 71.3
Zinc, 1 O Z, 1 S Acid 7 W 143.5
Alumina and Potassa (Alum) 474.55
Strychnia, 30 C + 16 H + 1 N + 3 O 234
Sulphur 16
Sulphuretted Hydrogen, 1 H + 1 S 17
Tin 57.9
Tartarized Soda, 1 Tart. Pot. + 1 Tart. So. + 8 W . . . 282.18
Tartrate of Potassa, 1 Pot. + 1 Acid 112.15
Bitartrate 188.15
Antimony & Potassa 350.17
Veratria, 34 C + 22 H + 1 N + 60 O 288
Water, 1 H + 1 O 9
Zinc 32.5
Oxide of, 1 Z + O 40.5

II.—TABLE OF CHEMICAL EQUIVALENTS OF SUBSTANCES BELONGING TO THE MATERIA MEDICA*.

ELEMENTARY SUBSTANCES.

Aluminium	13.7
Antimony	646
Arsenic	37.7
Barium	68.7
Boron	10.9
Calcium	20.5
Carbon	6.12
Chlorine	35.42
Copper	31.6
Hydrogen	1
Iodine	126.3
Iron	28
Lead	103.6
Magnesium	12.7
Manganese	27.7
Mercury	202
Nitrogen	14.15
Oxygen	8
Phosphorus	15.7
Potassium	39.15
Silver	108
Sodium	23.3
Sulphur	16.1
Tin	58.9
Zinc	32.3

PRIMARY COMPOUNDS.

Water	1 H + 1 O = 9
Ammonia	3 H + 1 N = 17
Etherine	4 H + 1 C = 28.48
Naphtha	5 H + 6 C = 41.72
Camphore	8 H + 10 C = 69.2
Cyanogen	1 N + 2 C = 26.39
Benzule	14 C + 5 H + 2 O = 105
Alcohol	2 C + 3 H + 1 O = 23.24
Ether	4 C + 5 H + 1 O = 37.48

Protoxides.

Potassa	1 Pot. + 1 O = 47.15
Soda	1 So. + 1 O = 31.3
Baryta	1 Ba. + 1 O = 76.7
Lime	1 Ca. + 1 O = 28.5
Magnesia	1 Mg. + 1 O = 20.7
Iron	1 Fe. + 1 O = 36
Zinc	1 Zn. + 1 O = 40.3
Bismuth	1 Bi. + 1 O = 79
Copper	1 Cr. + 1 O = 39.6
Mercury	1 Hg. + 1 O = 210
Peroxides of Manganese	1 M + 2 O = 43.7
——— Mercury	1 Hy. + 2 O = 218

Sesquioxides.

Alumina	2 Al. + 3 O = 51.4
Antimony	2 Sb. + 3 O = 153.2

Mixed Oxides.

Black Oxide of Iron: 1 Protox. = 36, 1 Perox. = 80	= 116
Red Oxide of Lead: 2 Protox. = 223.2, 1 Perox. = 119.6	= 342.8

Acids.

Acetic	4 C + 3 H + 3 O = 51.48
Arsenious	2 As. + 3 O = 99.4
Antimonious	2 Sb. + 4 O = 162.2
Benzoic	15 C + 5 H + 3 O = 114.68
Boracic	1 B + 3 O = 34.9
Carbonic	1 C + 2 O = 22
Citric	4 C + 2 H + 4 O = 58.48
Camphoric	10 C + 8 H + 5 O = 109.2
Chloric	1 Chl. + 5 O = 75.42
Gallic	7 C + 3 H + 5 O = 85.84
Crystals	1 Water = 93.84
Hydrocyanic	1 Cy. + 1 H = 27.39
Hydriodic	1 Iod. + 1 H = 127.3
Hydrochloric	1 Chl. + 1 H = 36.42
Hydrosulphuric	1 H + 1 S = 17.1
Iodic	1 Iod. + 5 O = 166.3
Kinic	13 C + 10 H + 10 O = 181.8
Malic	4 C + 2 H + 4 O = 58.48
Meconic	17 C + 2 H + 7 O = 100.84
Nitrous	1 Nit. + 4 O = 46.15
Nitric	1 Nit. + 5 O = 54.15
Oxalic	2 C + 3 O = 36.24
Tannic (from Catechu)	18 C + 9 H + 8 O = 183.16
—— (from Galls)	18 C + 9 H + 12 O = 215.16
Tartaric	4 C + 2 H + 5 O = 66.48
Crystals	1 Water = 75.48
Phosphoric	2 P + 5 O = 71.4
Uric	5 C + 2 H + 2 N + 3 O = 84.9
Sulphuric	1 S + 3 O = 40.1
Succinic	4 C + 2 H + 3 O = 50.48

Vegetable Alkalies.

Morphia	34 C + 18 H + 1 N + 6 O = 288.23
Codeia	31 C + 20 H + 1 N + 5 O = 263.87
Cinchonia	20 C + 12 H + 1 N + 1 O = 156.55
Quinia	20 C + 12 H + 1 N + 2 O = 164.55
Strychnia	39 C + 16 H + 1 N + 3 O = 237.75
Brucia	32 C + 18 H + 1 N + 6 O = 275.99

* This Table contains the corrections of Berzelius, Turner, and others: those taught in the University of London. It is made up from Turner's Elements, fifth edition.

Veratria:
34 C + 22 H + 1 N + 6 O = 292.23

Resinoids.

Caffein:
8 C + 5 H + 2 N + 2 O = 98.26
Salicina:
2 C + 2 H + + 1 O = 22.42

Chlorides.

Chl. of Sodium, 1 Chl. + 1 So. = 58.72
—— Calcium, 1 Cm. + 1 So. = 55.92
Perchloride of Antimony:
2 Sb. + 5 Chl. = 306.3
Protochloride of Mercury:
1 Hg. + 1 Chl. = 237.42
Perchloride of Mercury:
1 Hg. + 2 Chl. = 272.84

Cyanurets.

Cy. of Potassium, 1 P + 1 Cy. = 65.54
Bycyanuret of Mercury.
1 Hg. + 2 Cy. = 228.39

Iodides.

Iod. of Potassium, 1 P + 1 I = 165.45
Periodide of Iron, 2 Fe. + 1 I = 434.9
Protiodide of Iron, 1 Fe. + 1 I = 154.3
Iodide of Zinc, 1 Zn. + 1 I = 158.6
Period. of Arsenic, 2 Ar + 5 I = 706.9
Iodide of Lead, 1 Pl. + 1 I = 229.9
—— Mercury, 1 Hg. + 1 I = 328.3
Sesqui-iodide of Mercury:
2 Hg. + 3 I = 782.9
Biniodide of Mercury:
1 Hg. + 2 I = 454.6

SECONDARY COMPOUNDS.

Oxy-salts.

Sulphate of Potassa:
1 P + 1 S ac. = 87.25
Bisulphate of Potassa:
1 P + 2 S ac. = 127.36
Crystals, 1 Water 145.35
Sulphate of Soda:
1 So. + 2 S ac. = 71.4
Crystals, 10 Water 161.4
Bisulphate of Soda:
1 So. + 2 S ac = 111.5
Crystals, 4 Water 147.5
Sulphate of Magnesia:
1 Mg. + 1 S ac. = 60.8
Crystals, 7 Water 123 8
Sulphate of Protoxide of Iron:
1 Fe. O + S ac. = 76.8
Crystals, 6 Water 130.1
Sulphate of Zinc:
1 Zn. O + 1 S ac. = 80.4
Crystals, 7 Water 143 4
Sulphate of Copper:
1 Cu. O + 1 S ac. = 79.7
Subsulphate of the Peroxide of
Mercury, 4 Hg. + 3 S ac. = 992 3
Alum:
Sulph. Potassa, 1 eq. ... } = 258.95
Tersulph. Alumina, 1 eq. }
Crystals, 24 Water 474.95
Nitrate of
Potassa, 1 Pot. + 1 N ac. = 101.3
Silver, 1 Sil. + 1 N ac. = 170.15
Phosphate of Soda and Baric
Water 1 { Soda. 1 } + 1 P ac. = 143
Crystals, 24 Water 359
Biborate of Soda:
1 So. + 2 B ac. = 101.1
Crystals, 10 Water 191.1
Acetate of
Potassa, 1 Pot. + 1 A ac. = 98 63
Lead ....1 Pl. + 1 A ac. = 200.48
Copper..1 Cu. + 1 A ac. = 100 08
Carbonate of Potassa:
1 Po. + 1 C ac. = 69.27
Bicarbonate of Potassa:
1 Po. + 2 C ac. = 91.39
Crystals, 1 Water 100.39
Carbonate of Soda:
1 So. + 1 C ac. = 53.42
Crystals, 10 Water 143.42
Bicarbonate of Soda:
1 So. + 2 C ac = 75.54
Crystals, 1 Water 84 54
Carbonate of Ammonia:
1 Am. + 1 C ac = 39 37
Bicarbonate of Ammonia:
1 Am. + 2 C ac. = 61.39
Carbonate of
Lime, 1 Lime + 1 C ac. = 50.72
Magnesia, 1 Mg. + 1 C ac. = 42 82
Carbonate of Iron:
1 Fe. Ox. + 1 C ac. = 50.12
Carbonate of Lead:
1 Pl. + 1 C ac. = 133.72
Tartrate of Potassa:
1 Pot. + 1 T ac. = 115.63
Bitartrate of Potassa:
1 Pot. + T ac. = 189.11
Tart. of Antimony and Potassa = 351.31

Ammoniacal Salts.

Hydrochlorate of Ammonia:
1 H Cl. + 1 Am. = 53.57

Sulphur Salts.

Hydrosulphuret of Potassium:
1 Sulph. base + 1 S ac. = 72.35
Hydrosulphuret of Calcium:
1 Sulph. base + 1 S ac. = 53.7

Ferro-cyanurets.

Ferro-cyanuret of Potassium:
1 Basic Cyan. + 1 Co. Fe. = 155.47
Crystals, 3 Water 212.47

Salts of Vegetable Alkalies.

Sulphate of Morphia:
1 Morph. + Acid 6 Water = 382.33
Sulphate of Cinchonia:
1 Cin + 1 Acid + 4 Water = 232 65
Sulphate of Quinia:
2 Quina + 1 ac. + 10 Water = 419.2
Hydrochlorate of Strychnia:
1 Base + Acid = 274.17
Sulphate of Strychnia:
1 Base + 1 ac. + 3 Water = 304.85

Hyduret of Benzule:
1 Benz. 1 Hyd. = 107.68

Sulphurets.

Sulphuret of Potassium:
1 P + 1 S = 55.25
Sulphuret of Calcium:
1 Ca. + 1 S = 36.6
Bisulphate of Iron, 1 Fe + 2 S = 60.2

Sesqui sulphuret of Antimony:
2 Sb. + 3 S = 177.5
Oxy-sulphuret of Antimony:
Sesqui-S. 2 eq. ..... } = 508.2
Sesqui-Ox. 1 eq. .... }
Protosulphuret of Mercury:
1 Hg. + 1 S = 218.1
Bisulphuret of Mercury:
1 Hg. + 2 S = 234.2

III.—TABLE OF THE ULTIMATE COMPONENTS OF SEVERAL VEGETABLE AND ANIMAL SUBSTANCES, ARTICLES OF THE MATERIA MEDICA.

Vegetable Substances.

	CARB.		HYD.		NITROG.		OXY.	
Narcotina.....	L. 65	+	5.6	+	2.51	+	26.99	in 100 parts.
Narceia.....	L. 54.73	+	6.52	+	4.33	+	34.42	100
Emetia.....	L. 64.57	+	7.77	+	4	+	22.95	100
Delphia.....	L. 76.69	+	8.89	+	5.93	+	7.49	100
Picrotoxia.....	O. 61.434	+	6.11	+		+	32.456	100
Mannite.....	P. 38.7	+	6.8	+		+	54.5	100
Gum Arabic.....G.L.	42.23	+	6.93	+		+	50.84	100
Olive Oil.....G.L.	77.213	+	13.36	+		+	9.427	100
Camphor.....	D. 79.28	+	10.36	+		+	10.36	100
Oil of Cloves.....	D. 70.02	+	7.42	+		+	22.56	100
Oil of Bitter Almonds.	L. 79.56	+	5.56	+		+	14.88	100
Resin .....G.L.	75.944	+	10.719	+		+	12.337	100
Bees' Wax.....	U. 80.4	+	11.3	+		+	8.3	100
Ulmin.....	B. 56.7	+	8.3	+		+	36	100
Piperina.....	G. 80.95	+	8.13	+		+	10.92	100
Meconine.....	C. 60.247	+	4.756	+		+	34.997	100
Elateria.....	H. 17	+	11	+		+	18	46

Animal Substances.

Albumen.....	P. 50	+	7.78	+	15.55	+	26.67	100
Gelatine..... G.L.	47.881	+	7.914	+	16.998	+	27.207	100
Urea.....	P. 19.99	+	6.66	+	46 66	+	26.66	100
Cetine.....	81.666	+	12.862	+		+	4.578	100
Spermaceti.....	79.5	+	11.6	+		+	8.9	100

L. Leibeg; O. Opperman; P. Prout; U. Ure; G. Gobel; G. L. Gay Lussac; D. Dumas; B. Bouilay; C. Couerbe; H. Hennell.

NO. IV.

The following substance has lately been so much employed, that I think it proper to introduce a brief notice of it here.

Kreosote—named from the Greek word κρέας, *flesh*, and σώζω, *I save*—was discovered by M. Reichenbach of Blansko, and obtained from the tar which distils over with the pyroligneous acid, in the process of procuring it. The tar is distilled, and the oil which it yields being rectified and heated, the acetic acid it contains is saturated with carbonate of potassa. The acetate being separated, the oil is again distilled, and the first products rejected. The oil obtained is now treated with liq. potassæ, sp. gr. 1.2, and, the scum removed, the alkaline solution is boiled in an open vessel, oxygen is absorbed and it assumes a brown colour, and, when cold, the alkali is removed from the oil by sulphuric acid. The same process is repeated with the alkali and acid twice; and, lastly, a little phosphoric acid is added to saturate any ammonia associated with the oil. This oil is again dissolved in caustic potassa, and afterwards again separated from it by distillation: this is KREOSOTE.

When pure, it is a colourless, oily, transparent liquid, with a penetrating, disagreeable odour, like smoked ham: its sp. gr. is 1.037; it boils at 397° Faht. congeals at—16.6° Faht. and burns with a smoky flame. It unites with acetic acid in every proportion.

It forms combinations with the alkalies, which are again readily decomposed by all the acids, except the carbonic. It combines with lime: dissolves, when aided by heat, in acetates of potassa, soda, ammonia, lead, and zinc; muriates of lime and of tin; some of them crystallize. It reduces acetate and nitrate of silver. It combines with alcohol and ether in every proportion: coagulates largely diluted albumen; preserves meat and fish, and is said to be the antiseptic principle of pyroligneous acid: it does not act on pure fibrin. It excites a burning pain when placed on the tongue, and erodes the cuticle. M. Reichenbach says that it cures caries, cancer, and carcinomatous ulcers; allays rheumatic pains; and proves beneficial in pneumonic diseases. I have had no experience of its powers; but if those effects are produced, they must depend on its acting topically on the mucous membrane of the alimentary canal. On this account, it is scarcely requisite to say that it must prove highly deleterious in gastritis or enteritis.

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FINIS.

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CORRIGENDA.

Page 155, line 25, *for* straights *read* straits.
—— 188, ——— *for* Fœderé *read* Foderé.
—— 294, ——— *read* page 494.
—— 543, l. 13 from bottom, *for* Chloride of Lime *read* Calcis chloridum.
—— 338, l. 13, *for* short *read* shut.
—— 591, l. 12 from bottom, *for* they enter *read* their active principles.
—— 365, l. 11 to 14 from bottom *for* $\left\{\begin{array}{l}48\\31.3\\72\\\hline 15.3\end{array}\right.$ *read* $\left\{\begin{array}{l}48\\31.3\\72\\\hline 151.3\end{array}\right.$
—— 427, l. 14, *for* less *read* little.
—— 441, l. 14, *for* Dublane *read* Dublanc.
—— 548, l. 24, *for* preponderated *read* preponderates.
—— ib. l. 10—18 *for* Dewels *read* Dewes.
—— ib. l. 11, *after* was *insert* known.
—— 550, l. 39, *for* circumstance *read* circumstances.