GENERAL PATHOLOGY.

ELEMENTS

OF

GENERAL PATHOLOGY:

A

PRACTICAL TREATISE

ON THE

CAUSES, FORMS, SYMPTOMS, AND RESULTS OF DISEASE.

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Ratiocinationem igitur plurimum laudo, siquidem ex fortuita occasione ducat. Quod si non ex evidenti occasione, verum ex probabili rationis fictione ducatur, plærunque gravem et molestam infert affectionem.

HIPPOCRATES.

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TO

WILLIAM W. GERHARD, M.D.,

WITH RESPECT

FOR HIS IMPORTANT CONTRIBUTIONS TO PATHOLOGY,

WITH ADMIRATION

FOR HIS EMINENCE AS A PHYSICIAN AND A TEACHER,

AND WITH GRATITUDE

FOR THE SOUND DOCTRINE OF HIS PERSONAL INSTRUCTION,

AND THE EXAMPLE OF HIS INDUSTRY AND ZEAL,

This Work

IS AFFECTIONATELY INSCRIBED

BY HIS FRIEND AND EARLIEST PUPIL.

PREFACE.

English Medical Literature has hitherto possessed no work exclusively devoted to General Pathology. In nearly all of the systematic treatises and dictionaries of medicine in our language this subject is either discussed theoretically and imperfectly, or is altogether unnoticed. The well-known and valuable work of Dr. Williams forms scarcely an exception to this statement, for its scope not only embraces General Pathology in the proper sense, but also hygiene, prophylaxis, and therapeutics; in consequence of which extended plan the author was obliged to restrict himself to "a brief general view of Etiology, Nosology, Semeiology, Diagnosis, and Prognosis," subjects which will be found to occupy nearly the whole of the following pages.

It is hoped that the attempt now made to supply the deficiency which is thus disclosed in our medical literature will not be thought untimely, and that the difficulties inseparable from such a task, will secure for the writer the candid criticism of his professional brethren. He is convinced that among the most serious defects in the present system of medical education, are an almost total neglect of logical analysis, and a tendency, where generalization is at all encouraged, to speculate on fanciful analogies, rather than to extract truth from facts. How fatal these influences must be to a successful study of disease, and to that confidence in medicine which experience imparts to the philosophical physician, is too apparent to require illustration. The author is persuaded that the view of medical science which it is the province of General Pathology to afford, is eminently adapted to correct these evils, by encouraging a more healthful discipline, and infusing a more hopeful spirit, among those who are preparing for medical practice.

Defects like those complained of are nearly if not quite as palpable in the education of English physicians, whose writings but too often afford evidences of their existence. The eminent teacher alluded to above, fully confirms this opinion in the following words, which are respectfully commended to the meditation of American physicians: "I venture to affirm, that a chief reason why the practice of medicine has been commonly so distasteful, and so difficult in its study, and so unsatisfactory when tested at the bedside, is, because its foundation, *general pathology*, has not been efficiently taught."

An intimation was given in the original announcement of the publishers of this work, that it was to be prepared with reference to the *Elémens de Pathologie Générale* of M. Chomel. On reflection, this plan was speedily abandoned by the author, who preferred employing as a basis for the work the Lectures delivered by him in a medical institution of this city. He has the less reason to regret this decision, since there has just appeared in Boston, a translation of M. Chomel's treatise, by Dr. F. E. Oliver, and Dr. W. W. Morland. The lectures referred to have merely served as a nucleus, around which have been arranged much more abundant materials, derived from all of the best sources accessible to the author. The works named in the subjoined list, besides those mentioned in the text, have been faithfully consulted and freely employed. The most valuable assistance was rendered by that of

MM. Hardy and Béhier, which is the most complete, as well as the most recent, work on General Pathology.

While acknowledging his obligations to various sources for the materials of his work, the author takes the liberty of mentioning his indebtedness to his brother, Dr. Moreton Stillé, for important services rendered in preparing his manuscript for the press.

Philadelphia, March 3d, 1848.

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INTRODUCTORY ESSAY.

MEDICAL TRUTH.

ITS NATURE, SOURCES, AND MEANS OF ATTAINMENT.

General Pathology presents an almost boundless field for study. All branches of medical science and of medical literature, are, to some extent, included within it, because they furnish the materials out of which it is formed. Whoever, therefore, attempts its investigation is obliged to select, from the topics it presents, such as he is capable of grasping; and must apply to them such principles of reasoning as the peculiarities of his mind and education have rendered natural and familiar.

In common with most authors, the writer of the present treatise proposes to set *the truth* before his readers, but conscious that this phrase represents no medical doctrine received of all men, but only "that which every man thinketh," he makes bold to claim indulgence while endeavouring to expound his interpretation of medical truth.

Truth, which is an exact accordance with fact or reality, has no *absolute* existence except in the Creator of the universe, because no finite mind can stand in any conscious relation to all created things. *Revealed* truth is an expression of the Creator's will, and so far as it extends, is perfect, and, like its author, unchangeable. But medical truth is neither absolute nor revealed. *Intuitive* truth is that which carries conviction with itself; it has only to be stated to be admitted. Of this sort is the consciousness a man has of his own existence, a conviction which no reasoning can either strengthen or invalidate. It is this which gives sacredness to Genius. No man can seize all the relations of the moral and physical world, but some few possess the power of instinctively perceiving and elucidating *moral* truths. Such truths, and so discovered, are those which have been sung by the poet and taught by the moralist in all ages, and whose real accordance with the principles of human nature is shown by the fact that they are essentially the same, wherever promulgated. But medical truth is not intuitive. Again, there is *demonstrative* truth. Mathematical propositions are of this sort. They repose on axioms and postulates, which cannot be gainsaid, and which are, therefore, absolute and immutable. The conclusions at which they furnish the means of arriving are consequently certain. But it is to be observed that the elements of mathematics are mere abstractions. There is really no such thing as a straight line, a plane surface, a regular curve, a perfect sphere, a uniform solid, as defined by the geometrician. Hence it is that mathematical propositions in the abstract, pure mathematics, are rigorously true; but in practice, applied mathematics, are liable to all the errors created by defective senses, and imperfect instruments, errors which can only be corrected by observation and experience. Medical truth is not demonstrative. These several kinds of truth are intellectual chiefly; they have their origin in the mind; they are evolved, weighed, and applied by the mental faculties. But there remains another and a very different one. This is *inductive* truth. It is that which belongs to the physical sciences, which is the sacred element of all (so called) natural laws; the search after which is the life-spirit of astronomy, of chemistry, geology, and medicine, whose progress has been rapid while it was active, and slow when it declined. It is that very truth which is "the daughter of time, and not of authority," and which alone can outlive the waste of ages, and man's contempt and neglect. Its origin is not in the mind, but in external nature. Observation is the great instrument for its discovery, and next, experiment, which is observation under circumstances of our own choosing. Facts are its materials, co-ordinated facts contain its laws. The ancients were ignorant of it, or had but a faint perception of its power. They preferred to speculate and dogmatize rather than study the interpretation of nature. Their ambition was to form a sect and captivate public opinion; to triumph over their opponents rather than to prove themselves possessed of truth; to sharpen their wits rather than to exercise and improve their senses. Hence the barrenness of the ancient philosophy, its utter unproductiveness of anything really useful to mankind. Well did it deserve the sentence pronounced upon it by its greatest judge. "It is not wonderful," says Lord Bacon, "that the Egyptians (who bestowed divinity and sacred honours on the authors of new inventions) should have consecrated more images of brutes than of men; for the brutes by their natural instinct made many discoveries, whilst men made few from discussion and the conclusions of reason." If modern times have any advantage over antiquity, it certainly is not either in acuteness or force of reasoning, (which are of all ages and may be made to support a bad as well as a good cause,) but in that knowledge which has flowed from long and repeated observation. The theories which ruled the world successively, have disappeared one after another, like succeeding fashions in equipage and dress, while many of the *facts* recorded two centuries before the Christian era, recur in the daily walks of our profession, precisely as the Father of medicine inscribed them on his tablets. The Galenical theory, that of Paracelsus, of Borelli, of Van Helmont, of Silvius, all world-renowned in their day and generation, are now less honoured than the scattered dust of their inventors. No other destiny awaits the hypotheses which have more recently arisen and flourished. Brownism and Rushism, Broussaisism and Hahnemannism, with all the other fruits of a luxuriant fancy and a poverty of facts, must descend the inevitable slope to oblivion; but the vast collection of truths established by the observation of nature, are as immutable as herself.

It is not asserted that the originators of medical systems were wholly ignorant or regardless of observation, or that such physicians as Hippocrates, Celsus, Aretæus, Sydenham, Baglivi, and Morgagni, were entirely free from the shackles of speculation. But while the latter exerted all their industry and talent in collecting and pondering facts, caring little for the establishment of one doctrine rather than another, the former, by dint of meditation and subtle reasoning, elaborated from a *few* facts such complete and ingenious systems, that they were afterwards ashamed to descend to the gross and mechanical process of observing, and by degrees became so charmed with their own work, as to hold for certain what they had at first regarded as only probable. Since the days of Hoffman and Boerhaave, a little more than a century ago, even the most hardy theorists have professed to base their systems upon facts. Technical logic and metaphysical reasoning have been almost discarded from the schools, and no one now claims acceptance for his doctrine, upon the ground of any internal evidence of its truth, but simply on that of its conformity to the results of observation. Such is the spirit of the age. The reigning philosophy has almost always shaped medical theories. While the former occupied itself with unsubstantial shadows, the latter were subtle and flimsy,—mere cobwebs of the brain. But when the old philosophy began to totter under the sturdy blows of Lord Bacon, and was completely overthrown by the Sceptics of the last century, Aristotle and Galen were abandoned to the dust and the worm, and *Nature* began to be worshipped in their stead. The consequences of this revolution have been stupendous. The physical sciences, one and all, have revived, and in a few years advanced far on the road to perfection. But not content with narrow limits, they have taken under their fostering care the mechanical arts, infusing into them a vigour, and communicating to them an impulse which have reacted upon every human interest, social, political, and religious. Less than half a century has sufficed for this work, for changing the whole of Christendom from speculative to practical, and for rendering this, (what it is so often called,) the *mechanical age*. If the natural sciences were once crushed under the incubus of metaphysical and theological disquisitions, or etherialized by the refined and poetical tastes of our ancestors, they have already been avenged. They have driven from amongst us nearly all of true faith, of ennobling and generous poetry, of single-hearted devotion. It is the misfortune of humanity ever to run into extremes, to adopt a proscriptive policy, to lose sight of that portion of good which mingles with, and redeems from condemnation, even the most imperfect things. If the ideal once supplanted the natural, does it follow, that when nature triumphs, the imagination must be chained in the dust? By no means; for each has its appropriate sphere. The poet should hold undisputed sway in his own realm, the scientific investigator reign supreme in his. They cannot wield a common and united sceptre, for the subjects of the one are airy nothings,—people of the land of dreams, that rise at any moment, or in any shape that their master wills. Those of the other are the works of nature, which exist by no power of his, which change or pass away without his interposition, of which he is merely the spectator, and which he thinks his life well employed, if he can, at last, learn to interpret.

It cannot be kept too constantly in view, that there is no necessary connexion between medical and intuitive truth, between the physical sciences and poetry or religion. To assert such a connexion, is to pervert or degrade them all; to arrest the progress of human improvement, and to arm the unbeliever with the most fatal weapons. The literary world has, of late years, been deluged with treatises and declamations on the poetical and religious tendencies of science, and especially on the persuasives to religion furnished by medical investigations. All this is essentially erroneous, and indicates a complete misconception of the nature of truth, and an ignorance of the different kinds of evidence required by different truths.

One of the most ingenious and sublime conceptions of astronomical science,—the Nebular Hypothesis,—one which has inspired much ardent and elevated devotion, and been the theme of much impassioned admiration, was invented by the great Laplace,—not because he had exalted notions of the power and wisdom of God, or was impressed with a sense of his own and this world's insignificance, in the midst of that infinite number of systems and worlds with which immensity is filled, but, as he himself avowed, "*to do away with the necessity of a Creator*." Now, the religious, or rather anti-religious conclusion which he drew from the contemplation of natural phenomena, was precisely the opposite of that which other men, no less acute, inferred from the same premises. Both parties could not possibly be right, and yet neither could convict the other of a logical error. The paradox is explicable by the fact, that Laplace was an infidel before, as well as after his great invention, while those whose conclusions were opposed to his, were Christians. The two parties saw the same object through different media, and therefore saw it differently. If an impartial umpire could have been found, he would, probably, have given judgment against both parties, declaring that the facts in question were scientific facts,—that they had nothing to do with religion, and, of themselves, gave as little countenance to the blasphemy of the one, as to the enthusiasm of the other.

It is common for persons to imagine that the study of astronomy must be delightful; that it must purify and elevate the soul, and inspire it with sublime conceptions of the Creator of all things. With these laudable sentiments, they open an astronomical treatise, and find a sad array of ellipses, parabolæ, tangents, parallaxes, equations of curves, and other algebraic formulæ, which have no more to do with the visible or metaphysical relations of the heavenly bodies, than have the letters of the alphabet with the objects they are employed to name. The poetico-religious inquirer closes the book in disappointment, and reproaches astronomy for not teaching him what it never professed to teach,—what, indeed, it was incapable of teaching. He should have blamed himself for not having taken the pains to inquire how that science was to be studied,—what were its legitimate objects, and its appropriate sphere. The same remarks are true of the other sciences, and, to their full extent, of medicine. Whoever would cultivate it with pleasure and profit, must first inform himself thoroughly of its nature, capabilities, and aim; for, if he do not, one of two consequences will inevitably ensue: either he will fail to accomplish anything honourable or useful, let him labour never so assiduously, or he will, sooner or later, abandon the profession in disgust, persuaded that he has been deceived. He will have found that, instead of filling him with veneration of the wonderful contrivances of the human organism, and inspiring him with poetical or devotional feelings, it rather tended to diminish his faith, to materialize his speculations, to blunt his sensibilities; that instead of his finding in it exhaustless mines of metaphysical research, of gaining from it any light as to the cause of life, the nature of vitality, the connexion of the soul and body, it not only left him as ignorant of these things as ever, but taught him that they were unattainable, and endeavoured to narrow down his inquiries to mere objects of sense. If this has really happened to any one, the fault was his own. Before entering upon medical studies, he should have fully comprehended their nature, learned how they ought to be prosecuted, and what advantages might fairly be expected from them. From this error the writer would preserve his readers; he would convince them that the science of medicine is founded *alone* upon the observation of facts, to the *entire exclusion* of all hypothetical reasoning, and that, *as a science*, it has as little to do with the imagination or the conscience, as has the determination of a comet's orbit with the "Music of the Spheres."

It was stated that *all* the natural sciences are built up and perfected by observation; but the results of observation are not equally exact in all. This is owing to the character of the elements of which they are composed. In proportion as these are simple and determinate, will the results be accurate. In astronomy, which is concerned with vast masses, bearing but few and constant relations to one another, mathematical calculations are easily applied, and the few general laws of the science readily deduced. Hence it is that astronomers are able to predict the occurrence of an eclipse, or the return of a comet to a given point in space, with as much certainty as the rising of the morrow's sun. If an error is committed in a particular case, the fault is in the observer, or in the imperfection of the instruments employed by him, but not in the irregularity of the phenomena observed, nor in the principle on which the investigation proceeded. In inorganic chemistry, the elements are more numerous, the instruments less perfect, the principles less certain. In its study, therefore, errors are still more inevitable. In organic chemistry, again, the difficulties are multiplied; besides all of those which belong to its sister department, others, which are the result of life, abound, and substances of identical chemical composition no longer display the same, nor even similar physical properties. Advancing to physiology, we find the uncertainty augmented. Effects are there witnessed which cannot be arranged under any known chemical or mechanical laws, but are sometimes apparently in contravention of such laws. In physiology, we have to deal not only with matter, but with organized matter; not only with organized, but with living matter; not only with living matter, but with a living soul, in its thousand reactions with the body, which are, for the most part, not only unknown, but wholly incomprehensible. If, then, so much doubt and obscurity envelope our knowledge of physiology—of the normal and natural state of the human economy—how much thicker darkness must involve our notions of its abnormal conditions or diseases? If we add to all these difficulties, inherent in the subject itself, and which there is little hope of removing, those which ignorance, fancy, prejudice, and wilful deceit have added,—the *false facts* of medicine, as they have been called,—medical truth will appear to be shut up in a fortress, impregnable by human wisdom or human industry.

This is a discouraging and disheartening statement; one which would seem to admit, that medicine deserves all the sarcasms and ridicule which have been heaped upon it by the ignorant; that it is unworthy of the name of science, and scarcely deserves to be called an art. But, after all, what does this avowal amount to? Merely that medical knowledge is neither perfect in itself, nor easy of acquisition. Is it, therefore, to be condemned, and buried in the same tomb with alchemy and astrology? Or are not its very imperfections the rather to be studied, that they may be removed? For let it be remembered, that disease exists; and, in one form or another, medical art has existed from the beginning, and must endure just so long as man's physical nature continues to be what it has always been. We are not called upon nor permitted to decide whether medicine shall be abandoned; we can only choose between cultivating it seriously and ardently, and paying it a lukewarm and enforced respect.

The very uncertainty of medicine, if rightly understood, is one of the most effectual spurs to industry. It keeps benevolence warm; it makes us anxious and observant; it excites our ambition to rank with those who have most largely contributed to the resources and the progress of medicine. It is undeniable, moreover, that this progress is real; that built upon the foundation already described, our scientific edifice is yearly rising in more stately and elegant proportions, from amidst the rubbish accumulated around it by the lapse of time.

Allusion has been made to the *false facts* of medicine. Their sources are various, but are principally these: wilful imposture, and self-deception resulting from a too ardent temperament, or from trusting in a preconceived hypothesis. Of the former are the numberless expedients of charlatanism, both within the profession and external to it; the claims to important discoveries, and to the performance of cures in cases well known to be irremediable, or to a much larger success than is either probable, or proved by subsequent experience, or to the easy removal of diseases which the most honest and skilful practitioners admit to be very obstinate, if not incurable. These things, it is true, deceive none but the ignorant, and the progress of science cannot be long retarded by such small impediments. It meets with far more serious obstacles in some of its most zealous friends, in those who, by the inadequate study and rapid generalization of a few facts, proclaim new and wonderful results which are accepted as so many truths, upon the strength of their author's well-known veracity, and the assurance of their being the legitimate offspring of observation and experience.

Having now endeavoured to show that observation is the only instrument by which the physical sciences, and medicine amongst them, can either be created or perfected, and that false and imperfect observation forms the greatest obstacle to their improvement, it remains to be inquired what are the principles and the method of true observation in medicine.

The primary object of all medical investigation is, to distinguish diseases from one another. It is evident that all discussions about any disease, are utterly futile, so long as it is not agreed in what it differs from all other diseases. That there *are* various diseases, results from the most trivial and vulgar observation. The records of medicine in their most imperfect state, recognise the same fact, and it is employed as the very foundation of every treatise upon medical art. Consequently, in proportion as observation is minute and accurate, will each disease be exactly defined and separated from others which have a greater or less resemblance to it. Thus, formerly it was not considered possible to distinguish pleurisy from pneumonia; but a more rigorous investigation employed in later times, enables us to diagnosticate these affections with almost absolute certainty. Formerly there were united under the common name of inflammation of the brain, what are now known to be distinct affections; under the name of cardiac palpitations, diseases as widely different as organic and functional alterations: so, too, of continued fevers, and other affections. The power now possessed of discriminating between maladies which were once confounded, to the great injury of the science and all rational therapeutics, has been entirely conferred by a system of close and methodical observation, by series of cases reduced to writing, and analyzed, as nearly as possible, with mathematical rigour. It is affirmed, that the results already obtained are to be regarded, not as absolute and final, but only as provisional; not as the best possible, but only as the best for the time being. The correctness *of the method* is alone asserted to be positive, and beyond dispute.

Most of the writers whose names have been mentioned as connected with the real progress of medicine, seem to have adopted this plan to a certain extent, and none more fully than the Father of Medicine himself. But he, as well as all his successors, until very recently, preferred to communicate the general results, rather than the elements of their experience, in the form of aphorisms, or short, pithy maxims, which were easily remembered by their pupils. These aphorisms were what might be called the general impressions left upon the minds of physicians by the whole course of their experience. There is no evidence of their having been formed by any more rigorous process, and consequently, many of them have long since been shown to be unequivocally false, and many others are expressed so obscurely, as to have little practical value. The cases which have come down to us from the older writers, are, for the most part, such as are least valuable, the rare, namely, the curious, and the anomalous. It became necessary, therefore, that the moderns should apply themselves to the *natural* history of disease, and build up the science anew, from its very foundations, by slow and gradual labour. Thus it is, that nearly the whole domain of pathology, such as we now possess it, is of very recent acquisition, and in spite of their declamation against it, is used habitually, and valued by the very persons who insist that we have added nothing to ancient medicine, and who decry and ridicule the mechanical labour of observation. They consider the collection and observation of facts as among " the slow processes of a vulgar intellect," and would have truth seized by " the vigorous sallies of speculative genius ;" but they fail entirely to show a single medical truth which was ever revealed by means of their favourite method.

Bacon says of the necessity of recording experience : " The understanding is as incapable of acting on such materials with the aid of memory alone, as any person would be of retaining and achieving by memory, the computation of an almanac. We cannot approve of any mode of discovery without writing, and *when that comes into general use, we have further hopes.* . . . We shall then be able," he continues, " to put the forces of the understanding in due order and array, by *means of proper and well-arranged, and, as it were, living tables* of discovery of those matters which are the subject of investigation, and the mind can then apply itself *to the ready prepared and digested aid which such tables afford.*"

It is somewhat remarkable, that although these precepts were promulgated more than two hundred years ago, and many physicians since that time have professed to guide their inquiries by the Baconian philosophy, yet not until within twenty or thirty years has any one carried them into literal execution. It is hardly less remarkable, that the first to practise and teach successfully this method, was not one of that nation so justly proud of their great Lord Chancellor, but of that other people which has ever been their rival, and often their victor, in science, arts, and arms. If Bacon did not think it humiliating to man's intellect to employ this method in the pursuit of truth, we can well afford to feel unscathed by the " sallies of speculative genius" directed against it. He well knew, and declared with emphasis, that it gives to industry and honesty a large advantage over all speculation, however ingenious, and that, to use his own words, " it levels mens' wits, and leaves little to their superiority, since it achieves every thing by the most certain rules and demonstrations."

Upon the same subject, Baglivi says, " The whole history of diseases depends upon a diligent and patient description of all such things as the learned observer *has marked down* concerning their invasion, progress, and issue, and *committed to writing* with the same simplicity and sincerity that he used in observing them, *without adding anything of his own.*" The authority of Stoll's writings cannot be wondered at, when his plan of observation is known. "I shall," he says, "minutely detail the history of my patients, so that if my *reasoning* should cause any one to err, my observations cannot have that effect, because they are faithful and exact transcripts of the truth. I shall relate them, *not from memory*, on which little dependence can be placed, but out of my *case book*, for whose accuracy the numerous and daily attendants on the hospital can vouch." Heberden's high rank in medicine was gained by similar means. He tells us that the notes on which his Commentaries are based, were taken in the chambers of the sick, from themselves or their attendants.

The celebrated Bordeu has well expressed the same idea. "It would be well," says he, "if every one were obliged to produce the written proofs of his observations, since we too readily adopt the opinions of others, and nothing is easier than self-deception. We remember what was favourable to our views, and forget the rest. The observer, or he who is able to furnish well-recorded cases, must not be satisfied with saying, *I have seen*, *I have done*, such a thing, for your mere stone-blind observers may say as much; he must sustain his assertions by written proofs which will show that he really did see, and knew that he saw at a given time. He must be ready to convince even a sceptic, who may say to him, Pray, where did you observe? how did you observe? and, what is of still more consequence, what right had you to observe? what precautions did you take against deception? what proofs have you that you were not deceived?"

Additional citations might be made from other authors, but these suffice to show that the principle for which we are contending has long been recognised, as well by those who made an imperfect use of it, as by those who can hardly be said to have employed it at all. We may then, without further argument at present, regard it as proven, that written and detailed narratives of individual cases constitute the only sufficient materials for composing the history of any particular disease.

Admitting, then, that every correct history of a disease, and all satisfactory precepts for its management, must be drawn from a series of well-observed cases of the disease, not confided to the memory, merely, but preserved in writing; it may now be asked, by what process the result in question may be obtained?

Let it be supposed that when the Asiatic cholera first made its appearance in this country, our physicians had had no knowledge of it, either from reading or report. A case, the first case, occurs. The medical attendant of the patient is surprised at the novelty of the symptoms, and is at a loss how to oppose them. However, he prescribes, and the patient recovers. Soon afterwards he is called to another person affected very nearly like the first. He cannot help perceiving that he has again to do with the same disease; and, as a matter of course, he employs his original prescription. But the patient dies. A third person sends for him, attacked in nearly the same manner as the two others. What reflections does the physician make, instinctively. "Here," he observes to himself, "is the same disease; the prominent symptoms are precisely like those I have witnessed in the other cases. That much is settled. But, is the patient in danger? I have seen one die and one recover," he replies, "therefore the chances in the present case are equal, so far as it is possible for me to judge. But what treatment shall I employ? Again the same doubt; I have at least as good reason to resort to my first plan, as to reject it; the whole experience I have in regard to it amounts to this, that in one case where it was used the patient recovered, that in another similar case he died. The success *may* have been owing to my remedies, the failure *may* have been in spite of them, certainly was not because of them; I am bound, therefore, to try them again." They are once more prescribed, and the patient gets well. At this point our physician is met by a brother practitioner, who begs to be informed about this new and extraordinary disease. He may receive an answer framed in one or the other of the following styles. "I have seen a number of cases of this new affection; in some, the onset was sudden, in others gradual; in all of them there were vomitings, cramps, violent diarrhœa, with rice-water discharges; suppression of the urine, blueness of the skin; in some there was reaction after collapse, in others none. I employed such and such remedies, and have reason to be satisfied with them, for I have only lost one patient. The disease is certainly a very serious one, but I have cured more cases than I have lost." Or, "I have seen three cases of the disease, all of them in persons between the ages of 20 and 40, day labourers, and previously in perfect health. One of the three died, the other two recovered. In the fatal case, the onset was sudden, beginning with a chill, soon followed by vomiting and purging; in both of the other cases, the attack came on gradually, and was preceded by uneasiness, headache, sleeplessness, loss of appetite, &c. It was about twenty-four hours before these patients fell into the same condition as the first was in from the beginning; *then* the symptoms of all three became alike; there was vomiting, every five or ten minutes, of such and such matters, and stools at the same intervals; but, subsequently, without intermission, of such and such fluids, amounting to half a gallon or more in the hour. The pulse, in the fatal case, was imperceptible from the start; in the other cases it was small, quick, and beat about 90 per minute, until the collapse approached, when it rose to 120, 130, and at last could not be counted. The collapse was nearly the same in all three of the cases; its symptoms were so and so; in the fatal case, however, it terminated in death in six hours from the commencement; in the other two, (at the end of three hours, in one case, and four in the other,) the discharges, coldness, blueness, &c., diminished, and were followed by fever. In one of the cases, this lasted only about thirty-six hours, and ushered in full convalescence; in the other, the fever assumed a typhoid form, with such and such symptoms, which were not entirely dissipated until the 12th day from the commencement of the attack, when the patient slowly regained his strength. The number of my cases is, of course, too small to afford a complete picture of this disease; but it is the best my materials allow me to give. This is still truer of the treatment, for having no idea of what the mortality of the disease would be if left to itself, I cannot presume to say that my treatment had any influence on the results

I have obtained. I have adopted it owing to the remote analogy of the present affection with some other diseases familiar to me; but experience only can determine its fitness. When I shall have had one or two hundred cases under my charge, the results of my observation will possess a more definite value."

It will be readily understood from this illustration, that if the object of the inquirer was to learn all that he could about the cholera, the latter of the two answers to his question, could alone supply the information he was in search of, because it was a faithful narrative of what his informer had really observed, and was conveyed in language as exact as possible, while the first answer, although not absolutely false, was yet not strictly true, was an unfaithful representation of what had occurred, and led to, if it did not admit, false conclusions, for it was evasive, indefinite, and incomplete. The second answer was faithful, because it described minutely what had actually been seen and felt, and in terms admitting of no double construction. If a quantity was to be expressed, it was expressed in numbers; the ages of the patients, the duration of the several stages of the disease, the frequency of the pulse, the intervals of vomiting and purging, and the amount of matters rejected, were all capable of being represented by figures, and had, therefore, a claim to be so rendered, as the most, and indeed the only precise method possible.

It may seem strange, that there should be different opinions on such a point as this; that men should be found not only to question the utility of describing cases of disease with such rigorous nicety, but even to ridicule and deride the efforts of those who are labouring to introduce exactness into medicine, and to characterize them as dull and uninspired plodders, without the elevation or the enthusiasm of genius. Surely, if knowledge is valuable, it is only so in proportion to its accuracy; to deny this, would be to admit the absurdity, that nothing is worthy of being thoroughly known. Every one knows that gold is heavier than water; but is such knowledge to be compared to that of the man who can tell us that gold is 19·25 heavier than water? We all know that the pulse of an infant is more frequent than that of an adult; but have we no obligations to him who informs us that the average rate of the former is about 95 per minute, and of the latter about 75? We may be acquainted with the fact, that the fibrinous element of the blood is increased in inflammatory affections; but does he not deserve our thanks who proves, that although the normal proportion of this constituent is but 3 parts in 1000 of the blood, yet in the class of diseases mentioned, it is increased to 5, 7, 8, or even 10 parts in the 1000?

In the illustration presented a few moments ago, it was, we trust, made apparent, that the second answer attributed to our physician, was the only one that could be given in conformity with the strict demands of science. It was, at the same time, admitted, in consequence of the paucity of facts on which it was founded, to be insufficient for determining anything very certainly about the disease to which it referred. But if the same kind of note had been taken of one, two, or five hundred cases of the same malady, no argument is needed to show that deductions fairly made from them would have a much higher value than those drawn from the original three cases; for this is no more than to say what every one admits, that experience is valuable. It is equally clear that if all these were cases of persons about the same age, of the same sex, condition, health, and submitted to the same treatment, a general abstract of them would present a perfect picture of the disease as it affected that sort of persons, and we might fairly conclude that another equal number observed under the same circumstances would furnish nearly identical results:—for the operations of nature are uniform in disease, as elsewhere, and like causes must produce like effects.

In drawing out a general description of the disease we could proceed in one way, and in one only, if we meant to be accurate. Having two hundred cases and desiring to know the mortality amongst them we should easily obtain it by counting; desiring to learn how far cramps are to be considered a symptom of the cholera, we should have but to search through the whole series of cases, when perhaps it appears that 190 patients had this symptom, while in 10 it was absent, which result ought to be given in as many words, or the statement made that the symptom was nearly constant; desiring to know the average duration of the disease, we add together the periods of all the cases, and divide the sum by the number of cases; we may make this calculation separately for the fatal cases, and for those which recovered; or we may find, in a similar way, the maximum and minimum duration of the malady. And so in regard to all of the symptoms, and their various relations. If we would discover the anatomical character of the disease, we have only to count the lesions mentioned in our records, and to put those of each organ by themselves, by which means we presently come to the conclusion that such or such an alteration of structure existed in every case, that certain others were present in a majority of the cases, and others again, in a smaller proportion. In this way we learn to connect the constant lesions with the predominant symptoms, perhaps to discover that the former were the cause of the latter, and, in this way to form a clear and definite idea of the disease. If different modes of treatment were employed with different portions of the patients, we may be able to estimate the comparative values of the several methods by counting the proportion of deaths in the several groups of cases.

It has been assumed that the subjects of these 200 cases were under precisely the same circumstances of age, social condition, &c., that they were *perfectly comparable* with one another. Now it results from observation that many, indeed most affections, are considerably modified in their intensity, duration, and gravity, by the age, sex, previous health, condition, occupation, residence, &c., of the persons attacked by them; it is also a fact that it is almost impossible for one physician to collect a very large number of cases so nearly identical in every respect as to be perfectly comparable with one another. Hence the near approach to certainty, according to the plan just set forth, is somewhat lessened, first, because it is evident that in proportion as the cases in our series differ from one another, it will be difficult to deduce from them a general law; and, secondly, because the number of similar or comparable cases which it is possible to collect being very restricted, the conclusions drawn from them will be weaker than if furnished by a more extended series of facts. It follows, therefore, that a collection of observations made indiscriminately amongst the old and young, the rich and poor, males and females, in hospitals and in private practice, during and in the absence of an epidemic, is not made up of facts susceptible of being compared with one another. They must first be separated into as many groups as there are distinct and influential modifying causes acting upon the patients; each of these groups must be analyzed by itself, and the inferences made from it must not be applied to the other groups.

The following examples illustrate this proposition. Nothing is better established than that depletion is useful in pneumonia. Yet some years ago there was a prevalent inflammation of the lungs, in which, if the patient was freely bled, he died. And why? because the disease was really no longer the same; it was a pneumonia of a typhoid form, wholly different from the ordinary one, and requiring an opposite treatment. The two classes of facts were not comparable. Again, suppose that it were desired to know the mortality after amputations, and that we had at command the reports of two of the largest hospitals in Paris, Hôtel Dieu and La Charité, into which the same sort of patients, and in about equal numbers, are admitted. The average mortality derived from the two reports combined, is, say 50 per cent. But upon making a separate average for the two hospitals, we are surprised to find that for Hôtel Dieu it is 80 per cent., while for La Charité it is only 20. We are then informed that the former of these hospitals, owing probably to its situation on the river, was so notoriously fatal to the wounded, and those who had submitted to surgical operations, that the government ordered at least one half of it to be torn down. In this instance, also, the two classes of facts were not comparable.

Three precepts may therefore be laid down as fundamental, and essential in all researches after medical truth: 1st. That the cases must be observed and recorded honestly, minutely, and fully. 2d. That they must be very numerous, the more so the better. 3d. That they must be comparable. It is very true that these conditions are not easily fulfilled; the labour, the humiliation of intellectual pride, the length of time, the weariness of a pursuit so nearly mechanical, are all obstacles in the way, and not easily surmounted. But there is no royal road to truth!

But it may be objected that this pretended exactness is useless; that it makes no difference whether a disease is said to be mortal

90 times in a hundred, or that it is almost constantly mortal; whether the numerical form of expression, or the adverbial is employed, the result is the same, an approximation to the truth only is attained; for the proportion may vary with the next series of cases observed, and the numbers used represent nothing absolute or certain. The numerical method, it may be replied, is superior to the other, for the same reason that the best of everything is better than what is merely good, even when the best is imperfect. The method we recommend is acknowledged to be imperfect, but it is preferred as being *less* imperfect than others; its results are, indeed only approximative, but they approach nearer to truth than those obtained by any other plan whatever; it is certainly liable to abuse, but much less so than any other method, for it is much more probable that a man should assert a falsehood than commit a forgery; that he should say I *have* seen, when he had not, than that he should take the trouble of fabricating a series of cases which never existed. The question is not how shall we discover a perfect, absolute, and unerring instrument for revealing to us the laws of disease, and certain rules for their cure; that were as impossible as to predict the exact shape, dimensions, and duration of the leaf which is forming under the warm breath of spring. We may, indeed, foretell its general shape and size, the probable period of its fall, and its characteristics as the leaf of a particular species or variety of tree, but not its individual characteristics. Yet no one contests the claim of Botany to be called a science. The same thing is true of Medicine. So long as man is human, will our science be uncertain, simply because it has to deal with ever varying elements; and, therefore, when a plan is proposed for improving it, it is no sufficient objection that the plan is imperfect. If it can be shown to be superior to any other that has yet been employed, there is abundant reason for adopting it, even though it should condemn much that we have been taught to admire, and confute many things we have been accustomed to believe.

Exact observation and numerical analysis, in the several occasions for their use, are productive of results by no means uniform in value. The laws of the physical sciences are certain, just in proportion as the phenomena from which they are derived are simple and uniform. On this principle we placed Astronomy at the head and Medicine at the foot of the list. There are various degrees of certainty in the several departments of Medicine, and, for the same reasons, viz.: the more or less complication, and the more or less variableness of the phenomena belonging to them. The simplest and most positive of all is Pathological Anatomy. It may, at first sight, seem strange that this, one of the newest departments, should yet be the most perfect. But the reason is evident. This branch of medical science is concerned exclusively with matter, organized indeed, but dead, and susceptible of hardly any changes which cannot be readily explained. Form, dimension, colour, and consistence, are the few elements to be studied; *all* of them cognizable by the senses, and capable of being measured, that is, estimated by comparison with some fixed standard. We have our measures of length and capacity for some of them, and familiar hues, and well-known solids or fluids to compare with others. It is no wonder that with elements so easily valued, and with such cultivation as it has received during the last forty years, Pathological Anatomy should be well nigh exhausted, so far as the grosser solids of the body are concerned, and that those who laboured most to advance it, should now be turning to investigate the fluids of the economy; and, armed with the microscope, to extend their researches into the minutest recesses of organized matter. It is easy to see that the application of number to the details of morbid anatomy was natural and inevitable, for the measure or weight of anything is more readily expressed in number than otherwise, and the constancy with which the same structural alterations were observed in the same disease, must have suggested the statement of this uniformity or proportion, in numerical phrase.

The next most exact application of this method, is to the study of symptoms; to the phenomena of living matter, and of the soul. As already stated, the admission that there are different diseases, is equivalent to that of their symptoms being uniform respectively; of their occurring in one case very much as they do in another of the same affection. Some of them are more, and others less constant. Some present themselves with unfailing regularity, others very rarely, and, as it were, accidentally. From this it is at once evident that the relative frequency of a given symptom may be expressed in number. But in the large number of symptoms which, taken together, serve to characterize a disease, there is hardly ever *one* which is *always* present, one which is so invariable as to deserve the name of pathognomonic. The *greater* part only of a given group may be expected to appear, and rarely in any two cases, the same part. The recurrence of the same symptom, therefore, or of the same group of symptoms, is exceedingly variable and uncertain, and consequently the numbers expressive of their frequency declare no more than an approximate truth. If we turn from the frequency to the character of symptoms, we shall find its exact appreciation still more difficult. Take two cases of one of the most uniform diseases, small-pox for example, and there will not be found a single symptom in the one resembling perfectly the corresponding symptom in the other. There will be a difference of duration, of intensity, of extent, of sympathy, of effect, &c., and yet these differences are not such as to destroy the identity of the symptom, nor to make it unfit for comparison with that in the other case, although such comparison cannot be perfectly exact, nor made entirely by means of numbers. We can, indeed, measure the duration of a symptom as we can its frequency; but to what arbitrary standard can be referred degrees of pain, the wanderings of the mind, or the perversions of the moral sense? It is only when a very large collection of cases has been made, and it is attempted by an analysis of them, to arrive at a general idea, definition, or description of the disease, that the disparities between individual cases disappear; that number, which was quite inadequate to define the peculiarities of an isolated case, is the best possible means of expressing the characters of the type, the common features of the whole series of cases taken together; the best, that is, of declaring exactly what symptoms ought to be regarded as really characteristic of the disease, because the only one which can accurately point out the relative frequency and importance of the several symptoms.

The employment of numerical expressions, therefore, may be considered as of the highest consequence in giving precision to diagnosis, inasmuch as it is the only mode whereby the symptoms of disease, and its anatomical lesions can be accurately described.

In the course of the preceding remarks, occasion has been taken to contrast the results of industry and method, with those attributed to genius. Thus far the latter word has been employed in its popular sense, and in that attached to it by those who exalt its value in medicine; in the sense of an inventive or creative faculty, of a natural and inherent power of seizing truth intuitively, without the intervention of the mechanical processes which have been described. In that sense we have not hesitated to assert, and have endeavoured to show, that so far from conferring dignity on medical science, or promoting its advancement, this faculty has rather contributed to discredit the profession, and to arrest the progress of knowledge. Now, we would not be misunderstood, nor be accused of teaching that in the investigations of natural science, all men's talents are on a level, and that superior industry is alone sufficient to establish a claim to superior merit. We do, indeed, maintain that without industry and method the highest natural gifts are inefficient, and will actually accomplish less than moderate abilities sustained by these helps. But we assert that there is a genius, not a speculative, not a poetical, not a mere fantastic faculty, but a practical genius, which is, to say the least, a far more rare endowment than that just mentioned; "a power which is capable of penetrating into all things *within our reach and knowledge*, and of distinguishing their essential differences." It creates nothing, it does not even invent anything, it only *sees things as they are*, and discovers truth in what it sees. For the truth, as we are told by Rousseau, is in things and not in our minds, and the less of ourselves we introduce into our judgments, the nearer we shall approach to truth. Such was the genius of Hippocrates, of Sydenham, of Morgagni, of Haller, of Laennec, of Abercrombie, of Hunter, of Bichat, of Sir Astley Cooper; such *is* that of Andral, of Chomel, of Louis, of Cruveilhier, of Brodie, of Graves. These men saw relations amongst the phenomena of disease, which were invisible to less gifted men; and, having seen them by virtue of their genius, they did not stop there, and build up a theory upon them, assuming them to be true, but immediately applied themselves to discover *whether they had seen correctly;* they tested their inspirations by observation and experiment, and when they found them unable to bear these tests, they rejected them as delusions, as idle dreams, not even worth remembering; but when, on the other hand, they found them confirmed, they gave credit, not to the original penetration which had guessed at the truth, but to the series of facts which had established it. Or if these and other great men did sometimes form theories, nay, were even famous for their theories, what has become of them? They are regarded as nothing better than the vagaries of great minds, defects from which nothing human can escape; as spots upon the sun, or clouds upon the sky. No one quotes them as authority, no one adopts them as guides, no one imitates them as models. Yet the works of these men *are* authoritative, they are followed, they are imitated, but in so far as they interpret nature, and no farther. It is hardly worth while, then, for the man of genius, like the spider, to spin out elaborate cobwebs to catch the silly flies of to-day, when he may be well assured that his work will have perished ere the morrow. He may far better, like the Egyptian Kings, spend his life in building up a solid pyramid of facts, in which his memory will be embalmed through ages yet to come.

It is curious to observe what deference, what homage, even, is paid to the labours of these "men of *no* genius," who are unceasingly employed in hunting for the golden grains of truth amidst the sands of error, even by those who are most strenuous for the use of reasoning (by which they mean speculation) in medicine, and most clamorous against the humiliating processes of the school of observation. In the writings of these philosophers *par excellence*, whom do you find quoted as the principal authority under the head of phthisis? Louis. Whom under that of typhoid fever? Louis. Whom under that of emphysema of the lungs? Louis. Whom in the case of croup in the adult, of pericarditis, of true gastritis? Louis. Who has produced the most perfect treatise extant on pneumonia? The only complete history of the diseases of children? The only consistent account of neuralgia? The most perfect history of cancerous diseases? The first true statement of the pathology of hydrocephalus; of softening of the brain; of remittent fever; of tubercles of the bones; of alterations of the urine; of infantile pneumonia? Such men as Grisolle, Rilliet, Barthez, Valleix, Walshe, Rufz, Gerhard, Green, Durand-Fardel, Stewardson, Nelaton, Becquerel, and so on. All of these, with a single exception, are young men, and yet the authors of works which, by common consent, are placed in the foremost rank of the medical authorities of the present day. These are the men who have spent their five, ten, even fifteen years in the hospitals before entering upon private practice; who have comprehended their profession as a field of toil, and not as a garden of amusement; and who, when challenged as to their competency, can point their judges to what they have achieved, for *by their fruits* they are known. These are the men whose devotion, whose impartiality, whose aversion to hypothetical reasoning, whose single-hearted love of truth, whose industry, patience, and method, are most earnestly commended to the imitation and rivalry of American students and physicians, as the only qualities which can insure the formation of that national medical literature, without which the profession of this country can never maintain its rights in the scientific republic of the world.

ELEMENTS

OF

GENERAL PATHOLOGY.

PART I.

ÆTIOLOGY.

CHAPTER I.

PRELIMINARY OBSERVATIONS.

PATHOLOGY DIVIDED INTO GENERAL AND SPECIAL; OBJECTS OF THE FORMER, AND METHOD OF TREATING IT—GENERAL NOTION AND DEFINITION OF DISEASE—NOMENCLATURE OF DISEASES.

PATHOLOGY is the history of disease. The term is often very incorrectly used by medical writers and physicians. By some it is employed to express the essential nature of a disease; by others, it is used as synonymous with morbid anatomy; and by others, again, is made to include therapeutics. But ignorance of the intimate nature of a disease is no more a hindrance to its perfect description, than that of the ultimate elements of many minerals would be to the study of their physical relations. Morbid anatomy is a department of pathology, because it describes the physical lesions attendant upon disease, which lesions, no less than functional symptoms, belong to the phenomena of the disease, and although not wholly constituting it, are still to be included in its history. Therapeutics have come to be regarded as a division of pathology, because it has been found convenient to treat of the remedies for disease in the same works which describe it; but they have no more necessary connexion with pathology, than morality has with crime, or any other remedial agency with the mischief it is adapted to cure.

If pathology is the history of disease, and if each disease is marked by certain peculiarities which distinguish it from all others, there must be a pathology of each disease, or in other words, a special pathology. On the other hand, if many diseases possess certain features in common, the description of these features will no longer be special, but general pathology. The latter is nothing more than a generalization of the facts of the former.

Special pathology comes first in the order of nature. It is made up of individual facts, carefully observed, arranged, and classified according to some nosological plan. General pathology collects those facts, wherever found, which have a certain similarity, and arranges them, according to their natural analogies, so that whoever examines them in this view will have no difficulty in appreciating them as phenomena of particular diseases.

Hence it is, that wherever medical education is most complete, general pathology is taught as an introduction to special pathology; just as in treatises on chemistry, the general laws which have been deduced from special experiments and observations are always discussed first, so that the learner having obtained correct ideas of heat, electricity, affinity, &c., is able to apply them without hesitation to all the cases in which these agents are concerned. So the student of medicine, when he has learned that a certain class of causes, symptoms, and lesions, usually coincide, or follow one another, has manifestly gained knowledge that will be useful to him, wherever, or under whatsoever name, that combination of causes, symptoms, and lesions may recur. General pathology treats of the causes of disease, whether they exist within the individual or around him; of its forms, stages, symptoms, and terminations; describes its ravages in the organs of the human body; and points out the best methods of investigating and interpreting the symptoms furnished by them, in all the morbid conditions under which they have been observed. In other words, it includes whatever is common to diseases in general, and to particular classes of diseases.

One object, then, of general pathology, is to place the beginner as nearly as possible in the same position as the old and experienced physician, who, from the summit of the hill which he has climbed with toilsome steps, looks back upon the numerous objects that have grown familiar during his progress, and embracing them all in a single view, perceives their relative bearings and magnitude much more distinctly than while he was passing amongst them. This knowledge we propose to communicate to the student; to sketch for him the general portraiture of disease; to familiarize him with the language employed to describe it; to mark out for him the road he is to travel; to indicate the objects which chiefly deserve his attention, as well as the dangers to which he will be exposed; and the means and instruments he should employ to become acquainted with the one, and avoid the other. In this work we shall endeavour to lay aside all merely theoretical discussions concerning what are generally known as principles of medicine, and which are, for the most part, nothing more than hypothetical explanations of general facts. To adhere strictly to such a rule is not only difficult, but perhaps impossible, for the very language in which an event is described frequently involves an hypothesis of its nature, and that without any suspicion on the part of the writer that such is the case. However difficult, therefore, it may be to avoid speculation, we shall at least feel bound to attempt it.

The order in which the several divisions of general pathology will be discussed, is based upon the natural succession of events in disease. We shall in the beginning endeavour to give a correct general idea of disease, and afterwards enumerate its causes, and modes of generation. Our attention will next be directed to certain general forms or types of disease; certain varieties of course, duration, and termination; certain differences arising out of the seat and extent of diseases; the various means employed in the observation of disease; and general prognosis. From this branch of pathology we shall pass to the phenomena presented by the several parts and organs of the body in disease, pointing out the value of each in positive and differential diagnosis, and as indicative of the tendencies of disease. Finally, the subject of morbid anatomy will engage our attention, including an account of the processes which lead to alterations of structure in the body.

The word disease is used in two different senses; in a general and a specific sense. It may be said of a man that he is diseased without expressing the manner in which he is affected, just as a flower may be said to be coloured without designating its particular hue. In both of these cases we receive definite, although negative, ideas; in the one that the man is not in health, in the other that the flower is not colourless. But the man may have *a* disease, a pneumonia, or peritonitis, as the flower a positive colour. This distinction, so plain, and even trivial, to all who are content to receive the evidence of their senses as superior to the conclusions of sophistry, has, nevertheless, been a theme of prolonged and violent discussion amongst medical philosophers. There have been men in every age who, striving after hidden things, and creating where they could not discover, have obscured and complicated a really simple subject by their speculations in regard to life, and matter, and the essential qualities of that state or thing which we call disease.

Nor have these barren investigations been conducted by speculative men alone; the most sagacious and observant physicians have been sometimes tempted to indulge the natural propensity for the abstruse and metaphysical, but they have rarely allowed such pursuits to wean them entirely from the study of nature, or to colour their descriptions of its phenomena. Often indeed they have done no more than receive the current philosophy of the day, as inherited from former times, or contrived by their non-medical contemporaries. Hippocrates taught that there are four humours in the body,—blood, phlegm, bile, and atrabile; and that all diseases depend upon an excess or deficiency of some one of these. Galen inculcated the same idea, admitting, also, a change in the quality of the humours. To these notions Paracelsus and the chemical school superadded certain reactions amongst the humours. Then the mechanical school arose, illustrated by the great names of Boerhaave and Baglivi, the former of whom proposed a system in which the true mechanical properties of the human organism, together with a great many hypothetical ones, were assumed to be sufficient for demonstrating the intimate nature of disease. Baglivi, on the other hand, although fully persuaded of the truth of the mechanical hypothesis, totally disregarded it in practice, and was so cogent and eloquent in his praise of observation, and his condemnation of unfounded theory, that his works are even now well fitted to excite the admiration of every lover of medical truth.

Sydenham, the modern Hippocrates, as he has been justly called, and whose precepts and example contributed largely to form the scientific character of the eminent Italian just mentioned, admitted without question the doctrine that disease consists in a struggle between the vital and a morbific principle, that by a process of coction the latter is eliminated, and at the crisis of the disease thrown off. But these opinions had little or no influence on the conduct of Sydenham. Cullen, too, the great light of the Scottish school of medicine, whose descriptions and definitions of disease are unsurpassed even by those of Aretæus himself, was the author of the doctrine of spasm of the extreme vessels, a purely imaginary state. In our own time the teacher, who more than any one else fixed the attention of physicians upon the local phenomena of disease, Broussais, invented a doctrine in which "irritation" was represented as the source of every healthy vital action, and its excess the essence of disease, a doctrine world-renowned, and yet obsolete before its author's death.

These instances are cited not at all as a sketch of the history of medical theories, but merely to illustrate the assertion that, in every age, even those men who have contributed most largely to the natural history of disease, who have most enlarged and perfected the resources of medical art, who have held the soundest doctrines of the nature and necessary limits of scientific research; those, in fine, to whom medicine is most indebted for its progress,—have not been able to divest themselves of a tendency to go beyond the evidence of their senses, and to pry into the inscrutable recesses of essential causes.

But what is disease? Does a knowledge of the errors of our predecessors enable us to give a better definition than theirs? Various attempts have been made to furnish such a definition, but unsuccessfully. The same principle has guided them all. Since it is impossible to know, and therefore to define, the intimate nature of disease, it has been usual to frame such definitions of it as will include all its sensible phenomena. But hitherto, none has been contrived narrow enough for each particular case, and yet capacious enough to include all. Andral defines disease "to be any *derangement* whatever in the physical or vital laws which govern the economy." According to Chomel it is "a notable *alteration* in the position or structure of parts, or in the exercise of one or more functions." The authors of a recent work on general pathology, MM. Hardy and Béhier, define it to be "every *modification* of the economy occurring accidentally, and out of the regular course of organic action." Dr. Williams paraphrases the definition of Chomel, thus: "disease is a *changed* condition or proportion of function or structure in one or more parts of the body." Finally, according to Dr. Wood, "disease may be defined to be a *derangement* of the organization, or of one or more of the functions of the body."

Now, in substance, these definitions are identical; they point to the two grand nosological divisions, structural and functional diseases, instead of confining themselves entirely to some idea common to all forms of disease. An attempt is indeed made to express this idea by a word of like meaning in each definition. With Andral and Dr. Wood it is derangement; with Chomel, alteration; with Hardy and Béhier, modification; and with Williams, change. But derangement, alteration, modification, change—of what? Evidently of some pre-existent condition; that is, of health. It is clear, therefore, that instead of giving the above ingenious definitions, it would have been quite as much to the purpose, and far more simple, to say with Van Swieten, "disease is a deviation from health." This definition, it may be objected is vague, but so is disease; and though wanting in precision it is none the less readily apprehended. It is worthy of remark that words which men most commonly use without any suspicion of their vagueness are precisely those most difficult to be defined. No one has ever given a definition of God, of life, of truth, of health, &c., of which men believe their ideas so accurate that no good purpose would be answered by their greater precision. So, in the case of disease, there is no more distinct limit between it and health, than there is between night and day, at dawn and twilight; and yet light and darkness are habitually used to illustrate the most perfect contrasts which the mind can conceive.

Our idea of health is not more positive than our idea of disease. It would perhaps be impossible to find an individual without some derangement, greater or less, of his functions or organs; we must admit, with Galen, that what is called health is neither absolute nor indivisible, but a name applied to such a degree of soundness as enables a man, without suffering, to perform the ordinary duties of life. Many cases lie in the debatable region between health and disease. Such, for example, is a strongly marked nervous temperament; in which the imminence of some definite malady is so great, that it is hard to say whether a state of health really exists or not. Many malformations are of the same kind, as a sixth finger or toe, an elongated prepuce, an imperforate hymen; they are serious annoyances, and may become causes and elements of disease, yet they are not diseases. So, too, a certain state of a given function may be considered healthful in one individual, and morbid in another. A pulse, for example, which habitually beats 80 times in a minute, indicates disease when it falls to 40 beats in the same period; but the latter may be the natural physiological state of certain pulses, as it is said to have been with that of Napoleon. Most persons have but one or two stools daily, but not a few enjoy perfect health, although they evacuate the bowels but once a week, or fortnight.

Nature everywhere loves gradation; abrupt transitions are rare in her works. If then we would imitate her, we must frame our definitions so as to include not only those instances which partake unequivocally of the type to be defined, but those also which by almost imperceptible degrees, lose their resemblance to this type and acquire that of a distinct or opposite one. If these views are correct, it is not possible to define disease more accurately than in the terms already enounced—*Disease is a deviation from health.*

We have next to inquire what is meant by *a* disease. It is, of course, a particular deviation from health, and our notion of it ought therefore to include all the circumstances constituting that deviation, whether functional or organic. But as it is quite impossible to retain in the memory all of these circumstances, it becomes necessary to select from among them such as are most frequently conjoined, and uniformly present; and that, not only to insure our remembrance of them, but also, in order that, by giving a name to this group of constant phenomena, we may have at command a concise expression by which to designate the disease. For this purpose it is evident that not one alone, nor even a small number of examples of the disease to be defined, will suffice; the largest number possible of individual cases must be collected, arranged, and compared, so as to reveal those phenomena which are so constant that they may truly be said to characterize the malady. It is not enough that these characters be taken from amongst the most prominent in the most striking cases; the mildest as well as the severest case must contribute its part to this generalization, because it is the business of the physician to recognise diseases, even in their least alarming forms. The latter are, indeed, those which concern him most, as being the most common.

It has been maintained by some writers, that all diseases have their seat in the solids or fluids of the body, or in both, and that consequently, the proper definition of a disease must consist chiefly in a description of the organic alteration on which it depends. We are accustomed to look upon all vital acts as functions of the organs by which they are manifested, and to conclude that such acts are impossible without the intervention of the organs. From admitting this proposition in regard to the organs of organic life, it has at last come to be entertained in regard to the brain; and the soul is alleged by all of such reasoners as aim at consistency, to be nothing more than a quality of the cerebral substance.

Aside from the arguments deducible from a necessary belief in the separate existence of an intelligent and active spirit, whether in the Deity or in the higher orders of created beings, it would not be difficult to prove that insanity is a disease, not of the brain, but of the immaterial soul, whose instrument it is; and not much more difficult to render it highly probable that very many diseases commence, not in any tissue, but in the vital principle which informs that tissue, and that they may even run their course without affecting in any way the arrangement or composition of the particles of the body. If this be true, it is unphilosophical to assume that a disease consists in a lesion of some particular part, unless that lesion can be made evident to the senses.

No one can deny that the tendency of modern investigations has been to prove that a great many affections formerly supposed to be altogether functional, are accompanied with changes of structure; for pathological anatomy has revealed numerous lesions, which, of course, were unknown while dissections were neglected, or imperfectly performed; and the microscope many which the scalpel could not unfold, and chemistry many which had escaped both of these instruments, besides opening a new field of pathological changes in the various fluids of the economy. These wonderful results have disposed not a few ardent and impatient minds to anticipate the reduction of all possible maladies to the same class with those having a decided physical lesion, and to argue that, if in certain maladies we cannot now detect any alteration either of the solids or fluids, it is owing entirely to the imperfection of our means of observation. But however probable the existence of structural lesions in all diseases may be, upon the ground of the analogy just mentioned, their non-existence in some cases is equally probable, according to the argument adduced a moment before. To admit or reject them wholly in the present state of our knowledge, would be to travel beyond the record, and forsake facts for hypotheses.

It would seem to follow from the preceding remarks, that the definition or name of a disease, should not be drawn entirely from its real or supposed anatomical character. This latter should enter into the short description used to define the disease, but the name ought rather to be derived from some constant and striking feature of the affection, either structural or functional. When no change of structure can be detected by any of the means at our disposal, the definition should include the most prominent symptoms only, as in the case of nearly all diseases of the nervous system.

Yet the nomenclature even of these has been, from time to time, improved by the discovery of new lesions of the nervous centres, and a condition formerly regarded as essentially the same in all cases, been found to depend upon different organic states. An apt illustration of this fact is presented by paralysis, which is no longer described by good pathologists as an independent disease, but as a symptom of several structural alterations of the brain and spinal marrow, or of pressure upon a nervous trunk. So, too, tetanus must be considered as sometimes constituting a separate morbid state, supposed now to be functional, and sometimes as symptomatic of spinal meningitis.

But the error which has been pointed out as so prevalent in recent times, of naming a disease from its ordinary anatomical character, is perhaps quite as chargeable against the ancients. This is emphatically true in regard to external diseases, or those general disorders attended with cutaneous eruptions. Thus we have variola, from *vari*, pimples; urticaria, from *urtica*, a nettle, because the eruption resembles that produced by the stings of the nettle; and so on, through all the exanthemata. The modern anatomical school of pathologists has done no more than extend the principle of the ancients in naming diseases, by giving them titles derived from internal structural lesions, of which the ancients were ignorant.

The name of a disease, then, should be conferred in accordance with the following considerations. The first alteration of the economy *upon which all the subsequent ones depend*, is evidently the essential element of the disease. But as this is not often discoverable, the first tangible link in this chain of causation must be used instead. This will generally be found to be an organic lesion, *i. e.* a notable change in the solids or fluids. If such change cannot be detected, the most characteristic symptoms should furnish the title; and, finally, if death immediately follows the application of the morbid cause, the name of the disease will be that of the cause of death. As examples of the first class may be mentioned pneumonia, pseudo-membranous laryngitis, tubercular consumption, cancer of the stomach, &c.; of the second, epilepsy, typhus fever, diarrhœa, &c.; and of the third class, death from lightning, from drinking cold water, from a blow upon the stomach, from terror, from prussic acid, &c. It follows, from these principles, that the names of diseases should not be considered unalterable. They must change as our knowledge increases. Many which were once named after their symptoms, are now called according to the lesion from which most of those symptoms proceed. In our nomenclature and definitions we should not be constrained by the rules of any exclusive theory; neither resolving with some to see nothing in diseases beyond a group of altered functions; nor, with others, imagining that we have detected the secret and intimate essence of morbid states; nor, yet, with others, exceeding the warrant of our present imperfect knowledge, and assigning to each malady its distinct physical lesion. It were far better to rest satisfied with the simple truth, and suffer the imputation of advocating a defective system, rather than expose ourselves to the charge of engrafting on the tree of knowledge, the barren branches of our own conceits. By degrees, if this rule is adhered to strictly, the titles given to diseases will answer their purpose more completely, and become more and more expressive. But this improvement, to be useful and enduring, must wait upon the tardy growth of science, and not be undertaken in a ruthless spirit of innovation.

CHAPTER II.

ÆTIOLOGY PROPER.

SECTION I.

CAUSE DEFINED—CLASSIFICATION AND DESCRIPTION OF CAUSES.

The word cause is used in two senses. In the one, it signifies that invisible power and mysterious bond which connects two successive events; not the antecedent, merely, of an event, but its efficient antecedent, or that without which it could not have taken place. For example, when undigested food excites convulsions, or a splinter in the flesh inflammation, it is evident that there is some power intermediate to the irritant and its effects in both instances, because undigested food does not always induce convulsions, nor splinters in the flesh inflammation. This power, if it were known, or could be known, would be a true cause, or as it is usually called, a proximate or efficient cause; but it may be conjectured to be a purely vital action, and therefore wholly beyond our comprehension. The investigation of proximate causes is very interesting, and besides having a tendency to give logical acuteness to speculative minds, contributes directly to the discovery of many links in the chain between events which appear to depend immediately upon one another. Thus, in the instance just cited, of inflammation, it has led to a knowledge of numerous phenomena which follow the application of the cause, and precede the appearance of the symptoms proper to this state.

The other sense of the word cause is the only one which here concerns us. It has been well defined "as the antecedent or concurrence of antecedents, upon which a phenomenon is unconditionally and invariably present."

Unfortunately, there are, perhaps, no causes of disease which strictly fall within this definition, for there are none, except in two or three specific maladies, which are invariably and unconditionally present. Hence, it becomes necessary to regard as causes, those which are present in the large majority of instances. Diseases arise under circumstances so wholly dissimilar, that different, and even opposite causes must be assigned to the same affection. That is to say, different causes appear to produce identical results, but only appear to do so. Thus, diarrhœa may follow the application of cold to the surface of the body, or the presence of some irritating substance in the bowels, or an impression upon the mind. In each case, the apparent cause of the disease is different, but beyond doubt, in each, also, the diarrhœa may have had some common antecedent; as, for example, the sudden plenitude of the blood-vessels of the alimentary canal. But so long as this common element remains undemonstrated, it is necessary that the nearest tangible antecedent of the disease should be viewed as its cause.

The intensity of morbid causes, the circumstances under which they act, and the conditions of the individuals subjected to them, are so infinitely various, as to render it quite impossible that any great uniformity should be found in their effects. The individual who, to-day, is proof against the infection of an epidemic malady, may, by the loss of a single night's rest, become its easy victim on the morrow. Of a large number of persons exposed to the same morbid influence, no two may be affected in precisely the same way. A certain degree of heat or cold, or stimulation of any kind, may not only be well supported, but enjoyed, and yet a very slight augmentation of the same action may give rise to violent or destructive disease. Examples of a like description might be multiplied, but these suffice to show, that in ætiology, as in other departments of medicine, there can be nothing more than an approximation to truth. It is impossible to predict with certainty, that a particular effect will result from the application of a given cause, and equally so, to assert which one, out of all possible influences, may have given rise to a particular case of disease, unless those immediately antecedent to the attack be minutely detailed.

If, then, some portions of the ensuing remarks should appear to be vague, and less precise than the practitioner desires, let it not be forgotten, that the subject is one whose propositions admit only a low degree of probability, and that this amount of proof has been still further lessened by the very negligent and superficial manner in which medical observers have generally been content to inquire into the causes of the affections submitted to their treatment. Daily observation proves that no error is more common amongst the vulgar, than the attribution of effects to wrong causes, and that, in fact, one half of the grossest of popular superstitions spring from this source. It is no more than was to be looked for, that physicians who relied upon the testimony of their patients for ascertaining the causes of disease, should adopt, and by their writings perpetuate, the mistakes of the ignorant. The human mind instinctively demands a cause for every event, and in its eagerness to be satisfied, as readily adopts the apparent as the real explanation.

CLASSIFICATION OF CAUSES.

The causes of disease which have been admitted as legitimate subjects of investigation, may be arranged in two principal classes, the predisposing and the exciting. By *predisposing* causes, are meant, those which produce in the economy, certain changes which prepare it for the development of disease. They are usually slow and gradual in their operation, and not always cognizable, except by their effects. Such are the influence of climate, of sex, temperament, habits of life, &c. They may be either *general* or *special;* acting upon many at the same time, or upon a single individual. *Exciting* causes are those from which disease more directly springs. In this class may be included *general* exciting causes, or those which give rise to disease without determining either its nature or its seat: *special* exciting causes, which, while they occasion, for the most part, definite morbid states, are not the only ones from which those states may arise; such are nearly all those causes of disease, which act according to physical or chemical laws, and whose action can, therefore, be explained by those laws;

and, finally, *specific* causes, which not only engender distinct diseases, but are alone capable of exciting the diseases which follow their application; such are miasmata, and the several sorts of virus. Of these last it is further to be observed, that their mode of action is inexplicable by any known laws, and that their substantial existence is rather to be inferred from the uniformity of their effects, than from physical demonstration.

This classification of causes is not to be received as absolute, but merely as a more convenient arrangement than any other, under which to study the multifarious conditions which remotely or immediately occasion disease. The same agency may at one time act by creating a predisposition, and at another, by directly exciting disease. Thus, unwholesome food may give rise to a chronic constitutional affection, or to an acute inflammation, according as it is habitually or occasionally used. What is generally regarded as a mere predisposition, may by its prolonged duration directly develope disease without the evident intervention of any proper exciting cause, as where scrofula supervenes upon that state of the system which is termed the strumous constitution, or diathesis. But it is to be remarked in reference to this and similar illustrations, that the separation between the diathesis and the disease, is more artificial than real, the former being, in most cases, nothing more than the first or incubative stage of the latter. Even specific causes, whose operation is, of all others, the most independent, cannot be said in every case to produce their peculiar effects, without a predisposition on the part of the individuals attacked. Thus, the virus of small-pox would at first sight appear capable of generating the disease in all persons to whom it is applied; the susceptibility to it would seem to be universal. Yet it is notorious, that some escape the malady though frequently exposed to it, and even cannot be made to receive it by inoculation. It is still more a matter of common observation, that some children may be vaccinated repeatedly, before the operation proves successful. Hence, a cause of one sort may, by a peculiarity in its action, come to belong to another class of causes, or fail to display its appropriate power, unless conjoined with one of another class.

SECTION II.

GENERAL PREDISPOSING CAUSES.

The greater number of the causes to be now considered consist in certain prevalent constitutions of the atmosphere, or in certain local influences, either natural or accidental. The alterations of the atmosphere which generate disease, do not, so far as can now be known, affect its gaseous components, but belong to its temperature, degree of moisture, and dryness, and to the effluvia which it holds in suspension. To these may be added its electrical state, which, however, depends so immediately upon the hygrometric condition of the air, that but little advantage can arise from considering it separately.

Temperature, &c., of the Air.—A high temperature appears to favour activity in all the peripheral portions of the circulation, and when long continued, to give rise to inflammations of the brain, the skin, and the digestive organs. It is supposed, also, by diminishing the activity of the respiratory function, to augment that of the liver, which, like the lungs, gives exit to a large portion of the carbonaceous matter in the system. On this account, it is thought, hepatic diseases are so much more prevalent in tropical than in temperate regions.

But *great heat*, if the air remain dry, is usually much less prolific of disease than when accompanied with humidity. In the latter case, the disposition to inaction which heat alone creates, is sensibly augmented; the skin, no longer able to part with the moisture of the body, and by its evaporation, to maintain a tolerable temperature, is continually bathed in perspiration; the fluid which would otherwise have escaped from this emunctory, is poured forth by the mucous membrane of the bowels, and the various forms of intestinal flux, diarrhœa and dysentery, prevail. It is this association of atmospheric influences to which must be chiefly attributed that most fatal scourge of infancy in this country, the summer complaint, or *cholera infantum*. It is the same, also, which appears to be a principal element in the generation of those pestilential maladies which devastate the neighbourhood of marshes, and certain other moist localities, although, as will be more fully shown hereafter, other agencies contribute to, and indeed determine this result. It is remarkable, that although hot, dry air predisposes to cerebral, cutaneous, and intestinal inflammations, the lungs should be nearly always exempt from disease in such an atmosphere, and scarcely less so in warm, and moist weather.

Cold, on the other hand, while it spares none of the organs, hardly, which are deranged by heat, acts with peculiar violence upon those of respiration, possibly because their functions are notably augmented by a low temperature. Hæmorrhages and inflammations of the lungs are the frequent results of this cause, as are, indeed, these morbid states in other parts of the body. In general, dry, cold air imparts to diseases an acute inflammatory type, while, on the other hand, a cold, moist atmosphere predisposes to chronic affections, or to those acute disorders which are peculiarly liable to become chronic, such as rheumatism and bronchitis; dropsies, with all their various organic causes, and all the forms of tubercular disease, are ordinary effects of this cause. In a word, the combination of cold with moisture is more prolific of disease than any other cause, or union of causes whatever.

Seasons.—Heat and cold, dryness and moisture, already noticed in a general way, deserve attention also in their natural and ordinary combinations. One of the most interesting of these is the seasons. The influence of winter and summer may be inferred from the remarks which have been made respecting extremes of temperature. It results from the statistical accounts of the mortality in Great Britain, that the greatest number of deaths takes place in winter; spring follows next on the list, then autumn, and last of all summer. This succession appears also to hold in the northern parts of this country; but the neglect of the subject of registration of deaths elsewhere, renders it impossible to surmise whether the same proposition is true of those places which are visited by epidemic maladies in the summer and autumn.

The diseases of spring and autumn present a remarkable contrast. Those of the former are generally more acute, their symptoms more distinct, their duration shorter; they are more amenable to treatment, and less subject to relapses. Hæmorrhages, inflammations of the throat and chest, and in our climate, quotidian and tertian intermittents of a mild type, are peculiarly frequent at this season. Autumnal disorders, on the other hand, are more slowly developed, their characters more uncertain, their form is more insidious; they are more protracted, much more difficult to cure, and more subject to relapse, as well as to leave behind them organic alterations. Thus the liver and the spleen very commonly remain affected after the remittent and intermittent fevers of the Middle and Southern States. At this season, all diseases of malarious origin prevail in warm climates; and in more temperate regions, affections of the digestive tube abound, being directly excited by the sudden alternations of temperature between night and day, and by the imprudent use of fruits.

Climates.—These form a most interesting subject of study in their relations to the physiology of the human race, their connexion with the customs and physical peculiarities of different nations, and with the progress of civilization; but the present view of them must be limited to their influence in the production of disease. Climates are usually divided into cold, temperate, and hot, corresponding to the three great zones of each hemisphere. This division, though sufficiently correct in regard to the great spaces embraced in it, is not so in the case of particular localities. The latitude of a place is not a true index of its average temperature. The climate of Lisbon, for instance, is very different from that of Philadelphia, which lies under the same parallel, and the character of neither climate can be very accurately inferred from its geographical position. Such contrasts are, however, most striking between places on the eastern coast of America, and the western coast of Europe; but if the former is compared with the corresponding portion of the Asiatic continent, the same climate will be found in both near the same degree of latitude. Thus, while Philadelphia is so much cooler than Lisbon, its mean annual temperature is nearly the same as that of Pekin, which is in the same latitude as the other two cities. In polar and intertropical regions, where the temperature is extreme, we must chiefly look to find proof of the indirect or predisposing influence of climate in producing disease; the moderate average temperature enjoyed in other regions of the earth's surface tends rather to the preservation of physical soundness in the human race; and, indeed, it is within the temperate zones that the most surprising instances of active power and of endurance have been exhibited; their climate lacks the steadiness required in a predisposing cause, it rather operates by its vicissitudes directly to excite disease.

Cold Climates.—The inhabitants of polar countries, are subject to the immediately mischievous effects of intense cold, such as freezing of the extremities, of the nose and ears, and inflammations of the eyes, either from the action of piercing winds, or from the glare of sunlight reflected from the snow, and their diseases arising from accidental causes are apt to assume a low type. The barrenness of the soil, and the short period during which it can be cultivated, affords them a meagre supply of grain, and almost entirely deprives them of the ordinary products of the kitchen-garden. Hence scurvy is a frequent and fatal malady in cold climates; indeed, it was quite unknown in medical history, until regular intercourse became established between the north and south of Europe.

The depressing influence of cold, with the filthy habits, and the close unventilated dwellings of the people of arctic regions, is doubtless a principal reason of the singular violence of contagious diseases, when once introduced amongst them; small-pox and typhus fever are, under these circumstances, unusually fatal. Tubercular consumption is said to be unknown in northern climes; but those who go thither affected with the disease, are pretty sure to find its progress accelerated. The native of the extreme north cannot remove to temperate regions without experiencing all the mischiefs which result from the abstraction of his habitual stimulus, cold; and if, as an antidote to relaxation and debility, he makes as free use of alcoholic liquors and concentrated food as when at home, he is very apt to be attacked with diseases of a seemingly inflammatory type, but for which he is as little able to endure depletion, as the drunkard for delirium tremens. In like manner, the native of temperate regions, on migrating to tropical climates, is subjected to powerfully debilitating influences; he is very apt to fall a victim to some endemic malady; and the more so, if he attempts to carry with him his former habits of life.

Temperate Climates.—The countries of Europe which are generally said to enjoy a temperate climate, are situated between 45° and 63° of northern latitude. Within these limits, as has been stated, the human race acquires its most perfect physical development, and all that it does is marked by energy. And so of its diseases. They are, for the most part, sthenic; characterized by powerful reaction, and the inflammatory type, they tolerate decidedly antiphlogistic treatment, and that not unfrequently even when they prevail epidemically. Affections of the lungs and heart, with rheumatism, are more prevalent in these than in other countries. In America, the limits of the temperate region must be included between other degrees of latitude. Its southern boundary should perhaps be placed about the latitude 39°, on the eastern side of the Alleghanies, and, west of these mountains, on the lower boundary of Tennessee, in latitude 35°. In all of this extent, inflammatory affections prevail; nor can it be otherwise, since the vicissitudes of temperature are greater there than in any other part of Christendom. The difference between the mean temperature of the hottest and the coldest month in the year, is 45° Fahr. at Philadelphia, while it is but 31° Fahr. at Paris.

The extreme heat and cold of the climate of so large a portion of the United States, has probably some tendency to enervate the inhabitants, by exhausting their strength during the summer months, and habituating them to the close air of overheated rooms during the winter. The prevalent custom, in our large cities, of warming houses with hot air, may, like putting plants in a conservatory, prolong the lives and increase the comforts of the delicate and sickly, but it can have no other influence on those of good constitution than to render them effeminate, and subject to all the maladies incident to a climate not only capricious, but violent in its caprices.

Warm Climates.—The influence of warm climates is much like that already attributed to excessive heat. In the torrid zone, the mean annual temperature is between 70° and 80° Fahr., and upon the islands within the tropics, the range of the thermometer is very slight indeed. Thus, in the West Indies, it is stated by Sir James Clark not to exceed six degrees. Upon the continent, however, the diurnal change of temperature is sometimes extreme. Dr. Forry tells us that in East Florida, during the month of January, the thermometer, at mid-day, in the shade, stood at 84° Fahr., but often, just before daylight, sank to 45°. Nocturnal variations of temperature are amongst the most powerful exciting causes of disease in hot climates.

In these regions, the inhabitants present the traces of indolent and luxurious habits; they are altogether unfit for prolonged exertion, or for endurance of any sort, while they are easily impelled to sudden and brief action; their passions are strong, but, like the gusts which devastate their fields, end quickly in a violent explosion. The ordinary food of the natives of tropical countries is composed chiefly of vegetables; but, for the proper digestion even of this, some artificial stimulus appears to be required, and it has been bountifully provided in the shape of spices and various condiments which are produced only under the burning sky of the south.

The diseases which prevail in these climates, are chiefly known as they have been observed amongst European colonists, their descendants, and the aborigines in immediate contact with the settlers. Hence, it is not strictly correct to attribute to the peculiarities of the climate, many disorders which might more properly be traced to constitutions and habits brought from a distance, to be perpetuated under a foreign sky, and engrafted upon a stock with which they have no natural harmony. Many of the diseases of the natives, where colonies have been planted, are due to the vices of the emigrants, and to the passion of uncultured people for imitating those whom they regard as superiors. When, therefore, we speak of bilious derangements, and intestinal disorders as prevalent in hot climates, the remark is rather to be understood as applying to persons whose constitutions or habits of life are such as belong to inhabitants of temperate regions.

It is well known that strangers not unfrequently escape attacks of malarious disease, where such affections are endemic, by conforming themselves strictly to the mode of living adopted by the natives. A striking example of this sort is related by Dr. Copland.

When travelling in the most unhealthy parts of intertropical Africa, he met with an Englishman who had lived there between thirty and forty years, and was then in the enjoyment of health. This person ascribed his exemption from disease entirely to pursuing, as closely as possible, the modes of life of the natives, and adopting both their diet and beverage. Until he did this, he had continued to suffer from the effects of the pestilential climate. This leads to another view of the influence exerted by climate in the production of disease, and of that process which all new comers into a country different from their own, in soil, air, temperature, &c., must undergo, and which is called,—

Acclimation.—Emigrants from a cold or temperate to a warm climate are apt, soon after reaching their destination, to suffer from symptoms of plethora, which often terminate in the discharge of blood from some one of the mucous membranes, that of the nose, the bowels, and less frequently the lungs. They are also very liable to be attacked by inflammation of the brain, or liver, by dysentery, or by the remittent, or yellow fever peculiar to the locality. The nervous and vascular systems are excited by the augmented temperature; the lungs evince less activity, and the urinary and intestinal excretions decrease, while those of the liver and skin are considerably augmented. So complete a revolution in the functions of the economy must of course increase the liability to disease; but why it should give rise to the particular diseases which attack the unacclimated, is by no means clear. Yet many writers upon this subject have no difficulty in finding in it a sufficient explanation of the "febrile attacks," of the inordinate secretion "of acrid bile," &c., which occur under these circumstances; and some have even asserted, in the same spirit, that the influence of a vertical sun *upon the head* "is productive of diseases both of it and *of the liver*." The same diseases do not affect natives and acclimated persons alike, nor at the same season of the year; so that, when the one class is sickest, the other enjoys the best health. During winter the natives suffer most; the degree of cold is sufficient to produce amongst them, to some extent, the inflammatory affections familiar to more northern countries, while foreigners, from those countries, find the temperature much milder than they had been accustomed to, and are seldom ill during its continuance. At Rome, in the month of April, when the fields are already blooming, and the strangers in the city are sallying out in their summer garments, the Romans may be seen closely wrapped in their ample cloaks, and even then shuddering if they walk in the shade.

When the parching heat of a tropical summer succeeds to the mildness of the winter, the unacclimated suffer, in their turn, with inflammations of the brain, liver, and bowels, while the natives enjoy a more complete exemption from disease than at any other period. Still later, from July to October, when the air becomes loaded with humidity, the endemic maladies of the tropics prevail, and decimate the foreign population; remittent, intermittent, and yellow fevers, dysentery, the plague, and cholera, cut off multitudes of the unacclimated, many residents of European descent, and many natives who have adopted the habits of foreigners, and at the same time their susceptibiltty to disease.

The dangers of a hot climate to those accustomed to a lower temperature, are greatly aggravated by ignorance, and by imprudent habits of life. A resort to stimulating food and drinks with a view of counteracting the enervating effects of the heat, can hardly fail to bring on the very maladies they are intended to prevent, by destroying the tone of the stomach, augmenting the nervous susceptibility, and increasing the biliary secretion much beyond the wants of the system. These appear to be the sources of that remarkable proneness to ill-health which exists among the English residents in India. The natives of Great Britain, more than any other people, carry with them into foreign countries the modes of living which nothing but an inclement sky could render excusable in any place. Their fondness for animal food, and for malt and spirituous liquors, and strong wines, is scarcely less extreme when they live under a tropical sun, than amidst the fogs and showers of their native land; and to these causes their own medical writers attribute the high rate of mortality in the southern colonies of Great Britain.

Along with such errors of diet, or apart from them, as a cause of disease amongst the unacclimated in hot climates, must be mentioned the excessive use of sub-acid fruits, and other vegetable productions, which there abound; they are especially apt to be prejudicial to newly arrived emigrants, who have perhaps been almost entirely restricted to the use of animal food during a long voyage, and are therefore more prone to indulge their appetites in a novel and agreeable diet.

Foreigners, however, are not the only persons liable to diseases of acclimation in tropical countries. Natives who have been absent for several years, are, on their return, scarcely less apt than strangers to contract the endemic diseases. A case is mentioned by MM. Hardy and Béhier, in which a native of Cuba suffered three several attacks of yellow fever, at intervals of as many years, he having, during those intervals, resided in Europe.

It is by comparing the diseases of countries most dissimilar in their temperature, that the most striking illustrations of the morbid influences of climate are to be obtained; but others not less demonstrative of the reality of such influences are constantly met with on observing the effects of comparatively insignificant changes of residence, as from the mountains to the plains, from the interior of a country to the sea-side, from the city to the country, from a northern to a southern exposure, and in each case, conversely. Here we find exemplified on a small scale, the effects which have been ascribed to the several sorts of climate; forms of disease varying with temperature, dryness or moisture, the prevalent winds, the vicinity of marshes, &c., and which are much more apt to attack strangers than residents in the several localities. Some of these influences will call for notice amongst the exciting causes of disease.

There are several other conditions which admit of being ranked amongst general predisposing causes, since they may operate as well on masses as upon individuals. Such are wet clothing, which may give rise to various forms of ill-health in a large part of an army, or of a ship's crew, at the same time; putrid food, foul water, the want of bread or fresh vegetables, the emotion of fear or anxiety, causes which operate fearfully in camps, and ships, and in beleaguered towns, in time of war. Other emotions of the mind are also productive of disease. Chomel states that the influence of chagrin and disappointment upon the French soldiery was very apparent, after the disastrous campaigns of 1813 and 1814. The cases of sickness multiplied with frightful rapidity, when fortune ceased to favour the imperial standard. The social condition of a people has a distinct influence on their diseases; this is nowhere so plainly seen as in the prevalence of insanity amongst civilized nations, its rare occurrence amongst barbarians, and, in the former, its exact proportion to the degree of political liberty possessed by them. The people of the United States are, politically, the freest in the world, and they also occupy a sorrowful eminence as furnishing, in proportion to their number, more cases of insanity than any other people.

SECTION III.

SPECIAL PREDISPOSING CAUSES.

These are for the most part, peculiar to the individual. They include all that he is by virtue of his birth, age, sex, temperament and constitution, and all that he has been made by his trade, profession, condition of life, his previous diseases, his residence, clothing, food, and other circumstances, called hygienic; in other words, this class comprises all natural and acquired tendencies to disease.

Hereditary Predisposition.—Baillou has remarked that "parents transmit to their children disease as well as wealth, but the former much more certainly than the latter." It is indeed too often the case that a parent's early prodigality and debauchery permit him to bequeath no legacy to his children but his infirmities; a sad entail, which no human laws can break. There are family diseases, just as there are family features, and peculiarities of gait, gesture, or character. It would therefore, even apart from actual observation, seem probable, that whatever maladies depend upon peculiar organization would be hereditary; but observation furnishes abundant facts to illustrate this subject, proving conclusively the existence of morbid tendencies transmitted from generation to generation, although it gives no certain clue to the laws which regulate the transmission.

Of the affections generally admitted to be propagated in this manner, the most prominent are tubercle, cancer, organic diseases of the heart, emphysema of the lungs, insanity, epilepsy, gout, gravel, and apoplexy. It is not to be understood that either parent need be suffering from a transmissible disease at the period of the child's conception or birth, in order to its subsequent development, although the probability of this result is increased by the parent's being then affected with such a disease. In general, the predisposition only, and not the disease itself, is transmitted; for this latter does not usually make its appearance until adult life, or until after the age of puberty, and even then it often appears to be the result of habits of living, or other causes, competent of themselves to produce it, without any taint of the ancestral blood. But these very habits, &c., are commonly an evidence of the influence of the parents' constitution; for tastes, talents, and propensities, are inherited just as certainly as form and feature. It occasionally happens that an hereditary disease, in the sense just explained, becomes so in the vulgar sense, that is to say, is communicated to the child in the womb, and affects it at birth. This may be the case with tubercles and other forms of scrofula. But with these exceptions, all diseases of the fœtus are original, and independent of either parent. Syphilis and small-pox may be directly transmitted from the parent to the child.

The diseases of the mother are said to be more certainly transmissible than those of the father; and this opinion, founded on experience, is confirmed by the prevalent belief of breeders of cattle, that the peculiarities of the dam are much more likely than those of the sire to be reproduced in the offspring, and, also, by the numerous instances in which distinguished persons have been born of mothers remarkable for energy of character, and the rare examples of greatness among the sons of eminent men. In some instances several members of one generation in a family are affected with the same disease, although neither of the parents may ever have suffered from it. Dr. Holland mentions two families in which three brothers severally underwent attacks of hemiplegia; one also in which three sisters had epileptic fits; and another where four children died during infancy from affections of the brain; yet in none of these examples had either father or mother been affected with diseases like those which attacked their children. Here a strongly marked predisposition must be admitted, and although the hypothesis of its hereditary character may allow of some dispute, it seems more probable than any other.

Another variety in the hereditary transmission of disease is its being confined more or less completely to the males or females of the family affected; or it may happen that the males may be subject to one malady and the females to a very different one. Now the mother conveys disease to her daughters, and now the father to his sons, and in other instances, again, the morbid influence appears to pass from one sex in the parent to the opposite sex in the child. In certain cases, as of secondary syphilis, every other child has presented signs of infection. In others, again, whole generations profit by this sort of intermission; the grandfather and the grandson, the father and the great-grandson being similarly subject to, or exempt from the hereditary affection, as in the case of gout and insanity. It is another fact in the history of hereditary diseases that many have a tendency to evolve themselves at a period of the child's life, which is most likely to be that at which the parent was first attacked. The melancholy spectacle is not unfrequently presented of all the members of a large family cut off by the same disease on arriving at a certain age.

The age at which the hereditary tendency displays itself in the development of a particular disease depends upon the nature of that disease. None that is clearly hereditary, except the glandular form of scrofula, becomes manifest anterior to the age of puberty. Subsequent to this epoch we meet with, first, tubercular consumption, epilepsy, and insanity; in the early part of adult life emphysema of the lungs and hypertrophy of the heart, and somewhat later, gout, gravel and apoplexy.

Age.—Age is not, strictly speaking, a cause of disease; but each of the different epochs of existence is more liable to some diseases than others, and may therefore be regarded as predisposing to them. Some diseases never appear before a certain epoch, and some are almost unknown after a particular age, while others may and do commonly attack, with equal readiness, persons of every age.

Many are peculiarly frequent in *infancy* and *childhood.* In the former are to be found hydrocephalus and tubercular meningitis, cyanosis, icterus, sclerema, &c.; in the latter, numerous disorders proceeding from dentition, strophulus, impetigo and other cutaneous eruptions, including small-pox, scarlet-fever, and measles, glandular scrofula, mumps, gangrene of the mouth, stridulous and pseudo-membranous laryngitis, whooping-cough, convulsions, cholera infantum, and worms. The period of adolescence is often marked by disorders of the nervous and nutritive systems, as chorea, hysteria, debility and various derangements of the economy arising from a too rapid growth, or from an undue excitement of the sexual propensities. Although *adult life* is less remarkable for its liability to particular diseases, than for its susceptibility to all, yet this period is distinguished by the frequent occurrence of pulmonary and intestinal affections, and those of the genital organs. Neuralgia, melancholy, and other forms of insanity, the several varieties of organic and inflammatory disease, and hemorrhages, are more prevalent during this than any other period of human life.

In the *decline of life*, and in *old age*, if not before, men pay the penalty of having overtasked or abused their organs. Most of the maladies which disturb that serenity which should mark the evening of life, are due to a prolonged and habitual neglect of hygienic rules. This is especially true of diseases of the generative and digestive apparatus. The epicurean tendencies of civilized life bring on premature exhaustion of these two systems; and, as the opportunity has been lost of correcting the evil by the adoption of more prudent habits, the consequences of repeated indulgence grow into confirmed disease. The slight and temporary indigestion of former days is followed by chronic dyspepsia and gout, or by organic disease of the stomach or liver; occasional constipation has become habitual and obstinate, and hæmorrhoids, fistula in ano, or scirrhus of the rectum, succeeds. A little irregularity in the quantity of the urine, or slight difficulty in voiding it, is followed by enlargement of the prostate gland, by unyielding stricture of the urethra, or by stone. At the same time the brain is liable to be attacked with softening, or torn by hæmorrhage, or its proper functions degenerate into mental imbecility. The arteries may become ossified, producing gangrene of the extremities, or those appalling symptoms supervene which arise from thickening of the valves of the heart. Many of these affections, it is true, occur in persons who have not habitually sacrificed health at the shrine of pleasure; some of them, as that variety of catarrh called *senile*, may depend upon unavoidable exposure to the exciting causes of disease, or upon the natural decay of the powers of life, but it is, nevertheless, certain, that in the great majority of instances a temperate and prudent manner of living would have mitigated, if not prevented, them.

Sex.—Although there are a great many diseases to which both sexes are equally liable, yet it is evident that each sex must have some maladies peculiar to itself, if we only regard those connected with the function of reproduction. The womb and its appendages constitute not only the anatomical peculiarity of woman, but their natural and morbid actions distinguish her from man both in health and disease. Hence the disorders which attend menstruation, pregnancy, and parturition, have no parallel amongst those of the opposite sex. Besides these, females are especially subject to tubercular consumption, chlorosis, crural hernia, cancer of the mamma, uterus, and ovaries, with neuralgia, hysteria, chorea, and the whole catalogue of nervous disorders, some one of which, or some derangement of the menstrual function, is perpetually complicating and obscuring the inflammatory and other affections which attack this sex.

It is sometimes asserted that women who inhabit populous towns are alone subject to the diseases which have here been attributed to the whole sex, and that in proof of this we shall find women who live in the country less subject to nervous affections than men who pass their lives in the enervating pursuits of cities. Admitting this contrast to exist between the laborious and masculine peasant woman of Europe, and the idle and profligate men of the great capitals of that country, it cannot be substantiated in regard to this country, for we have not, on the one hand, in our farmer's families a hardy race of females, nor on the other, in our large towns, any class of men devoted entirely to sensual gratification; or if any, they are addicted, not to the vices which render the nervous system more delicate and susceptible, but to those which blunt and brutalize it.

It is said that females are less liable than males to be attacked by epidemic diseases, a fact which is attributed to their more regular habits of life, and their less frequent exposure to the causes of these maladies. Men, on the other hand, are more subject than women to all those affections which proceed from the direct influence of atmospheric vicissitudes, of physical injury, and the several forms of intemperance, such as inflammations, especially of the brain, and the viscera of the thorax and abdomen, rheumatism, renal and vesical calculi, and the scaly forms of cutaneous eruption.

Temperament.—The ancients enumerated four temperaments, the sanguine, the bilious, the nervous, and the lymphatic. This division will answer for the present purpose, although physiologists of modern times scarcely admit its correctness.

The principal influence of the *sanguine* temperament consists in giving a marked inflammatory character to diseases, and in predisposing to plethora and hemorrhages.

The *bilious* temperament is said to predispose to affections of the digestive organs, and to modify the type of various other diseases by adding to them bilious symptoms. But the existence of this temperament in an individual does not seem to be very susceptible of proof, until the actual occurrence of hepatic disease. Unlike the sanguine temperament, it is not a physiological condition.

The *lymphatic* temperament, whether properly so called, or not, does certainly exist, and is justly charged with creating a tendency to mucous and serous fluxes, catarrhs, and passive dropsies, tuberculous and scrofulous affections of the lungs, joints, and skin, &c. These diseases have one feature in common: they are all chronic. Slowness of evolution is one of the most striking characters of the lymphatic or phlegmatic constitution. It is marked by sluggishness of mind and inertness of body, as well as by a tedious development of disease.

The *nervous* temperament is the direct opposite of the last, and is marked by quickness and susceptibility. It predisposes to all the forms of disease which affect the nervous system; but, more particularly, to functional disorders; to insanity, convulsions, and neuralgia, for example. It also modifies the course of other acute diseases, and, by the complication of delirium and convulsive disorders, renders their symptoms more violent, and their issue more uncertain.

Constitution.—The constitution may be strong or weak. A robust constitution, is the substantial representative of perfect health, and cannot, therefore, be said to predispose to disease, but on the contrary, must offer the strongest possible resistance to morbid causes. But, on account of the very energy with which all the vital actions are performed, when once a person of strong constitution becomes affected with disease, these very actions, in their perverted state, are executed with singular vigour; in other words, the diseases of a strong constitution are also strong, and prone to assume the inflammatory type.

Delicate, or feeble constitutions, on the other hand, are more susceptible of injurious impressions, and react less powerfully under them. They are easily prostrated and exhausted, unable to offer much resistance either to the disease, or to the treatment required to cure it; and, indeed, they are peculiarly subject to latent forms of disease, to those which run their course of structural disorganization, without betraying themselves by distinct symptoms, and, consequently, without inviting the interposition of medical art. If the diseases of the robust are more violent, they have also more strength to overcome; if those of the feeble are apparently mild, they are not so in proportion to the ability of the patient to sustain them. It is a vulgar error to suppose that a certain delicacy of constitution is of itself favourable to longevity. Without that prudence which a consciousness of danger inspires, the feeble would not survive. The robust perish because they are unconscious of the dangers which perpetually surround them.

One of the effects of modern civilization, is the increase of the average duration of life. It cannot be doubted that a large proportion of this increase is owing to that of the number of feeble children, now preserved by means of the additional physical comforts which have been enjoyed by each successive generation, for the last two centuries. The aggregate of life is indeed greater than formerly, but individual examples of vigour are more rare, and probably the sum of physical force is less for the same population.

Idiosyncrasy is a peculiar susceptibility to, or immunity from, certain diseases, on the part of an individual. It has, indeed, a wider signification, including nearly all personal peculiarities, and amongst them such as relate to the action of medicines. The term is frequently applied to acquired peculiarities, but ought to be restricted to those implanted by nature. The hemorrhagic idiosyncrasy is one of the most remarkable; by preventing the arrest of hemorrhage, it has made dangerous, and even fatal, such slight injuries as the bite of a leech, and the extraction of a tooth. Certain remarkable cases of bloody sweat, recorded by Boerhaave, Boivin, and others, appear to belong to this class of hemorrhages.

Certain articles of food cannot be eaten by some individuals with impunity. The most common of these are members of the molluscous tribe, such as crabs, lobsters, and especially the salt-water muscles, so much esteemed in Europe, and which frequently produce an attack of urticaria, or of coma, resembling narcotism. On the other hand, there may be an apparent insusceptibility to several diseases, to small-pox and vaccinia, for example; but it has been remarked, that some persons who at one period cannot be inoculated with these diseases, readily contract them subsequently.

One or two peculiarities in reference to therapeutical agents may here be mentioned. The exciting and harassing effects of opium and its preparations, and the violent strangury sometimes following the external use of cantharides, are familiar instances; but there are others which no analogy would lead us to anticipate. A medical friend of the writer cannot even smell a bottle containing syrup of ipecacuanha, much less a package of this drug in powder, without suffering a profuse watery discharge from his nose and eyes, and a swelling of these parts, which lasts for several days.

Habits of Life and Profession.—These are amongst the most powerful of the causes under notice, and may be considered together, inasmuch as the habits of an individual are determined chiefly by his ordinary pursuits. Those which require exercise in the open air are most likely to induce inflammatory disorders, while such as are consistent only with a sedentary life dispose to affections of a lymphatic type; and if conjoined, as they frequently are, with continued mental application, they occasion congestion of the brain and epistaxis; and if with excessive indulgence in eating and drinking, they bring on general plethora, cutaneous diseases, and derangement of the digestive and urinary apparatus. They very commonly, also, give rise to hæmorrhoids and fistula in ano.

Particular employments occasion particular diseases; those who ride much on horseback are liable to hernia; singers, and all who use the voice excessively, to affections of the larynx; housemaids, in England, to a particular disease of the bursæ of the knee-joint; chimney-sweeps, in that country, to a variety of cancerous disease of the scrotum; bakers, to rheumatism; and workers in metals to several forms of poisoning. But these subjects can only be alluded to in a general way, in an elementary treatise like the present.

Food and drink.—The effects of insufficient food are too well known to need description here. Debility includes them all, for it invades every function of the economy, whether organic or mental. If, as Bichat defined it, "life is the sum of the powers that resist death," and if disease be only the instrument of death, of course whatever enfeebles life, predisposes to disease. The ravages of famine in besieged towns, and the epidemic maladies which so often desolate the lower classes of the Irish, denote this influence on a large scale. The type of these disorders is adynamic. Imperfectly nutritious food is also productive of disease. A too copious, or too nutritious diet may prove injurious, either by overstimulating the digestive organs, and ultimately exhausting them, or by immoderately increasing the amount of blood, fat, or muscle. Excessively corpulent persons are exposed to death from suffocation, whenever an accidental cause diminishes their already feeble powers, or from apoplexy upon any unwonted exertion or excitement; indeed, when attacked by almost any form of disease, they offer but little resistance to its progress and fatal termination.

The diseases of the poor and of the wealthy, when contrasted, show the influence of opposite modes of living. The former are for the most part, those of debility, as typhus fever, scurvy, scrofula, and dysentery; while the latter generally proceed, in the first instance, from over-stimulation, and include gout, gravel, dyspepsia, hypochondriasis, apoplexy, and chronic cerebritis.

Although water may, as a general rule, be the safest, or the only safe drink, it can be used intemperately as well as alcohol; and if its taste and primary effects were as pleasant as those of fermented and distilled liquors, it would be hardly less pernicious in its effects. When drunk immoderately it impairs digestion and nutrition, and reduces the system to a condition so far resembling that proceeding from spirituous drinks, as to render it an easy prey to the attacks of every severe disease, by despoiling it of its elasticity and vigour. An habitually intemperate use of wine and alcoholic liquors leads to consequences which, unfortunately, are too familiar to require a detailed description. The drunkard, besides suffering from delirium tremens, and being corroded by disorders of the stomach, liver, and brain, directly excited by his brutal vice, is in imminent danger of perishing from causes which are harmless to other men. He is always amongst the first victims of epidemic disease, and when attacked with sporadic disorders, his treatment is embarrassing and unsatisfactory, for he can neither support disease, nor the treatment necessary for its removal.

Coffee and tea can hardly be said to be independent causes of disease, except when they act upon persons otherwise morbidly disposed. The former, when properly made, improves digestion, and promotes cheerfulness, but when taken in the evening, is very apt to prevent sleep; when made so as to extract the bitter principle of the berry, the decoction of coffee becomes heating, exciting, and astringent, disordering the stomach, occasioning headache, and confining the bowels. Tea, when used in moderation, especially black tea, is equally a gentle stimulant to the nervous system; but green tea, when imprudently taken, deranges the system much more than coffee. It not only dispels sleep, but produces a restlessness, and a sense of tension in the nerves, which is almost intolerable, and by degrees brings on dyspepsia, attended with remarkable peevishness, and sourness of temper.

Dress is by no means unimportant, as creating a predisposition to disease. Garments which leave a portion of the surface of the body uncovered, expose to attacks of rheumatism, catarrh, pneumonia, and the other inflammatory affections produced by atmospheric vicissitudes. The prevalent fashion of leaving the bosoms and arms of little children bare, is thought by some physicians to render them more liable to croup and thoracic affections generally. Too warm clothing disposes to very similar consequences, by promoting unduly the cutaneous transpiration, rendering the surface of the body more sensitive to cold, and so reducing the strength as to increase the susceptibility to all injurious impressions. Warm beds act much in the same way, and in females are a prolific cause of excessive menstruation and leucorrhœa. They are said also to predispose to calculous disorders, by augmenting the perspiration, and of course, concentrating the urine. Of this effect some doubt may be entertained. Warm cushions incline to the disorders of females just mentioned, besides which they pretty surely give rise to piles.

Garments often act injuriously by compressing different parts, by thrusting organs from their places, or interfering with their proper functions. Tight corsets are remarkably mischievous in this way; they compress the stomach, and prevent its reception of sufficient food, or the digestion of what it receives; they so hamper the liver as to change it from a flat to a conical figure, and imprint upon its surface the outline of the ribs; they prevent the descent of the diaphragm, and the expansion of the chest, and thus enfeeble the lungs, and displace, even when they do not disorder, the heart; they debilitate the muscular walls of the abdomen, and interfere with the passage of food through the bowels, thus giving rise to constipation, with all its consequences; they press upon the gravid uterus, and sometimes produce abortion, or failing of this effect, may occasion some malformation of the fœtus, which reduces it to the class of monsters; and finally, they arrest and destroy all that development of the mammæ and upper part of the chest which is not only one of the greatest of female charms, but which is of the highest importance to the female as a mother. Tight cravats and other garments compressing the neck, tend to produce congestion of the brain and apoplexy, bleeding at the nose, and feebleness of vision; tight garters cause œdema and varicose veins of the legs; and small shoes deform the toes of growing children, giving rise to corns and bunyons, impede the freedom of the general circulation, and, in those who are predisposed to the disease, may bring on a fit of the gout.

Fatigue, when excessive, although it cannot be said to bring on any particular disease, renders the system very susceptible to whatever morbid influences may be present, and imparts to the disease then contracted, an unusual degree of gravity. The exhaustion produced by loss of sleep is equally dangerous, and when, to many nights of constant watching, is added anxiety or distress, the nervous system acquires an unwonted irritability, and is very apt to manifest distinct disease. Over-indulgence in sleep, on the other hand, diminishes the activity of all the functions; it stupefies the mind, enfeebles the muscles, and hinders the discharge of excrementitious matters from the body, thus favouring plethora with all its consequences, including congestion, and other disorders of the brain. It has been noticed, that attacks of apoplexy and of gout are more liable to come on during sleep, than at any other time, and it is of still more general notoriety that early risers enjoy a remarkable immunity from these, and indeed most other maladies, and are more apt than other persons, to reach a good old age.

Like fatigue, *convalescence from disease* induces a state of debility favourable to the impression of morbid causes. This is a matter of daily observation, and is the motive of those precautions which it is customary to recommend to the convalescent patient. It is still more strikingly seen in the readiness with which such persons are attacked on the first appearance of epidemic maladies.

Previous Disease.—With the exception of those affections which occur but once in the same individual, nearly all others have a tendency to return. Thus, it is very uncommon for a person to experience only one attack of spasmodic croup, gout, epilepsy, hysteria, &c. Every organ that has been once inflamed, is peculiarly liable to repeated attacks of inflammation. The first of these may be said to predispose to those which follow, because the original affection has so far modified the structure of the organ, as to render it more susceptible than at first, to disturbing influences. But in gout, epilepsy, &c., one attack can with no more propriety be said to cause the succeeding one, than one paroxysm of intermittent fever, that which follows it. The aggregate of the paroxysms constitutes the disease. Each one, after the first, depends as directly upon some cause in the system, as did the very first itself. Every fit of gravel, or of bilious colic, is the immediate consequence of the formation of a renal or biliary concretion, and its arrest in the ureter, or gall duct; the several fits have no other connexion than through the medium of this common cause.

The Position of Organs, &c.—It is probable that amongst uncivilized nations, the structure of the human organism is perfect in reality, as well as in plan, but this is far from being the case in countries where art has supplanted nature to a great extent; for we there find certain maladies evidently depending upon the anatomical relations of organs, upon their congenital or acquired deviations from the normal type, or upon the manner in which their functions are performed. Thus, the natural position of the uterus exposes it to be readily displaced; the manner in which the testicle descends, and the anatomy of the groin, predispose to hernia; the form of the aortic arch renders it liable to aneurism; the softness of the cerebral tissue, and the delicacy of the walls of the arteries supplying it, account, in part, for the frequency of apoplexy. So, too, congenital deformities of the chest develope cardiac and pulmonary diseases; narrowness of the pulmonary artery is one of the causes of cyanosis; that of the aorta tends to produce disease of the heart; imperforation of the hymen may cause the menstrual fluid to distend the womb, &c.

The exaggeration of any function predisposes to disease. The overtasked or harassed mind is a ready prey to insanity; all the secernent organs are prone to organic disease, when the quantity of their discharge becomes excessive; and such discharges, by inducing debility, expose to various forms of disease. The pregnant and parturient states are the indirect sources of a large number of serious or vexatious disorders.

Sympathy.—When an organ is observed to be usually affected on the occurrence of disease in some other part, the former is said to be sympathetically disordered, and thus, by sympathy, one disease predisposes to another. There is, indeed, a general and reciprocal dependence of all the organs upon one another; so that a derangement can scarcely take place in one, without its being responded to by all the rest. But this is not the point at present under consideration; it is, rather, the liability of two or several organs, to be habitually affected in succession, by a disease commencing in one of them. It has been observed, that those which are conjoined in the performance of a particular function, are very apt to display morbid sympathies, as the uterus, the ovaries, and the mammæ; the intestine and the liver; the lungs, and the respiratory muscles, &c.; and in this way, injury of either one of the double organs is apt to induce disease in the opposite one. It has also been noticed, that distant parts of the same structure sympathize; as the lower bowels and sphincter ani with the stomach, in nausea and vomiting; the mucous membrane of the nose and tongue, with disorder of the intestinal canal; the orifice of the urethra, with irritation of the pelvis of the kidney or ureter, by a calculus. Organs which lie in contact, suffer from each other's diseases, either by the actual extension of these latter from one to the other, or by their exciting functional disturbances in the organ secondarily affected. An example of the first sort is the extension of inflammation from the lung or pleura of the right side, to the liver, and of the second, the occurrence of vomiting and constipation in peritonitis. Finally, there appears to be a sympathy between some parts which have no functional community, nor any direct anatomical connexion, as between the parotid gland and the testis, the liver and the right shoulder, the brain and the stomach, &c.

Attempts to explain these various phenomena, and even to class them, have failed of success. Many of those belonging to sensation and motion have of late years been pretty satisfactorily shown to depend upon nervous connexions between distant parts, not by direct communication, but, indirectly, through the medium of the spinal marrow; yet by far the most numerous cases of sympathetic disorder still continue to be unexplained, and are, in all probability, inexplicable.

There is another form of morbid dependence which ought, perhaps, to be included under the general title of sympathy; this is the tendency of an organ to become diseased in consequence of the disorder of another organ of analogous, but not identical function. An example of this is furnished by the mutual dependence of the liver and lungs, both of these organs being intended, as physiologists suppose, to remove carbon from the blood; and another by the frequent coincidence of hepatic and cardiac maladies, owing it may be presumed, to the fact that so large a quantity of blood passes through both the liver and the heart, that one cannot be curtailed of its office without overloading the other.

CHAPTER III.

EXCITING CAUSES.

SECTION I.

GENERAL AND SPECIAL EXCITING CAUSES.

Exciting causes, it was stated, may be divided into general, special, and specific. The first of these divisions includes all those which directly develope disease without determining its nature or seat, and consequently all which have been enumerated as predisposing causes; for when their action, instead of being protracted and feeble, is sudden and energetic, they not only promote but actually determine some morbid state. In this manner the ordinary denominations of causes have sometimes to be reversed. Marsh miasm is of all other causes one of the most direct and specific in its action, and bodily fatigue one of the least precise, for it does not dispose to one disease more than another, yet in the following example quoted from Dr. Copland, the action of the specific cause would never have been made manifest but for the intervention of a predisposing, now become an exciting, cause. "Between twenty and thirty persons were exposed all night, without cover, to the air of one of the most fatal sources of miasmata furnished by a warm climate, during the unhealthy season, but were soon afterwards removed to sea—far from any further exposure to this specific cause. They continued well for six or seven days, when about half their number experienced great fatigue. All these were, nearly simultaneously—on the following day—seized with remittent fever; whilst those who had not been subjected to this consecutive cause, with the exception of two who were not attacked till several days subsequently, entirely escaped, although all had been equally exposed to the specific cause of that form of fever."

Another illustration of the difficulty of separating predisposing from general exciting causes, and an evidence that these latter are correctly named, may be found in the fact that in the histories which we possess of individual diseases, the separation is not often attempted, nor often successfully; and also that for many affections a catalogue of causes is given including nearly all which have been discussed in the preceding pages. Without, therefore, again treating of all of these in their new aspect, it will still be proper to allude to one or two.

Cold.—A temperature below the freezing point of water, if it act for a considerable length of time, will destroy life, and if applied to a part for a shorter period will benumb or paralyse it. Cold evidently causes the solids to contract, and in that way diminishes the amount of blood in the vessels, and the generation of animal heat. When the whole surface of the body is exposed to it, the internal organs become gorged with blood, their functions are impeded, the brain acts feebly, the sensibility is blunted, and death is imminent. When, however, the cold is less intense, or operates for a shorter time, reaction takes place in the affected part; redness, pain, and heat succeed to pallor and numbness, and there may ensue a gradual return of the part to its usual condition, or the development of some form of inflammation. It seems probable that internal inflammations, when caused by cold, are due to its influence upon the surface of the body, where it not only drives the blood inwards, congesting the internal organs, but arrests the cutaneous exhalation, and thus causes excretory matters to be retained in the system. Whatever organ happens to be the weakest or most exposed at the time is most likely to suffer first.

If cold be applied to one portion only of the surface, the nearest organ will be most in danger. The throat, lungs, and large joints, are most readily affected by this cause; the former in consequence, probably, of the upper part of the trunk perspiring more freely than any other part of the body; and the last, it may be conjectured, because they are either not well covered by muscles, or because the fibrous tissues investing them contain but little red blood, and therefore generate but little heat. The retreat of the blood from the surface and its accumulation in the abdominal organs, appear to explain the sudden attacks of diarrhœa which cold and dampness produce in persons of feeble constitution, and in those labouring under depression of spirits or bodily fatigue. The marked increase in the urinary discharge on the approach of cold weather may be referred to the same source. But exposure to a low temperature, and especially getting the feet wet, *arrests* at least one internal secretion, the menstrual. How happens it that internal congestion favours the loss of fluids by the bowels, but suspends the flow of blood from the uterus? Writers inform us that a certain degree of congestion in a part arrests its secretion, and that a somewhat greater degree augments the discharge, but as we have no means of determining whether the congestion of the bowels which favours diarrhœa is greater or less than that of the womb which suspends the menstrual flow, the explanation is not very satisfactory. The truth is simply this: observation teaches that the condition of the system most favourable to the regular flow of the menses, is that of perfect health, in which the temperature of the body is moderate and equable, and the circulation everywhere of the same activity; observation also teaches that a similar condition of the circulation and of animal heat is most conducive to the normal action of the bowels; and finally that cold, which breaks up the order of favourable circumstances, substitutes in each case a morbid for a healthful result. Beyond this, our knowledge does not extend; it does not enable us at present to reduce the two different and apparently contradictory phenomena under the same law. It is well, therefore, not to accept as explanations of pathological facts, many phrases which are current as such, but which really explain nothing; but rather to study attentively the natural sequence of phenomena in each particular case, and having established their dependence upon one another, rest contented without attempting violently to force them into subordination to some general law.

Pain and Mental Emotion.—The brain is not only the instrument of the mind, but it presides over, and controls the functions of all the other organs. Its own disorders can hardly fail, therefore, to affect them. This influence has been observed in all ages, and is the source of those theories which have designated the liver, the stomach, and the spleen, as the seat of the passions. Strong emotion may not only suspend or pervert particular functions, but is even capable of destroying life, by arresting the action of the heart. When disease is already present, as, for example, softening or habitual congestion of the brain, tubercles of the lungs, aneurism, &c., its effects are still more to be dreaded. Every one must have felt how suddenly digestion may be suspended by disagreeable tidings or events, and will be ready to understand the pernicious influence of habitual grief, upon the functions of the digestive organs. Under its corroding blight, the skin loses its freshness, and grows dry and yellowish; owing to the derangement of the liver, the bowels become confined, and their habitual constipation is apt to be followed by permanent disease in their lower portion, and by congestion of the brain, with all its consequences.

Terror is very apt to bring on miscarriage, or suppress the menses, or excite sudden diarrhœa, or frequent voidance of urine. High-wrought anxiety may have the same effect. An eminent lecturer of this city was in the habit of relating to his class an illustration of this fact. He was on duty as medical officer during one of the first naval engagements of the last war with England. From the time when the hostile vessel was first made out, until the commencement of the battle, he remarked that both officers and men were running, at every instant, to the ship's side, to empty the bladder, so intense was the anxiety and excitement amongst men who had never before met an enemy in fight.

Anger often brings on a convulsive attack; and, occasionally, when smothered, has been known to produce universal jaundice in a few minutes. The fact is too familiar to need illustration here, that insanity frequently follows close upon exaggerated mental effort, and especially upon violent mental emotion, whether terror, grief, or joy.

A special exciting cause, it has been intimated, is one which, while it immediately precedes the development of disease, and gives to it a definite form, is not the only one from which the resulting disease may arise. It may be added, that most of the causes, of this class, operate without the aid of any evident predisposition. It includes mechanical and chemical causes, and poisons.

Mechanical Causes.—These are innumerable. It will be sufficient to mention some examples of them. Such are all kinds of instruments used to wound or otherwise injure the body; falls against hard substances; ligatures, or other means of compression, by which the circulation, or the passage of the air or other matters through their respective canals is impeded; obstacles to the entrance of the air into the body, whether this result from immersion in water, carbonic acid gas, or any other irrespirable medium; obstructions within the various canals of the body, as foreign substances in the œsophagus, or windpipe, the nasal or auditory passages, the vagina, urethra, or bowels; a collection of hardened fæces in these latter; the arrest of a gall-stone in the biliary ducts, of a calculus in the ureter, or of a parasitic animal, or worm, in either.

Chemical Causes.—These are also very numerous, and include all which destroy the natural organization of a part by virtue of chemical affinity. Metals, and other substances, at a high temperature, boiling liquids, and caustics, whether solid or liquid, acid, alkaline, or saline, act in this manner. Some of them, like corrosive sublimate, and the arsenical preparations, from their usually producing their effects after being taken internally, are ranked amongst the poisons. Taken in this manner they produce disease in one of two ways. If in large doses, they prove injurious or fatal by their direct action upon the tissues of the stomach, which they destroy chemically; if in smaller doses, and frequently repeated, they prove fatal by injuring one function after another, until not enough are left unimpaired to sustain life.

Poisons.—It is difficult to frame a definition of these agents. That of Foderé is sufficiently precise in practice. He considers poisons to be those substances which are known by physicians to be capable of altering or destroying, in a majority of cases, some or all of the functions necessary to life. They are usually divided into *irritants*, *narcotics*, *narcotico-acrids*, and *septics*. "The class of irritant poisons," says Christison, "comprehends both those which have a purely local irritating action, and likewise many which also act remotely, but whose most prominent feature of action is still the inflammation they excite wherever they are applied." The chemical agents already mentioned, cantharides, iodine, chlorine, &c., are of this class. *Narcotic* poisons, on the other hand, produce little or no effect upon the part to which they are applied; but act through the medium of the nervous system, occasioning various perversions of the intellect, sensibility and muscular power, and generally threaten or destroy life by inducing asphyxia. The most prominent amongst them are opium, hyoscyamus, prussic acid, and their preparations, to which may be added carburetted and sulphuretted hydrogen gases.

Narcotico-acrid poisons include those which possess a double action; the one local and irritating, the other remote and upon the nervous system, by which latter, indeed, they generally prove fatal. Of this extensive class may be cited belladonna, stramonium, tobacco, conium, aconite, strychnine, alcohol, and ether. Certain vegetable effluvia, which occasion disease, find, perhaps, a more appropriate place along with the two last classes of poisonous agents, than elsewhere. An atmosphere loaded with the odorous principle of the jessamine, the tuberose, the hyacinth, the lily, &c., produces headache, nausea, vertigo, and even syncope, when confined within close apartments. During the season of roses, and at the hay-harvest, not a few persons suffer from coryza, with fever, which goes under the name of hay or rose fever.

Septic poisons, or those which are generated by putrefaction, give rise to affections which are characterized by a typhoid or adynamic state, are often complicated with gangrene, and generally tend to a fatal issue. The pernicious matter may be introduced into the economy along with the food, as in unsound meat or damaged flour; or through the lungs, as in camps, besieged towns, and crowded military hospitals; in graveyards and churches, when soil saturated with the results of putrefaction is upturned, or long-closed burial-vaults are opened; or it may be inoculated through a wound, as so frequently happens to those engaged in anatomical studies. Retention of the urine and fæces has some analogy with the morbid causes just considered. When fæcal matters accumulate in the bowels, besides disposing to ulceration and perforation of their walls, the more fluid parts are absorbed, and may even communicate a fœtid odour to the breath and perspiration, as well as dispose to typhus fever. This is strikingly the case during protracted abstinence, or refusal to take nourishment, among the insane. Suppression of urine, as is well known, is apt to be followed by fatal coma.

Venom, a liquid secreted by an apparatus peculiar to certain animals, and which serves them for attack or defence, must be ranked among the exciting causes of disease. Its action is usually very prompt, and may either be limited to the part stung or bitten, or involve a limb or even the whole body. The rattlesnake and the copper-head, amongst serpents, the hornet, the wasp, and the bee, among insects, are the well-known representatives of the venomous tribes in this country.

SECTION II.

THE SPECIFIC CAUSES OF DISEASE.

By specific causes are meant those which, not only like what have been already considered, engender distinct diseases, but also, and unlike them, are the *only* causes of the maladies which follow their application respectively. Such, at least, is a strict definition of the phrase, derived from the phenomena of paludial fevers, and inoculable diseases, but some affections which ordinarily arise from a particular cause, and from that alone, do in exceptional cases, proceed from another cause. Thus, several diseases whose rule of propagation is from individual to individual, do in exceptional instances appear to be spontaneously generated, and still more, upon the other hand, those which seem to be of atmospheric origin, are at times unequivocally disseminated by contagion. For the better understanding, then, of the present subject, we shall consider the whole field in which the action of specific causes is more or less constant and apparent, including the general laws of endemic and epidemic diseases, and as a preliminary to that discussion, make a few remarks upon infection and contagion.

Infection.—By some writers, the terms infection and contagion are used as synonymous, and undoubtedly, if reference be had to the etymology of the words, this usage is, to a certain extent, correct. The Latin word *inficere* signifies to corrupt or vitiate, and hence infection includes every means by which the system may be corrupted or vitiated; hence also contagion, which merely implies contact, must in its pathological sense, indicate corruption or vitiation of the system by contact with a person previously diseased. In other words, contagion is a mode of infection.

But, since it must be admitted that some maladies are generated spontaneously, while their further propagation by contagion, is altogether accidental; and that certain others are in nearly every instance disseminated by contagion, while their origin from atmospheric or other non-animal sources is altogether exceptional, it follows that to include both modes of propagation in the same description, is to unite what nature has divided. We shall therefore commence by giving some account of infectious agents proper, and of the laws which govern their action.

These agents consist almost entirely of decayed or diseased organized substances, and of animal emanations or secretions. Some of them have been partially referred to under the head of poisons. They are found to exist most abundantly in marshy and alluvial soils, in slaughter-houses, common-sewers, dissecting-rooms, graveyards, and in those places where a large number of living persons are crowded together; particularly if the effluvia of their excretions taint the atmosphere. Such places are called centres or *foci* of infection, because from the morbid influence there concentrated, disease spreads in every direction. These sources of infection are not at all times endowed with equal energy; their action is most powerful in tropical climates, and during the summer and autumn in temperate regions.

The insalubrity of the neighbourhood of marshes, particularly on the side exposed to the wind sweeping over their surface, has been known in all ages, and its reality proved by the restoration of the sickly district to health, on the water of the marsh being carried off by drainage. In fact, wherever a rich, wet, and low soil, abounding with vegetable and animal matters undergoing decay, is exposed to a powerful sun, after repeated irrigations or inundations, remittent and intermittent fevers will prevail, and of a more malignant type as the heat is more intense. It is probably owing as well to the vast number of the exuviæ of insects which crowd the salt-water marshes, as to the high temperature of the air, of intertropical countries, that the mortality of the diseases occasioned by them is owing. But even in these situations it is not so much during the heat of day, as after nightfall, that the infection is active, a circumstance which has been plausibly explained by supposing that the deleterious emanations being mixed with the moisture of the air, are kept diffused through it during the day, but when the coolness of evening succeeds, descend to the lower strata of the atmosphere, where they of course act with redoubled vigour.

When the infectious locality is of small extent and so situated that the effluvia accumulate within it, their power of generating disease is rendered so intense as sometimes to prove fatal almost immediately. This is especially true of emanations from putrescent matter, such as is collected in sewers, privies, &c., but almost as rapid an action has been observed in the case of paludial exhalations. Pringle, in his work on diseases of the British army in Holland, relates that among the foraging parties sent out early in the morning, when the meadows and marshes on each side of the road were covered with a thick fog of offensive smell, several men were so suddenly taken with a phrensy, as to throw themselves from off their trusses into the water, imagining they were to swim to their quarters. But in general, centres of malarious infection are not of so malignant a nature. Their influence diminishes rapidly with the distance from them, even upon the surface of the earth, and still more rapidly above this level; on the other hand it is augmented wherever anything tends to arrest and confine the vitiated air, such as cellars, the courts and lanes of towns, and narrow valleys.

A high temperature tends to produce malarious diseases, chiefly when the air is loaded with moisture, a fact which goes far to favour the opinion that the infectious cause is something substantial, which cannot be supported and carried about in so rare a medium as dry air. It is further corroborated by another fact, viz., that a calm state of the atmosphere is most favourable to the prevalence of malarious disorders, while a strong wind, especially if it be cold, abates or even puts an end to them. It may be added to these illustrations that a wind blowing over an infected district may cause the prevalent disease to be experienced in regions where it was before unknown; that if a hill be situated in the direction towards which the wind sets steadily for some time, the people living upon the side nearest the infected locality are more likely to suffer than those who inhabit the intermediate country, and the residents on the further side of the hill may escape the noxious influence altogether. In the same manner walls, houses, running streams, long and winding streets, &c., have been known to form barriers to the progress of infectious disease in one or more directions.

Animal secretions and emanations have a just claim to be ranked amongst the infectious causes of disease, because, although their effects are not absolutely uniform, yet they generally give rise to maladies capable of propagating their like by means of contagion. It is, however, to be remarked that the particular form of disease generated in crowded receptacles of human beings,—jails, hospitals, &c., will depend very much upon the nature of the predisposing and concurrent causes. The most usual form is typhus fever, and here the concurrent causes are generally poverty and unnutritious food; another is dysentery, which commonly requires cold and moisture, along with unripe fruit, for its production amongst soldiers and other large bodies of men; puerperal fever, and purulent ophthalmia in children's hospitals, depend upon some occult cause, as well as upon crowding the wards appropriated to the subjects of these diseases.

A singular example of the effects of crowding, and one showing their dependence upon a very slight change of circumstances, is furnished by Dupuytren, in his report upon the fatal malady which prevailed in his wards at Hotel Dieu. The usual number of patients in them was two hundred, and then there was no unpleasant odour, nor any sign of infectious disease. But no sooner had the number increased to two hundred and twenty, or more, than a peculiar fœtor became perceptible, and many of the patients fell victims to hospital gangrene and adynamic fevers.

The active principle of marsh miasm, as well as of that given off by human bodies, is unknown. The air collected from the surface of certain stagnant swamps and lakes has been found to contain carbonic acid, carburetted hydrogen, and nitrogen. Sulphuretted hydrogen has also been detected in the water of both salt and fresh marshes, and in the air in contact with them, by Dr. Gardner, now of Philadelphia. But these results are far from being uniform. The vapours of the putrid waters of Fuentès, of the rice fields of Lombardy, and of the Campagna of Rome, have been found identical in composition with the most salubrious air, or rather it would be more correct to say, that such is the result of chemical analysis; but it does not by any means follow, that there may not have been material differences in the air of the places mentioned, although the means of analysis employed were inadequate to their discovery. We are much better entitled to infer a difference of composition between mountain air and that of the pestiferous fens alluded to, from their palpable effects, than to receive as conclusive the results of experiments which may have overlooked, or actually destroyed, the virulent principle, minute in quantity, but pregnant with pestilence.

But to return. By condensing the vapours arising in certain malarious districts, small portions of mucus, containing animal matter, ammonia, and hydrochlorate and carbonate of soda, have been obtained. This discovery would appear to countenance the hypothesis of Varro, that marshy emanations contain innumerable and invisible insects. Dr. Holland has, in our own time, revived this hypothesis, which he has illustrated in a style no less elegant than ingenious. Some maintain that heat and moisture, followed by a low temperature, conditions which do certainly exist in the neighbourhood of marshes, are sufficient to account for the phenomena of malarious diseases; and however untenable such a position may be, it must be admitted that these conditions of temperature and humidity may act as concurrent causes, by diminishing the power of the system to resist the influence of the miasm which is alone capable of exciting the diseases in question.

There has been a great deal of discussion, and there is still a great deal of doubt, in regard to the manner in which infectious principles invade the economy. It is evident that there are three possible modes by which they may obtain entrance; through the skin, the alimentary canal, and the lungs. The cutaneous surface may be pretty safely considered as offering a barrier to their passage, so long as the epidermis is intact. The experiments of Bichat, which appeared to show that the odorous particles of a dissecting-room could be taken into the system through the skin, so as to be perceptible in the gas discharged from the bowels, are open to several objections; and those of Collard de Martigny, which seemed to demonstrate that the poisonous effects of carbonic acid gas might be produced by its absorption through the skin, have been contradicted by the results of others, conducted in the same manner. The mucous membrane of the bowels is protected, by its position, from contact with the atmosphere and the morbific particles suspended in it, except so far as these latter may become entangled in the food and drink; but there is neither any direct evidence of the reality of this mode of action, nor, judging from the small quantity of material that could be conveyed in the manner supposed, any probability in its favour.

There remain, then, the lungs; and nearly all modern authorities agree that it is chiefly through them that infectious agents are introduced into the economy. It is well remarked by Dr. Copland, that upon the respiratory surfaces the air may be said to undergo a process of digestion, certain elements or portions of it entering into the circulation, and certain others being given off which have served their purpose in the economy. This writer, however, considers that the morbid agents received into the lungs make their impression upon the organic system of nerves, and thus lay the foundation of the subsequent disease. Without denying the reality of this influence, in view of the very rapid effects sometimes produced by malaria, and of which an illustration has been given on a preceding page, it would appear more worthy of credit that the pernicious substance is absorbed into the blood, which it more or less quickly vitiates, and thus occasions the subsequent symptoms. Two considerations render this supposition probable: the one, that in the class of diseases now more particularly under notice, the blood undergoes sensible alterations; and the other, that in constitutional contagious affections, properly so called, and which have so close an analogy with infectious disorders, it is difficult to imagine any other mode of origin than through a change in the circulating fluid.

Contagion.—Contagious diseases, strictly so called, that is to say, which cannot be traced to any other source than communication mediate or immediate with persons already attacked by them, and which cannot be referred to any atmospheric or other external cause, or combination of causes, but only to pre-existent cases of the same kind, have been well characterized by Gaubius. "As in their origin, so in their natures, they greatly differ among themselves, and every one possesses its own peculiar powers, by which, when they have come into bodies favouring their action, through their proper channel of communication, they every one procreate their own distinct form of disease by a constant law, no otherwise than the semina of plants and animals, received into fit places, evolve their determinate species. Hence, a particular disease arises from every different contagion." The contagion of small-pox, of syphilis, of scarlet fever, of rabies, of pellagra, &c., produces its own disease, and no other; it is a specific virus or influence, perpetuating a malady always presenting the same essential characters.

Amongst these diseases there are several, which, although their ordinary or normal mode of spreading is by contagion, yet, beyond reasonable doubt, do sometimes arise spontaneously; this is the case with small-pox, rabies, and glanders, the two last, indeed, being only of spontaneous origin in the lower animals, from which they are communicated to man. There are others, again, distinctly contagious, which, like scarlet fever and measles, are usually thought insusceptible of transmission by artificial inoculation, and one, primary syphilis, which, so far as we know, arises in no case without contact.

But the degree of contact necessary for communicating contagious diseases, is not the same for all; it may be direct or indirect. It is direct, when the virus is conveyed immediately from one person to another; and this may take place in one of several ways: 1st, by proximity to the sick person, as in his chamber, when the air is saturated with emanations from his body. In this way, typhus fever and small-pox, and the other eruptive fevers, are commonly propagated ; 2d, by direct contact, as in attending upon, or sleeping with a person ill of a contagious disorder ; 3d, by contact of a fluid containing the specific virus, with the skin or mucous membrane, and more certainly, when these surfaces are abraded, or the morbid fluid is introduced by inoculation. Rabies, vaccine, and syphilis, are communicable in no other manner. It is to be remarked, that the vehicle of the virus is different in different diseases. In small-pox, malignant pustule, and syphilis, pus is the medium of inoculation ; in vaccinia, either this liquid or the serum which precedes its formation in the vesicle ; in rabies, the saliva ; and the medicine is uniformly the same for each disease.

Contagion is indirect, when it is effected by substances which are capable of imbibing and retaining for a considerable time, not only the palpable and contagious virus or morbid secretions of the sick, but the invisible emanations from their bodies.

And here let it be borne in mind, that such substances so impregnated, communicate the disease by contagion, and not by infection, as clearly as the lancet which transfers the contents of a variolous pustule to a healthy system, gives the small-pox by contagion. This is a point too often overlooked. A cargo of rags from the Levant arrives at one of our ports, and on being discharged, creates disease in all the neighbourhood of the vessel ; if the disease thus originating is like one which was prevalent at the place whence the cargo came, the rags are a source of *contagion*. If there is no such similarity, or there was no prevalent disease at the Eastern port, then the newly-arisen malady must be attributed to the filth of the cargo, which is, in that case, a source of *infection*. This distinction, we repeat, is often lost sight of, but it is one which really exists, and ought to be insisted upon by all who attempt to study the details of the intricate subject before us.

The materials which are reputed to be most susceptible of preserving and transmitting contagious principles, are animal productions, particularly woollen and hairy substances, bedding and body-clothes, furs and feathers. It is thus, no doubt, that physicians become media of contagion, by carrying the emanations of the sick chamber in their clothing. A physician of this city, who had been visiting a patient ill of small-pox, and worn his cloak in the room, returned directly home without unfolding his cloak, and meeting his wife in the hall, embraced her as she ran to meet him. In a few days she was attacked with small-pox, although there was no case of the disease within the knowledge of herself or husband, except the one he was attending. Dr. Copland relates a case precisely similar; and many analogous instances might be furnished by the history of puerperal fever. Such facts should inculcate the duty of attention to those circumstances which impair the energy of the contagious principle. One of the principal of these is exposure to the air.

It is one of the most singular phenomena connected with contagious diseases proper, that several of them do not attack the same individual a second time, appearing thus in their first attack, to exhaust the susceptibility of the patient to contract them ; such are scarlet fever, small-pox, measles and hooping-cough, which are of extremely rare occurrence a second time in the same person. It is scarcely less surprising, however, that syphilis, which is supposed to resemble the diseases just mentioned, in so many other points, should be unlike them in this, and that a person who has once contracted the disorder, so far from enjoying an immunity from it in the future, is even more likely than ever to contract it anew. There is, however, so palpable a difference between the acute febrile constitutional symptoms of the exanthemata, and the local sore of syphilis, that one can readily understand that the former indicate a profound and radical modification of the system, capable of subverting its original susceptibility, while no such action can be attributed to the latter. It is impossible to conjecture whether a first attack of rabies would afford protection against subsequent ones, for no one has ever yet recovered from the first.

It has already been mentioned that several, indeed many, diseases which usually originate from external, atmospheric, or other causes, may, under certain circumstances, be propagated by contagion. A neglect of this consideration has given rise to many of the hot disputes which have prevailed, regarding the contagious quality of certain diseases, disputes which even now are rife, and in many places have had a practical bearing upon quarantine regulations. The question of the contagiousness of a malady is not absolute; a disease in its sporadic and mild form may be totally innocuous to persons who are in constant communication with the sick, and yet appear to be highly contagious when many subjects of it are gathered together in the same ward or building. This is true, to some extent, of the most contagious of all diseases, small-pox: the writer has repeatedly seen cases of this affection in the wards of the Parisian hospitals where all other diseases were treated, without its extension either to the assistants or to the patients in the adjoining beds. If then, we were asked, are yellow fever, the plague, cholera, &c., contagious, we might safely declare that they both are, and are not; that originally and essentially they are not, but that when many subjects of any one of them are brought together, and measures are not rigorously enforced for keeping the air of the apartments occupied by them perpetually renewed, all healthy persons coming within the sphere of their influence, will be likely to be attacked. This mode of communication is by some writers called infection, but it is clearly one of those cases which we have illustrated under the head of mediate or indirect contagion, one in which the air serves as the medium of contact.

Upon this subject, the late Dr. Hosack remarked with characteristic good sense: "The visiter or attendant contracts disease from one of *two sources*, either from the filth of the sick room, or from a *specific something* issuing from the body of the sick, the consequence of the peculiar disease under which he labours. If a person visiting another ill of the yellow fever or plague, derive his disease from the impure atmosphere of the apartment, I ask how it happens, in all instances, *he contracts the same disease with that of the person whom he visits?* If he derive anything specific from the sick, his disease is then, assuredly, not to be considered as occasioned by the atmosphere, but depending on the peculiar condition of the fluids, or state of the system induced by the action of a specific poison; in other words, it is to be considered a *contagious* disease." If then, we are to understand by a contagious disease, one *capable* of being transmitted by contact, nearly all of those are so at times which have heretofore been spoken of as properly infectious; but if by that term is intended such an affection as is *ordinarily* communicated by contact, it should be applied to those only which are inoculable, and not to such as arise under the influence of local or general atmospheric conditions. When the question is proposed whether any particular disease is contagious, it must first be understood in which of the two senses just mentioned the word is employed, and this being settled, an answer can be readily furnished by a reference to the history of the disease.

The circumstances which render infectious diseases contagious, have been incidentally alluded to: they are, bad ventilation, want of cleanliness, crowding of the sick together, allowing their excretions to remain in the apartment, and, along with these, a calm and moist state of the atmosphere. Yet, there are probably some others, which have hitherto eluded detection. For example, typhoid fever, as it occurs in Paris, rarely, if ever, appears to be propagated by contagion, yet there is abundant evidence of the contagiousness of this very disease, in the country and villages of the French departments.

There is a feature characteristic both of infectious and contagious diseases, and which consists in what is called the period of incubation, a metaphorical term borrowed from the process by which birds hatch their eggs. Thus, a person who has passed the night in a malarious locality, may betray no symptoms of having contracted disease, until several days or weeks afterwards. A more familiar illustration of the phenomenon in question, is afforded by inoculable diseases. The virus of small-pox, vaccine, syphilis, or rabies, is introduced into the system, and yet several days, and in the case of rabies, several months may elapse without the slightest indication of the disease which is subsequently to appear. How the virus acts during this interval of apparent quiescence, and how it finally determines the reaction of the constitution, is altogether unknown. Liebig imagines this matter to consist of a sort of ferment, which, like the minute quantity of yeast that leavens a large lump of dough, gradually modifies the chemical relations of the fluid elements of the body. Other observers, upon the ground of an alleged discovery, that leaven acts by propagating vegetable germs, suppose the different sorts of virus to contain animal ova, or vegetable germs, which, by rapid generation, fill the body with parasitic insects or invisible plants, whose presence constitutes the disease. When the microscope shall have revealed the existence of either of these sorts of bodies, in the fluids through which inoculable diseases propagate their kind, it will be time enough to give the hypotheses in question a serious consideration. Meanwhile, physicians may find abundant and more profitable occupation in investigating the relations of phenomena cognizable by the senses; in any other mode of searching for truth in our present subject, the most acute understanding is employed to little purpose.

Medical Constitution.—The preceding remarks form a necessary introduction to a general notice of several remarkable modes in which infectious and contagious causes operate, or the circumstances under which they act upon a large number of persons. The first of these we shall mention, is the medical epidemic constitution. This state has been erroneously defined the *appreciable* aggregate of meteorological conditions, during which diseases prevail epidemically. The phrase is synonymous with prevailing medical diathesis; it relates entirely to the peculiarities of the prevalent diseases, and incidentally alone, and that by way of explanation, to the existing state of the weather. It has been more correctly described as a general tendency, by virtue of which, nearly all diseases, at a particular time and place, no matter how different in seat and character, assume, to some extent, a common aspect. Thus, inflammations of the brain or bowels may both be complicated with bronchitis, which complication is then said to be the effect of the medical constitution. In like manner, when various diseases are attended with symptoms which indicate disorder of the liver, the medical constitution is said to be bilious, and we have bilious pneumonia, bilious pleurisy, bilious remittent fever, &c. So, too, the prevalent type of disease may be either inflammatory, adynamic, or ataxic; and thus it happens that an affection which, at one period, has been found amenable to a particular treatment, will, at another time, require an opposite management. Inflammations which last year may not only have borne, but seemed to require for their cure the most profuse loss of blood, may in the present, or the following year, be aggravated by moderate depletion, or even receive benefit from stimulating remedies. In connexion with this point, it may also be stated, that the alternate triumph and failure of the same remedy or class of remedies, has been observed even without there being any common feature in the diseases for which they were prescribed, or any, it would be more correct to say, which observation could detect.

The medical constitution must not be confounded with epidemic disease, for the former is evinced by a common symptom or symptoms in numerous affections otherwise dissimilar to one another, the latter is a definite and peculiar malady. Yet during the prevalence of an epidemic, some one of its principal features is very apt to distinguish nearly all of the sporadic disorders which arise at the same time; so diarrhœa was an ordinary complication of most diseases during the prevalence of the cholera. In such cases it is fair to infer that the infectious cause of the medical constitution acquires unusual energy, not only capable of giving an impress to diseases generally, but of originating an independent malady.

Endemic and epidemic diseases.—These words are derived from the Greek words εν, δημος, in or among the people, and επι, δημος, upon the people, the former indicating a prevalent disease arising from some local cause, and the latter one produced by an atmospheric or other general agency, operating upon the inhabitants of an extensive region. The one term refers to the place of a disease, the latter to its extent. Hence it is usual to speak of an endemic malady becoming epidemic. The yellow fever is endemic in Havana and Vera Cruz, i. e. is generated by causes existing in and about those places, yet when it *prevails* in either it is described as an epidemic. The same disease, as it frequently prevails in New Orleans, cannot be called endemic, because if we are to believe the highest testimony, it never appears in that city unless imported from abroad.

Another point of difference between the two classes of disease, is that the one is to a great extent permanent, or recurs periodically, in the same form, because its causes operate steadily or with regular intermissions, while the advent of the other is irregular and uncertain, and cannot be foretold, any more than its probable form, extent, course, duration, or mortality.

Most of the diseases which have already been described as infectious, belong to the class of endemic maladies, more particularly those of malarious origin, such as the different forms of remittent and intermittent fevers. But there are others which have long existed in particular districts or countries, the causes of which may therefore be presumed to be local, although for the most part unknown. Cretinism, which consists in a stunted or imperfect development of the body, with mental imbecility, has for centuries affected many of the inhabitants of the valleys in the south of France, Switzerland, and Austria. Goitre, or hypertrophy of the thyroid gland, prevails in the same situations. Plica, called *Polonica*, from its prevalence in Poland and the neighbouring countries, is a disgusting malady, in which the hair is matted together by a dark-coloured glutinous secretion, exhaling a nauseous smell. Frambœsia, or the yaws, is a disease endemic on the Guinea coast, and in the West Indies, and is also highly contagious. It consists of a fungous eruption over a large part of the body, resembling raspberries; whence its name. Elephantiasis in the West Indies, pellagra in Lombardy, and beriberi in Ceylon and on the Malabar coast, may also be classed amongst the strictly endemic diseases. Ophthalmia in Egypt, colic in Devonshire and Poitou, cholera infantum in the United States, trismus nascentium in the intertropical regions of America, are in some sense endemic or peculiar to certain countries or districts, but they can generally be traced to causes which are well known and tangible, in which respect they differ entirely from those before enumerated.

Epidemics, we have said, which are not mere extensions of endemic disease, epidemics properly so called, are for the most part independent of local causes; they occur at uncertain intervals, prevail for indefinite periods, and in general attack the inhabitants of different regions, however dissimilar in climate and in the character of the people, and whatever the season of the year. The most remarkable amongst them for the wide extent of their ravages, are influenza and cholera; the latter of which, starting from its lair in Bengal in 1817, has since that time made the circuit of the entire globe, seizing its prey in every climate and season alike. Epidemics, which, like this disease, the plague, and typhus fever, sometimes prevail extensively, and occasion a very great mortality, are usually denominated pestilential. As before remarked, there appears to be no uniform relation between them and the state of the weather, and this is true, though not literally, in the case of epidemics of more limited extent. Some have asserted that great commotions in the elements, earthquakes, hurricanes, volcanic eruptions, &c., give rise to epidemic disorders, but the assertion is unsupported by adequate testimony, and it is undeniable that these disturbances frequently occur without being followed by any such result.

There is a combination of causes which has repeatedly been observed to occasion epidemics of typhus fever and dysentery, and which was alluded to in the remarks upon predisposing causes; it is that of famine amongst a people labouring under mental depression and poverty, a combination which has lately worked such fatal mischief in Ireland, and even affected this country, by pouring upon its shores large numbers of persons labouring under the typhus fever, engendered by the causes in question. A scarcity of wholesome food imposes the necessity of consuming what is unnutritious or positively injurious, and in this way both impairs the power of resisting disease, and occasions the development of distinct disorders. Foderé, quoted by Dr. Copland, states that during 1815, 1816 and 1817, in several parts of Italy and France, the inhabitants were obliged to have recourse to such roots and herbs as they could procure, the grain having been remarkably scarce and of bad quality, and that, in consequence, scurvy, diseases of the skin, and malignant and infectious fevers, became very prevalent among the lower classes. It has occasionally happened that ergot, mixed with grain, has produced gangrene, abortion, &c., amongst the inhabitants of a considerable district. But this is a case of general poisoning rather than of an epidemic disease. Of a similar character are those instances of prevalent disease from eating the meat of animals which have been over-driven or in any way rendered unhealthy. Malignant typhus and dysenteric affections are the usual effects of this cause.

Not only do general causes productive of debility favour the development of epidemic maladies, but weakness, in whatever manner occasioned, is the most evident cause of individuals being attacked by the reigning disorder. The disproportionate mortality amongst the drunkards of this country in the cholera of 1832, must still be fresh in the recollection of every one who witnessed the ravages of that disease; and European writers record a similar observation. During the prevalent influenza of 1837–38, the old and feeble were amongst the first victims of the complaint, and suffered more than younger persons throughout its entire course. It is a fact, established by universal observation, that none contract epidemic diseases more readily than those who live in constant dread of their attack. These circumstances, it will be remembered, were pointed out in the discussion of predisposing causes, but their influence is more perceptible in the case of epidemic than of sporadic diseases, because in the former the morbid cause appears to be endowed with greater energy.

There is a feature, common to many epidemics, which must not pass without notice; it is the faculty which they have of taking the place, either in whole or in part, of the sporadic diseases which ordinarily occur in the regions where they prevail. It seems as if all morbid predispositions were, on such occasions, forced to assume the same mode of active development by the superior power of the epidemic influence. In a previous section the fact was mentioned, that if a number of persons were exposed to cold and humidity, many among them would be affected differently, according to the organ most predisposed to disease in each; conversely, in the case before us, it would appear that in the infected district nearly every one must have his constitution modified in the same way by the morbid epidemic principle, since the same form of disease results, whatever be the character of the exciting cause which directly produces it. It is on this account that, in estimating the mortality of a place during an epidemic, the number of deaths arising from ordinary causes, during a corresponding season in other years, are not to be added to those produced by the epidemic; for it not unfrequently happens that although it may have destroyed a large number of individuals, yet the total mortality from all causes

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may very little exceed the average of other years, so completely has the prevalent disorder become a substitute for the rest. We are accustomed to lament the insecurity of life in certain cities which are annually or periodically visited by epidemics, and to suppose their average mortality greatly to exceed that of places which enjoy an immunity from this evil; but it results from the vital statistics of these cities that their total mortality is not greater than that of others, and that if they suffer more from epidemic disorders, fewer of their inhabitants die of sporadic disease.

Endemic and epidemic diseases are propagated in one or both of two ways, by infection and contagion; that is to say, immediately, by an atmospheric or other analogous cause, and directly or indirectly from the bodies of those who received the disease from that cause. It hence becomes a question of great delicacy and difficulty to determine how far a particular epidemic is contagious. The very fact that a large number of persons are attacked, argues a predisposition on their part, and it would therefore appear impossible to decide whether they contracted the malady from its original source, or from some of the persons around them already attacked. It is not a sufficient objection to the latter supposition, that they have had no communication with the sick, for the media of contagion are innumerable, and no one can tell with certainty whether he has been exposed to their action or not. On the other hand, it is not conclusive evidence of contagion, that a person going into a sick family has there acquired the disease, or that the members of that family have successively been attacked by it; for it is highly probable that when several persons live together, and are subjected in all respects to the same local and general influences, they will all become liable about the same time to suffer from the same infectious cause.

It may be supposed that where a disease is essentially contagious, and is communicable by inoculation, there can be no doubt of its being propagated, during an epidemic, by contagion alone. But this is far from certain. If a large number being attacked argues a strong predisposition on their part to the disease, who shall decide that this predisposition is not strong enough to engender the malady directly, and without the intervention of contact or communication with the sick? It amounts to a strong probability that in certain epidemics, even of small-pox, the first cases have arisen spontaneously, because the subjects of them resided at considerable distances from one another, and had no intercourse, either direct or indirect.

We are not entitled to conclude that a disease whose ordinary mode of propagation is by contagion, can be engendered in no other way; it is evident that at some time or other contagious diseases must have sprung from a concurrence of natural causes, for there certainly was a period when they did not exist. If such causes were once adequate to their production, it cannot be denied that they may be so still, and that hence it is impossible to affirm, precisely, what part is borne by infection and what by contagion in the spread of epidemics.

The difficulties of deciding upon the contagious character of an epidemic, or the degree to which the disease possesses this character, are very much enhanced by the imperfect method of observation which has generally been pursued in investigating this subject. It is apt to be forgotten that the condition of the sick person and of him who is exposed to contamination, as well as the virulence of the contagious principle itself, may all vary so much, as to modify or reverse the ordinary liability of the disease to be disseminated. The particular period of the disorder, the idiosyncrasies of those affected, and the parts or textures through which communication takes place; the actual health of the person exposed to the contagion, including his constitutional susceptibility, his strength or weakness, the state of his mind, and the duration of his exposure; the state of the atmosphere as regards dryness, moisture, calmness, and renewal in the apartment of the sick; the nature of the substance, articles of clothing, &c., (fomites) which are supposed to have been the media of transmitting the contagion; these points, which ought plainly to be ascertained in every case of presumed contagion, are seldom investigated as they deserve to be. Dr. Holland, who insists strongly on their importance, remarks, "So far from being difficult to explain why a given disorder should occasionally appear infectious, (contagious) at other times not; why it should spread rapidly in some localities, and not at all in others; why it should affect some persons and leave others free; why the cases should be violent at one period, mild in another,—it is rather perhaps matter of wonder that the circumstances are not still more varied and irregular. Where there are such numerous elements of difference, the combination of these may well give scope to every assignable variety of result."

Abandoning, then, the attempt to determine by an infallible rule what cases of an epidemic disease are dependent upon infection and what upon contagion, we shall conclude this subject by pointing out the general grounds upon which the contagiousness or non-contagiousness of an affection ought to be decided, due regard being had at the same time to the modifying circumstances alluded to in the last paragraph.

The question is, simply, do persons, ill of a given disease, communicate it to others? Here it is necessary, at the outset of the inquiry, that there should be no other cause to which the sickness of the persons consecutively attacked can fairly be attributed; the affection must not be an endemic one, habitually prevalent, or arising periodically, where the cases of it under examination are observed, nor traceable to any known atmospheric or other exciting cause,—it must be contracted by the previously healthy upon the arrival of one or more sick persons amongst them, in order that its contagiousness may be rigorously proved.

When travellers affected with small-pox came amongst a tribe of our Western Indians, and one after another of its members was attacked by the disease, and nearly the entire tribe thus miserably perished, the proof that the malady was contagious became complete. But this highest degree of evidence can rarely be obtained, especially in large cities, where individuals may be attacked simultaneously, who believe that they have not held any intercourse with those previously sick, but who may in reality have contracted the disease from them through indirect channels. Under such circumstances the proof of contagion consists in the *more* frequent occurrence of the disease amongst the nurses, attendants, families, and friends of the sick, than elsewhere, and it may be added, amongst the patients of the physicians who have charge of the greatest number of those suffering from the malady in question.

It is this latter evidence that places the contagiousness of puerperal fever (typhoid metro-peritonitis) beyond all cavil or reasonable denial.

Other things being equal, the extension of the malady should be directly proportioned to the degree of communication with the sick; those who are much in their apartments are more liable to suffer than casual visiters. And yet there is some limit to this proposition, for it has sometimes been noticed that nurses and other constant attendants have escaped, altogether, or with slight attacks, when persons occasionally present have been more severely ill. It is supposed that the class of persons who appear to enjoy this partial exemption, become, as it were, acclimated by habitual residence in sick rooms. Such may be the case, but their immunity is doubtless, owing, in some measure, to their having no fear of the danger. This sense of security, it may be conjectured, is the great safeguard of the physician in his perilous treatment of contagious diseases. Further; the contagious qualities of a disease are to be inferred from its extension to those who have been in contact with garments or any other articles impregnated with the atmosphere of the sick room. If the laundress who washes the clothes of the patient be attacked, no other cause of her illness appearing, it is reasonable to suppose the garments to have been the medium of contagion.

The converse of the foregoing circumstances confirms by negative, what they establish by positive proof. Thus if it be observed that no persons but such as hold communication direct, or indirect, with the sick, are attacked; that just in proportion as the intercourse is restricted between the immediate locality of the disease and the adjacent districts, the progress of the disease is stayed; that the removal of the sick to a distance, is followed by a cessation of the malady, &c.—then upon these grounds alone there is a fair presumption that the disorder is contagious; and, if in addition, the aforementioned direct evidence can be obtained, then no candid mind should entertain a doubt of the contagious nature of the disease.

PART II.

GENERAL PHENOMENA, THEORY AND CLASSIFICATION OF DISEASES.—GENERAL DIAGNOSIS AND PROGNOSIS.

CHAPTER I.

THE TYPE, DURATION, STAGES, AND TERMINATIONS OF DISEASE.

By the course of disease is meant the mode in which its symptoms arise and succeed each other. As their origin, succession, association, duration and tendency vary exceedingly, and yet appear to be subordinated to general laws, in such wise that a knowledge of these circumstances leads directly to the distinction of diseases from one another, and to some anticipation of their result in individual cases, it will be necessary to examine these several particulars somewhat in detail.

SECTION I.

OF THE TYPE OR FORM OF DISEASE.

Type, or general character of disease, is a term used to express the succession of symptoms in one of three ways, to which observation teaches that all diseases more or less strictly conform. The first of these is the *continued* type, or that of diseases which go on from beginning to end, without material interruption or abatement. But these affections can be called continued in a comparative sense alone. None of them maintain strictly the same uniform intensity throughout their course, but on the other hand, they offer none of those decided interruptions of activity which belong to the other types. No disease is equally severe at every period of its progress; it must run through certain stages, which alone would prevent its being literally continued, and, moreover, none is exempt from occasional augmentations of severity, which are called *exacerbations*, and which, at times, occur with such regularity every morning or evening, or on every other day, as to place the disease amongst those of the remittent or intermittent type. Of this, the fever called remittent affords a striking illustration. In the early part of its course, it runs steadily on with little or no deviation from a certain intensity; subsequently it becomes marked by periodical exacerbations, and not unfrequently, at a later period, distinct paroxysms occur, separated by complete intermissions. This, and many analogous facts, have led to an opinion extensively entertained, that periodicity is the natural or primordial type of diseases attended with reaction. The type is *intermittent* when a disease is composed of separate paroxysms, in the intervals between which, the patient is free from any symptoms indicative of the disease under which he labours. A disease of this type is said to be regularly intermittent, when the paroxysms return after equal spaces of time, whether these be measured by hours or days. In febrile disorders, the interval between the paroxysms is termed *apyrexia*, (α priv., and πυρ, fever), in other intermittent affections, the convulsive, for example, the occurrence of the morbid phenomena is called a *fit*. There are several varieties of the intermittent type: the quotidian, in which the paroxysm occurs daily; the tertian, in which it occurs every third; the quartan, in which it occurs every fourth day, &c. These are elementary types, and may be variously combined. Thus, either may be doubled, so that two paroxysms fall on the same day, or two distinct series of paroxysms may exist, occurring on different days, but separated by the usual intervals. Regular intermittence is of extremely rare occurrence in any other disease than intermittent fever; next to which, neuralgia most frequently assumes this character. The periodicity which is observed in hectic fever, does not belong to the type under discussion, because depending upon profound, and generally incurable organic disease. It is characteristic of true intermittence, that its cause is occult, and has never been even plausibly assigned. In some cases of convulsive disorders which are marked by irregular intermissions, it is, indeed, often impossible to specify the cause of a particular attack, yet this can most generally be done; but just as they approach to regular periodicity, the cause becomes obscure, and even eludes pursuit entirely. The *remittent* partakes of the characters of both the other types of disease. Its most striking illustration is the malarious disorder known as remittent fever, which presents, in common with intermittent fevers, paroxysms marked by chill, fever, and sweat, and in common with continued fever, excitement of the circulation, and various disorders of innervation and secretion, which persist with more or less violence throughout the disease.

SECTION II.

OF THE DURATION OF DISEASES.

The period intervening between the invasion and the termination of disease, may vary in length from a few minutes to the greater portion of a lifetime; but experience teaches that nearly all diseases may be divided into two classes, viz., those which tend to terminate within a comparatively short time, and those whose duration is uncertain and indefinite. The former are termed *acute*, (*acutus*, sharp, brought to a point, viz. of time,) not only, perhaps, to express the shortness of their course, but also their sharpness or severity, since their general character, as compared with chronic diseases, is violence, a quality which in many of them is proportioned to their brevity. Instances of this fact are found in apoplexy, and some other hemorrhages, in cholera, and in peritonitis from perforation of the intestine; but the rule is not absolute, for several of the mildest disorders have the briefest existence, and on this account are called *ephemeral*. Such are most of the slight inflammations of the mucous membrane. It is, of course, impossible to fix a term within which all diseases shall be considered acute, but by general consent, those are so regarded which do not extend beyond forty days; or, more precisely, the name is restricted to such as are not prolonged beyond about half the period named, and that of sub-acute conferred upon those which attain the further limit. Considering the number, the frequency, and the severity of acute diseases, it is remarkable that, in their sporadic form, they should be so seldom fatal. They very commonly evince a natural tendency to cure, which contrasts strongly with the more general direction of chronic maladies to a fatal termination.

There is a class of acute diseases, whose duration is so nearly uniform, that it may be called definite. These are the *exanthemata;* in the large majority of cases, each one of their stages occupies a given number of days, so that the duration of the disease itself may be pretty safely predicted. The patient, however, may be more or less enfeebled, according to the severity of the attack and its complications. His recovery, therefore, does not always date from the cessation of the primary disease.

Chronic diseases (χρονος, time), are those which are of slow progress, and exceed in duration the ordinary existence of the acute class. They may arise as consequences of acute disorders, or be developed originally in the form which they long afterwards preserve. For the most part, their symptoms are not violent, and if they cause pain, it is only at considerable intervals of time, or when they are approaching the fatal conclusion to which most of their number tend. They are, in a majority of instances, connected with some organic lesion, a fact which explains their ordinary result, as well as the general loss of health which the subjects of them experience. These affections are very apt to be complicated with acute diseases, either from the progress of the lesions which are peculiar to them, or from weakening the constitution, and thus predisposing it to suffer from external morbid influences.

SECTION III.

OF THE STAGES OF DISEASE.

Pathologists usually divide the course of disease into three periods or stages: the first, that of *increase;* the second, that of *acme*, in which the symptoms remain stationary; and the third, that of *decline*. But these stages are far from existing in all diseases, or of following one another in regular succession. In acute diseases alone, are they presented with distinctness and regularity. There are some affections which may break out suddenly, in their full force, so that the first stage is wanting, and others which terminate abruptly in death, without any period of decline.

In others, again, there may be more than one acme; in small-pox, for instance, active fever precedes the eruption, abates upon its appearance, and is again lighted up during the maturation of the pustules. Notwithstanding these numerous exceptions, some one stage, at least, is marked in every disease; that of invasion, more frequently, perhaps, than the others. This one is highly important in its relations to diagnosis and treatment. In acute diseases, the invasion is usually attended by a chill, followed by fever, nausea, vomiting, pain, and loss of strength; in children, convulsions are often the initial symptom; in females, syncope; and in many persons, symptoms peculiar to the disease about to be developed. Such are pain in some particular organ threatened with inflammation; pain in the loins preceding eruptive fevers; epistaxis before typhoid fever, &c. As the disease advances, the functions grow daily more and more disordered; the physiognomy more altered; the thirst more urgent, digestion feebler, the tongue fouler, the pulse more frequent, and the skin hotter. These changes are completed in the course of a few, rarely more than seven, days, and retain their severity, or experience a somewhat further aggravation, during another period, and until the stage of decline arrives. The transition from the first to the second stage, of growth to maturity, and even, (though not so constantly,) from the latter to decline, is so gradual and often imperceptible, that it is not possible to say when the one ceases and the other begins.

During the stage of *decline*, the symptoms begin to subside, the general symptoms first, and then those belonging more immediately to the local lesion, if any there be. It is of importance, in practice, that temporary remissions be not mistaken for the permanent improvement which precedes convalescence,—that the practitioner should not allow himself to be deceived, nor induced by apparent amelioration to flatter the patient and his friends with false hopes. Due regard must be paid to the period at which the improvement takes place, and to its maintaining itself for a reasonable time, before it can be considered as belonging to the regular decline of the disease. Convalescence is described by some writers as included in this stage, and although oftentimes, doubtless, the one passes into the other by insensible gradations, it seems more appropriate to regard convalescence as one of the terminations of disease, under which head it will be duly considered.

The stages of chronic maladies are generally less distinctly marked than those of the acute; they are always of longer duration, and more liable to accidental modifications. The formative period is, for the most part, obscure, and may extend through many years; it sometimes, however, presents decided symptoms, which clearly indicate the future disease. Thus, in pulmonary consumption, it is not unusual for hæmoptysis, or a mere loss of flesh without assignable cause, to precede by many months the proper symptoms of the malady; a similar remark is applicable to several of the forms of cancer, and to most of the organic diseases of the heart. In most of such examples the second stage consists merely of an aggravation of the symptoms observed in the first, together with a more distinct and characteristic display of local symptoms. The decline of these affections, when they tend to a fatal issue, is marked by the most striking symptoms both local and general; the former vary with each particular malady, but several of the latter are common to nearly all internal chronic diseases; such are progressive emaciation, colliquative diarrhœa and sweats, and that breaking up of the constitution which is attended by hectic fever.

The characters of disease which have now been described are modified by various circumstances, which should be known, lest a too absolute idea be entertained of the regularity with which morbid phenomena are developed. Diurnal changes appear to have a decided influence on the course of disease. Before daybreak sweats are frequently observed, both in acute and chronic disorders; this is the period in the twenty-four hours when the system seems most to require support, when absorption is most active, (as shown by the disappearance or abatement of œdema of the extremities,) and when, according to some authorities, medicines intended to act through this medium are most efficacious. It is also alleged that soon after sunrise the signs of plethora are more distinct than at any other time, and that in affections attended by fever, there is usually a slight exacerbation about noon. These statements may admit of some question; but there can be no doubt that the symptoms of nearly all diseases are aggravated at the close of the day, and usually continue to grow worse until after midnight. The sick, wearied with the noise, and movement and light of the day, become exhausted, and at the same time restless and uneasy; as night advances the fever increases, and with it the disturbance of the mind, which, in severe cases, attended by sleeplessness, is apt to pass into delirium. Some chronic diseases display their severity almost exclusively by night; such are rheumatism, especially of the syphilitic form; asthma, whether nervous or dependent upon emphysema of the lungs; aneurism of the great vessels, diseases of the heart, large tumours of the abdomen, and dropsical effusions which impede respiration in the recumbent posture, &c.

Temporary changes in the weather do not exert a very marked influence on the course of disease, except when very sudden and extreme, and chiefly when they consist of a rapid transition from heat to cold. Chomel remarks of hospital patients, that when cold weather abruptly succeeds a moderate temperature, most of those who are in a very low condition die within twenty-four or thirty-six hours, a circumstance peculiarly noticeable in institutions which receive the aged only. Neuralgia and rheumatism are generally aggravated by cold weather, particularly if it be also damp.

Spring and autumn, the seasons in which the greatest vicissitudes of temperature occur, are also those most prejudicial to chronic complaints. In Europe there is a popular notion that the sick are very apt to die when the leaves fall, and external nature tends to decay; a similar idea is entertained here in regard to the boisterous month of March. Many consumptives look forward to its approach as the sure termination of their lives. During the entire cold season chronic maladies are aggravated, and those not immediately fatal are infinitely more intractable than at any other time. So powerful is this influence that the same remedies which have been fruitlessly employed during the winter, seem to acquire new power on the approach of spring, in consequence of the disease then assuming a mitigated form. Mr. Phillips has copiously illustrated this fact in his work on scrofula.

Lunar influence was formerly believed to control the ebb and flow of disease as certainly as it does the tides. The arguments in favour of this doctrine were chiefly drawn from the phenomena of nervous diseases; but it has gone nearly out of favour, and the only remnant of it remaining is an opinion that the insane are peculiarly liable to exacerbations of their disorder at the full moon. Indeed, a residence in an insane hospital must convince any one that about this period maniacal patients, and all disposed to be noisy, are more obstreperous than usual, and that, especially, by night. But it has been conclusively shown by Esquirol and numerous other observers, that the moon produces these effects through the influence only of her light, which, as every one knows, prevents or disturbs the sleep of many who are also rendered wakeful by the extravagant fancies of a disordered brain.

Food and drink, labour and rest, pain and pleasure, mental excitement or depression, and many other analogous circumstances which it would be impossible even to enumerate, have a very decided influence upon the character and issue of diseases. Chomel and Dr. Latham dwell upon the power of fatigue in aggravating diseases of the heart, and every physician who has passed much of his time in hospitals will confirm their remarks. Frequently, some of the greatest symptoms of these maladies, such as dyspnœa, and œdema of the lower limbs, disappear after a few days' rest. The subjects of these cases nearly always belong to the most indigent and laborious classes of society, in whom scanty and bad food, intemperance, and exhausting labour, produce symptoms which the cardiac disease would not of itself have induced until a much later period. Nearly every disease, in persons of this class, is singularly improved by the comforts and repose of a public institution. Consumption, dysentery, rheumatism, and insanity may be mentioned as peculiarly apt to improve from this cause.

The age of the patient plays an important part in regulating the duration of his disease. The diseases of infancy and childhood are, with few exceptions, short and active; those of old age, on the contrary, are more apt to be subacute and chronic. In the early periods of life the severest symptoms are often followed by sudden and unlooked-for recovery; "childhood is the age of resurrections:" in advanced life, the slightest attack of disease requires watching, for it is often the prelude to a fatal seizure. The diseases of males have, for the most part, bolder features, and a more regular course than those of females, in whom the nervous temperament and disorders of the uterine system give rise to the most whimsical irregularities and the most unmanageable complications. Pregnancy is reputed to exert a strong control over many diseases, and even to have effected a cure in rheumatism, hysteria, insanity, cutaneous affections, &c., and what is still more surprising, to have suspended the progress of organic diseases. It is alleged that consumptive females often have the development of pulmonary tubercles arrested until after parturition, when the disease resumes its downward course. If phthisis always ran its course in a given time, the influence of pregnancy in retarding it could easily be determined; but since nothing is more variable than the duration of tubercular disease, it becomes a most difficult problem to solve, whether or not the cause assigned for the extension of the cases in question was the real one. It is also a fact, which cannot be gainsaid, that pulmonary consumption does sometimes arise, and run on towards its fatal termination, precisely as in the unimpregnated state of the female; but whether it does so or not in the greater number of cases, is still undetermined by adequate evidence.

SECTION IV.

OF THE TERMINATIONS OF DISEASE.

All diseases end ultimately in recovery or death, but they do not always reach either point without passing through one or more of several intermediate gradations, which, relatively to the original disease, may be called terminations. These we shall discuss successively, giving, 1st, some account of recovery in general; 2d, of convalescence; 3d, of crises and critical days; 4th, of metastases; and 5th, of death, and its several modes or varieties.

Recovery is said to have taken place when the functional or organic derangement in which the disease consisted has entirely ceased, and the system has returned to its wonted condition. The *mode* in which this occurs is extremely diversified, for it varies with the organ affected, and the nature, degree, &c., of the affection. As already intimated, the constitutional symptoms are the first to disappear, pain, and the other morbid phenomena belonging to the nervous system, usually taking the lead; then the disturbance of the circulation ceases, the general operations of the economy resume their natural course, and, last of all, the injured organ regains its proper function. When the disease consists of constitutional disturbance alone, as in idiopathic fevers, the circulation gives, in general, the earliest evidence of improvement, the pulse approaching more nearly to the standard of health; then follows the amelioration of the nervous symptoms, including an increase of strength, and ultimately the secretions and excretions become natural. Paroxysmal disorders mark their subsidence by a gradual diminution in the violence of the attacks, unless, as frequently happens in intermittent fever, they are cut short by the treatment employed.

In local diseases, so called, in those, namely, where the system sympathizes but feebly with the lesion of texture, and in those also where such sympathy is strongly marked, but is strictly proportioned to the degree of the local alteration, the termination may occur in either one of several ways. The most favourable is that by *resolution*, in which the entire result of the morbid process is removed, and the part is restored to its pristine integrity. In literal terms this seldom occurs, except upon a cutaneous or mucous surface. There are few diseases of a parenchymatous organ, or of a serous structure, that do not leave some trace behind, though it is often so inconsiderable as in no wise to interfere with the function of the part. Sometimes an alteration disappears suddenly, as in cutaneous affections the eruption may abruptly recede. This, in the case mentioned, is termed *repercussion*. The French pathologists give the name of *delitescence* to every sudden removal of the results of morbid processes. Numerous diseases, which consist almost entirely of a single symptom, are sometimes abruptly arrested in their course, as neuralgia, hemorrhage, and the mucous fluxes. Suppuration, gangrene, and cicatrization, are also terminations of the local elements of disease; but as they, with those just enumerated, are all peculiar results of inflammation, their further discussion may be for the present postponed.

The immediate consequences of the processes just described is not absolute health, but a state which is introductory to it, an intermediate condition, in which the patient cannot be said to be either sick or well, but in which he is *convalescent*, (from *convalesco*, I increase in strength); he is cured, but is still feeble, and has not yet completely recovered his vigour. Although the term convalescence is not used in connexion with the local process of cure, yet the part affected passes through a corresponding state. A wound, although cicatrized, is for some time prone to open from slight injuries; a fractured limb, although perfectly consolidated, continues weak, perhaps for months, &c.; indeed, the convalescence of the entire system is nothing more than the aggregate of the improved conditions of all the parts which have been impaired by disease.

In chronic disorders convalescence is singularly slow. It is long before the patient can get rid of the expression which suffering has impressed upon his features; for a long time his gait is tottering, for his shrunken limbs are slow in regaining their former size, and that partly because his appetite is feeble, and his digestion slow. The older he is the more tedious and uncertain is his progress towards health. Young persons recover more rapidly. I have seen a lad convalescent from coxalgia who was carried on pillows to the sea-shore, pale and extenuated, in a few weeks afterwards capering in high glee amongst his playmates, as fat and sunburnt as the rest.

Recovery from acute diseases is more rapid, and marked by more peculiarities. The first signs of the decline of the disease after the cessation of fever, are emaciation and paleness. In most febrile diseases the body appears swollen so long as the heat of skin persists, but no sooner does the circulation fall to its natural standard, and the surface grow cool, than the flesh seems to shrink. At the same time the patient begins to be conscious of his debility; his limbs, his voice, his mind, are all feeble, and, though he enjoys the luxury of thinking without pain, yet the slightest argument, or contradiction, will ruffle his temper and bring on headache, restlessness, or fever. Even agreeable conversation, if prolonged, or pleasing intelligence if abruptly communicated, may produce the same effect. This susceptibility of the nervous system does not seem to be entirely removed by sleep, which is rarely sound, but commonly disturbed by dreams in which enticing scenes of feasting and other carnal pleasures mock the fancy. This is doubtless owing in a great measure to defect both in the quantity and quality of the blood; the paleness of the tissues shows that this fluid is scanty and impoverished. This condition is further indicated by œdema of the face and lower limbs, and by shortness of breath and palpitations of the heart which come on after any unusual although slight exertion. On such an occasion, if the heart and large arteries are auscultated, a bellows murmur will be heard instead of the first sound of the heart, and a sound of similar character, or a humming or musical note will be audible in the vessels.

Meanwhile the tongue begins to lose its morbid coating, and hunger becomes as imperious as was the longing for liquids during the height of the attack. At first, perhaps, food may seem to lack its appropriate savour, but it soon affords so exquisite an enjoyment that the patient is very apt, in eating, to exceed the bounds of moderation, and overtask his stomach. Some years ago a patient in the Blockley hospital who was convalescent from typhoid fever, devoured his food so greedily, that a piece of tough meat contained in the soup he was eating, became wedged in his rima glottidis, and before assistance could be rendered, put an end to his life. The proper medium between abstinence and over indulgence of the appetite is not readily found at this period of imperfect restoration of the patient's health, and yet upon its due observance depends the rapidity of his recovery, and oftentimes the prevention of a relapse. In some diseases where the digestive organs have themselves been the seat of inflammation or other lesion of texture, the management of the diet during convalescence is of infinite importance. The greater numbers of cases of perforation of the intestine after typhoid fever are due to the imprudent and premature ingestion of solid food.

The bowels of convalescent patients are usually torpid; often the dejections are of a light colour, indicating the absence of bile; the stomach is apt to become distended with gas after eating; in a word the digestive function is not yet equal to the labour it is required to perform, and until the whole system has become invigorated by exercise, the alvine discharges do not resume their natural appearance. At the period of which we are treating there is a remarkable sensibility to cold; the hands and feet are habitually cool, and the least exposure excites a feeling of chilliness. The hygienic relations of this fact are of high importance.

After fevers, and more especially the exanthemata, there is more or less desquamation of the skin, and a herpetic eruption appears upon the lips. Not unfrequently the hair falls out, and is very apt to reappear of a different shade and texture, or else it grows again but partially, leaving the crown of the head bald. It is not uncommon for the hair to become gray after a severe febrile attack.

There is a class of phenomena described by some writers as *consecutive*, and which are generally manifested during convalescence, although, as they may extend far beyond this period, they cannot properly be said to belong to it. Such, for instance, is the jaundiced hue of the skin, which remains for a long time after the obstruction in the gall ducts, or whatever else may have caused it, has been entirely removed. These phenomena are frequently attributable to a partial continuance of the textural lesion peculiar to the disease; to imperfect cicatrization of the brain in the case of prolonged feebleness or trembling of a limb after an attack of apoplexy; to thickening of the lining membrane of the larynx when the voice continues to be hoarse after croup or simple laryngitis; to partial closure of the ulcers of the colon when the bowels remain irritable after dysentery, &c. In diseases which have no acknowledged anatomical lesion, in which function only is disordered, we are led by analogy to conjecture that the molecular alteration in the instrument of the deranged function has not entirely disappeared, when we find occasional indications of weakness in the performance of the function after the complete restoration of health in all other points. One of the most remarkable of the phenomena under notice is the recurrence after intermittent fevers, and on the days corresponding to the paroxysms, of slight chilliness, or flushes of heat, or pain, loss of appetite, or a copious lateritious sediment in the urine.

Crises.—The word crisis in the original Greek signifies a judgment, or judicial decision, because by it the life or death of the patient is determined. It is not every change of a disease, though it tend directly to a favourable or fatal termination, which is called a crisis, but only that which happens suddenly, and is preceded or attended by some remarkable disturbance of the body, and followed by a decided alteration of the symptoms either for better or worse. The phenomena which accompany the change are called *critical*, and the evacuation, if any, which at that time takes place, a *critical discharge*.

There is no point of medical doctrine which has been more generally and more intemperately contested, than that which relates to the crises of disease, their causes, their effects, the days on which they occur, &c., and some have even gone so far as to deny their existence altogether. It is true, that this last sign of incredulity has been given only in very modern times, when to doubt, seems more proper to man than to believe. It has been advanced, in explanation of this denial of an opinion accredited in all previous ages, that the climates of northern Europe, where medical inquiries have, in recent times, been chiefly made, and of this country, where the unbelief is equally general, are very different from that of ancient Greece, where the doctrine first prevailed; that modern physicians are more prone to disturb the salutary efforts of Nature than the ancient, or than those even of whom Galen complained, that they were never satisfied without they had administered a clyster, opened a vein, or applied cupping-glasses, and could not come near a patient without doing some mischief; that our system of dietetics for the sick is not as rigid as that of the ancients, &c.

The learned and acute Van Swieten, however, who admits such reasons to be not without their weight, is still of opinion that the chief reason of our not observing crises, is because we neither know how, nor will take the pains to look for them. He relates, that having collected some hundreds of acute cases, *not trusting to his memory, but writing down before the patient everything he could observe* each day through the whole course of the disease, he with great pleasure saw that the results of his observations agreed substantially with those of the ancients, and that "the chief fault lay in our being so forward to make the ancient physicians wiser, and presage more than they intended." He then proceeds to show that it was never pretended that crises happen in all diseases, nor that every disturbance and discharge are to be regarded as critical, nor that every crisis is necessarily followed by a decided and permanent change in the disease, either for better or worse. It is freely admitted by the author just quoted, that critical changes may be delayed or suspended, or entirely prevented, either by the physician's interference, or by that of persons, or causes, over which he has no control; that yet, if they actually exist, they deserve to be attentively studied, for they teach us in what manner Nature cures diseases, and afford us a motive for not disturbing her in her salutary work by any impertinent endeavours to substitute for hers, inferior processes of our own invention.

But on the other hand, that such forbearance would not necessarily result in showing critical phenomena to be of ordinary occurrence, may be inferred from a statement made by Chomel, in regard to this point. "In a large proportion of acute disorders," he remarks, "and especially in inflammations of moderate severity, I do not, as a general rule, employ any of those active remedies which are held capable of preventing critical phenomena, and I am bound to declare, that in a vast majority of the cases, I have seen the patients get well without any remarkable phenomenon to signalize their recovery : a gentle perspiration, more copious or more loaded urine, a few evacuations by stool, cannot, in my opinion, be looked upon as critical phenomena. I hold them to be such, only when something unusual in their nature or degree,—something, in fact, which distinguishes them from the symptoms of ordinary diseases, arises to arrest attention."

When, however, it is remembered that, when Chomel expressed this opinion, the principal sphere of his observation had been the wards of an hospital, there is less reason to be surprised at his belief in the infrequency of critical phenomena ; for the remark of Dr. Conolly is a just one, that country practitioners, long engaged in watching maladies at the bedside, are more likely than hospital physicians, who make but a daily and formal visit, to witness the critical phenomena of disease.

It is worthy of remark, too, that M. Grisolles, who collected the larger part of the materials for his classical work on pneumonia, in the wards of M. Chomel, as *resident* medical officer, and therefore in constant communication with his patients, states, that of one hundred and thirty cases of pneumonia proper for the inquiry, one fourth began to recover on the supervention of critical phenomena, and further, that the proportion of patients who manifested them, was greatest among those whose treatment was least active. Believing, for our own part, that the weight of evidence is entirely in favour of their reality and importance, we shall proceed to lay before the reader a summary of their most ordinary forms.

Critical phenomena manifest themselves on the mucous membranes ; on the skin ; in the glands ; the cellular tissue ; and the serous membranes.

A critical discharge from the *mucous membranes* is usually in the form of a flux, and frequently indicates the cessation of inflammation in this tissue. A copious watery discharge from the nostrils, often announces the sudden solution of a coryza, which had entirely impeded the passage of air through these openings ; discharges of a similar kind, or of mucus, from the bronchi, intestinal canal, or vagina, have immediately preceded the cessation of maladies not seated in either of these parts. I have seen the cure of an ovarian tumour large enough at last to fill the whole abdomen, take place upon a copious discharge of serous fluid from the vagina, which lasted for about a week. The patient had borne the disease for five years, and except that, towards the conclusion, its size and weight began seriously to incommode her, and that, at one time, she was greatly exhausted by injudicious evacuant treatment, her health had been excellent; her menstruation was regular; for a year, at least, previous to the event, she took no medicine; nor could any cause whatever be discovered for the fortunate occurrence which restored her to comfort at the very time when she was threatened with suffocation from the growth of the tumour. The cessation of ascites, upon the occurrence of repeated serous evacuations from the bowels or bladder, is an event of much more ordinary occurrence, and doubtless gave rise to the treatment of the disease by means of hydragogue cathartics and diuretic medicines. The secretion of saliva sometimes becomes very abundant, and has been regarded as a critical phenomenon in adynamic and intermittent fevers.

Hemorrhage from mucous membranes has been regarded in the same light, and with better reason: from the rectum, it sometimes attends amelioration of the symptoms in several inflammatory diseases, and particularly in that of the liver; epistaxis has a similar value in inflammations of the chest and head, particularly when copious; bleeding from the lungs, stomach, or kidneys, must nearly always be regarded unfavourably, even when decidedly critical, unless the discharge appear to be a substitute for that of the catamenia.

Certain states of the *urine* were formerly regarded as indicating, more certainly than any other circumstance, the occurrence of crisis in disease, and to ascertain them, great care was taken in examining this fluid at each visit of the physician. At the height of the disease, if the urine became turbid upon standing, and deposited a lateritious sediment, the early subsidence of the symptoms was pretty confidently expected, and, unless this condition of the renal secretion were present, other apparently critical phenomena were held to be of little value. Since the revival of pathological chemistry, the urine has been the subject of minute study by a great number of physicians, and the value of the signs derived from it, as will be more fully shown hereafter, has been amply demonstrated; but so far as they relate to our present subject, the only new result obtained, is the fact observed by Martin-Solon, and others, that during the decline of many acute diseases a copious deposit of coagulated albumen takes place, when the urine is treated with nitric acid or heat.

Critical *sweating* is alleged to be of frequent occurrence in acute diseases, and it occasionally puts an end to dropsical effusions; but, as daily observation teaches, the occurrence of this excretion is by no means a uniform indication of the subsidence of a disease. The copious and exhausting sweats of rheumatism are familiar to every physician; such only, however, are to be considered critical as come on suddenly after the skin has been for some time hot and dry, and which are accompanied by an improved state of the pulse. Miliary eruptions, or sudamina, may be regarded as critical under like circumstances; they are of too ordinary occurrence during the height of typhoid fever, pneumonia, rheumatism, &c., to be looked upon at that period as anything more than a complication. Other cutaneous eruptions, of the pustular or squamous classes, are occasionally critical, and have been observed to attend the suspension of acute and chronic bronchitis, and, in some happy examples, their appearance has proved the cure of insanity. Esquirol and Rayer both relate such cases.

Besides the critical secretions from *glands*, noticed above, these organs sometimes indicate, by their swelling, the occurrence of a crisis. The parotid glands occasionally become swollen, and even suppurate, during the decline of typhoid fever; and inflammation of the lymphatic glands of the groin or axilla is said to be critical in the plague. Swelling of the testicle has been noticed as critical in catarrhal affections.

The *cellular tissue* has been regarded as the seat of critical phenomena in such cases as the following: when it is distended with a serous effusion in certain acute diseases; when boils form within it, and sometimes, even, when it is attacked with carbuncle and gangrene. But these, like the so-called critical phenomena manifested by *serous membranes*, are complications which do not modify the existing state of the original disease; they merely add to it conditions which increase the patient's danger. Effusion into the several serous sacs, although it may allay the violence of the inflammation, forms part of the disease, and is not, like a crisis, something incidental and superadded.

Critical phenomena, like all the other symptoms of disease, are subject to an infinite number of disturbing influences—to all, in fact, which in any way act upon the sick. They are more common and more distinct in those of strong constitution, in infants and young persons generally, in temperate climates, in elevated situations, in the spring season, &c.; whenever, in other words, there is but little to interfere with the regular course and development of the malady. Old and feeble persons, and those in unfavourable conditions as regards residence, climate, food, attendance, &c., are much less apt to have their diseases marked by crises; and when this happens, it is usually by some mucous or serous discharge, while hemorrhages and sweats are more frequently met with in those of vigorous constitution.

Critical Days.—The doctrine of critical days, which is, that crises occur on certain days rather than on any others, must be judged independently of that of crises themselves. The latter may be, and we believe *is*, true, because the most accomplished men in every age have confirmed it by their testimony; the former has met with no such universal acceptance, but is sufficiently accredited to render a brief statement of it proper in this place.

The ancients remarked that crisis might take place upon any day whatever of a disease, but that there were some on which a greater number of perfect crises occurred than on any other. Of these, the 7th was the principal; after which, were the 14th, the 20th, the 27th, the 34th, and the 40th, which numbers, it will be observed, are formed by adding from six to seven days to the original number seven. The whole number seven was not added at each time, because a week, or the fourth part of a lunar month, contains but six days and twenty hours. The intermediate days to these were also regarded as next in value as critical epochs; to wit: the 4th, 11th, 17th, 24th, and 31st; or rather, these were thought to be occasions on which signs were given that a crisis was about to take place; hence they were called *dies indicatorii*. By a further subdivision, other critical days, but of inferior importance, were established, with the title of *intercalary*, to wit: the 3d, 5th, 9th, 16th; and finally there were the remaining days, the 2d, 8th, 10th, 13th, and 15th, on which it was affirmed that crises seldom or never took place, and which were hence called non-critical or vacant.

Hippocrates, however, in whose writings are found the earliest record of this system, did not insist upon it as absolute, but even went so far as to admit, that a crisis might take place on the day preceding, or on that following the critical epoch, which, as has been well remarked, amounts to asserting that a crisis may take place on any day whatever! At the present time, there are few, if any physicians, who adhere strictly to the doctrine of critical days. Dr. Laycock, who has written with much learning and ingenuity upon time as an element of disease, attempts to show that nearly all the processes of vitality are marked by regularly remittent or intermittent movements taking place in *heptal* periods, which are multiples, or sub-multiples of the number seven, and he adduces an immense array of facts relative to the phenomena of generation and gestation, to sustain his theory. He shows, for instance, that the period of incubation, gestation, of the chrysalis state, of puberty, in all grades of animated nature, is obedient to the "heptal law," and thence reasons chiefly by analogy, and partially from experience, that disease must follow the same law. But, admitting the wonderful and inexplicable mystery, that the lunar week is the unit of a countless number of physiological periods, it does not follow that the periods of disease are subordinated to the same law; the question still remains to be decided by direct observation. This has not yet been satisfactorily applied. Dr. L. is said to have shown, (we have not seen the original Essay,) "that the periods of exanthematous fevers are, for the most part, heptal, that the 4th, 7th, 14th, 17th, are critical days in small-pox; that the exanthematous typhus is a twenty-one-day fever; that shingles run their course in fourteen days; and that pemphigus, rubeola, scarlatina, &c., are all amenable to the general law." M. Grisolles, on the other

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hand, who is, perhaps, the only physician who has yet examined this subject by means of a rigid analysis of accurately observed cases, gives a very different result so far as regards pneumonia, the disease, of all others, in which critical phenomena are alleged to present themselves with the greatest regularity. Taking the thirty-five cases of this disease, in all of which he had noted distinct crises, he shows that *three* of them only underwent the salutary change upon the seventh day, *twenty* upon the intercalary days, *eight* upon the non-critical days, and *four* upon the sixth day, which was looked upon by the ancients as peculiarly dangerous; and further, that of ten patients who were trusted to the powers of nature, more than one half experienced crises on the non-critical days.

Without insisting that these results, however unfavourable to the Hippocratic doctrine, are sufficient to overthrow it, they nevertheless demonstrate its weakness conclusively, and should prevent its acceptance until, at least an equal number of cases, noted and analysed according to the same severe principles, shall furnish different conclusions. Of course, in making the calculation, the position of the critical days will depend entirely upon the point from which the commencement of the disease is dated. Now, it is clear that the result will vary according as the day of the exposure to the cause of the disease, or that on which the first uneasiness is felt, or that, finally, when the patient takes to his bed, is assumed as the starting point. There appears to be no general agreement amongst physicians, as to which of these dates should be preferred, and hence the conclusions at which they arrive, must necessarily be at variance.

We have dwelt upon this subject from a belief that there must, in spite of the discrepancies of authors, be some foundation in nature for a doctrine which is so respectable for its antiquity, and which has commanded the assent of many distinguished and independent observers in all parts of the civilized world, and because, if true, even in its most prominent features, it ought to have a decided influence upon our methods of studying and treating disease. If nature, in conflict with disease, tends upon certain days to obtain the victory, it becomes us to watch for the contest,—to observe all the phenomena which mark its successful or unfavourable issue, and, while carefully avoiding untimely interference, to be ready at a moment's warning to promote the wholesome struggles of the system, and to sustain and protect it when ready to sink.

Metastasis.—When a disease affecting one part of the body, disappears upon the occurrence of disease in another part, there is said to be metastasis, or change of place. It is evident that this term is appropriate in so far only as the newly-arisen disease is of the same sort as the original one, and to such cases it was originally restricted, cases in which it was believed, that the morbid matter was transferred through the circulation to a new seat; but at present it is applied to all instances where there is a substitution of one disease for another.

As examples of true metastasis, the following may be enumerated. It is not uncommon for hæmoptysis or hæmatemesis, to replace the catamenial discharge, or suppressed hæmorrhoids; for pulmonary catarrh to succeed the suppression of chronic diarrhœa, or vesical catarrh. Here, the transfer of disease is from one mucous surface to another. In like manner, a fit of sciatica may suddenly cease, and be followed by neuralgia of the stomach, or by asthma. But in other cases, while the disease appears to be essentially the same, its seat is different: thus, gout and rheumatism, when driven from their original position, often attack the pericardium, the pleura, or the meninges of the brain, passing thus from a fibrous to a serous tissue. Or the successive diseases may be seated in tissues having less analogy than these, and display symptoms entirely different; as when erysipelas leaving the face, is followed by meningitis or peritonitis, or when either of these latter inflammations, or pneumonia, immediately succeeds the repercussion of small-pox, measles, or scarlet fever; or when dropsy, or mania, follows the spontaneous cure of some chronic cutaneous affection. Suppression of the perspiration, milk, or menses,—which, indeed, are not morbid secretions, but still, discharges maintained by a vital action, and therefore, in their relations to the causation of disease, fairly comparable with pathological processes,—when abrupt, is frequently the immediate forerunner of internal inflammations, dropsies, apoplexy, insanity, &c.

In other and more numerous instances the arrest of some morbid secretion is followed by the development of a new disease; eczematous discharges from the skin, if suspended, may be followed by anasarca; suppressed gonorrhœa, by ophthalmia; *fistula in ano*, and pus-secreting sores generally, when dried up, by apoplexy, by pulmonary tubercles in persons of scrofulous constitution, or by some internal inflammation or functional derangement. Not many years ago the abscesses which formed in the lungs, liver, and other organs, after various surgical operations, were regarded as examples of the termination of disease under notice, and hence were called metastatic. Their formation is now, however, pretty well understood, and is believed to depend upon the transfer of pus from the inflamed veins of the wounded part to the several organs, and its exciting inflammation and suppuration in these latter.

Such extraordinary phenomena as those just alluded to have naturally excited the curiosity of scientific physicians, and led to many ingenious attempts at explaining them. These have always been made in accordance with the prevalent medical theory of the day. The followers of the humoral pathology conceived that "the morbific matter after it was concocted and rendered movable, was not always evacuated, but sometimes deposited in various parts of the body and so produced a new disease," while the vitalists and solidists of the modern school assure us that metastasis is nothing more than "a transference of irritation" from one part to another. That there is in every disease a *materies morbi* which can be carried from place to place, like pus in phlebitis, is, however probable, yet strictly nothing more than an hypothesis. It is needless to say that it is impossible to form any idea of "irritation," and still less of its transference. The one doctrine sets a hypothetical substance travelling through the system, the other sends upon the same journey an abstraction. How far the one is preferable to the other let the ingenious decide.

The important questions are, in what diseases do metastases most commonly occur, and under what circumstances; when do they impress a salutary change on the condition of the patient, and when increase his danger? It may be answered that they are most apt to take place in acute diseases, and in those of uncertain seat, as gout and rheumatism; in a direction from without inwards, that is to say, from the surface of the body towards its interior, from the extremities to the head and trunk; and that when anything interferes with the action of the disease, whether accidental influences, such as atmospheric vicissitudes and mental emotion, or attempts to arrest it by medical art. Original metastases are rarely salutary; yet they are occasionally so; as when a person predisposed to gout is attacked with symptoms of apoplexy which subside immediately on the supervention of swelling in the great toe. In nearly every other case the disease abandons the outworks and assails the interior defences, placing life in imminent peril.

Death.—Physicians as well as unprofessional observers are aware that there are two modes of death, the one more or less sudden, the other gradual. The former is the least common, and either takes place as the termination of some extensive organic disease seated in an organ directly essential to life, as in extensive cerebral hemorrhage, and other injuries of the brain, rupture of the heart, aneurism of the aorta, &c., or else upon some sudden exertion during exhaustion from protracted disease, as occasionally happens in the last stage of pulmonary consumption, and cancer, and in anemia. In these cases death is instantaneous, gives no warning of its coming, and takes place without a struggle.

The phenomena of gradual death vary a good deal in different diseases. It is a beneficent provision that the exit out of life should oftener be more terrible to the spectators than to the patient; that before the struggle comes which is to separate the body and soul, the one should become insensible to impressions, and the other unconscious of suffering. Comparatively speaking, it is very unusual for the mind to remain unimpaired until death; the final struggle does not usually commence until coma has thoroughly blunted the perceptions. Then a cold and clammy sweat stands upon the skin, the respiration grows quicker and shorter; and seemingly anxious, but really automatic efforts, are made to expel the mucus which chokes up the lungs, and begins to rattle in the throat; the artery at the wrist pulsates more rapidly, but with gradually decreasing regularity and strength, until it can no longer be felt;

the hands roam about with an uncertain and tremulous movement, as if in search of something, and coldness seizes upon the fingers and toes and slowly advances towards the trunk. In maladies attended by much emaciation, the state of the countenance is that called *hippocratic*, after the writer who first described it. It is attended by a total loss of the natural expression of the face; the skin is dry shrunken and pale, or of a greenish, livid, or leaden hue; the nose is cold, sharp, and has its extremity drawn to one side; the eyes are sunken, filmy, and half closed; the temples and cheeks hollow; the ears shrivelled and retracted; and the lips and lower jaw completely relaxed.

The duration of these phenomena may not exceed two or three hours, or may last for one or two entire days. They are most frequently observed at the close of chronic diseases, but are occasionally met with in what is improperly called sudden death, but which is only a sudden and a short disease: we allude to those cases of apoplexy, in which death takes place within from ten to twenty-four hours after the commencement of the attack. The progress of the mortal symptoms is often, in such cases, precisely what has been described above.

By the publication of Bichat's masterly analyses, our knowledge of the mechanism of the act of death has been materially increased. We shall describe its principal varieties. There is a natural and there is an accidental death. The former occurs in old age, and is marked by the steady and gradual decay of all the powers of life, organic as well as animal. As man advances to the natural limit of his earthly existence, he loses one after another his means of intercourse with the external world; one by one all the avenues of sense are shut up, the ear grows dull, the eye dim, and smelling, tact, and taste are blunted; his mind, but feebly impressed with the objects and events around him, lies dormant, or is moved only by recollections of days long past; his tottering gait, his shrivelled and horny skin, his yearning for the fireside and the genial warmth of the sun, show how languidly the great functions of the circulation are performed; by degrees his digestion becomes impaired, and then the decline proceeds more rapidly; innervation, calorification, absorption, and secretion, all become embarrassed as the capillary circulation languishes; sooner or later this function ceases, and last of all the heart dies. Death advances from the circumference to the centre. Frequently, it is true, old persons are cut off by definite diseases, and then their mode of death differs in no essential respect from that of the young.

On the other hand, there are many sudden deaths in which the starting point and succession of the terminal phenomena of life can be distinctly traced. In these, the cessation of function which constitutes death proceeds from the centre to the circumference, commencing either at the heart, the brain, or the lungs. These three organs appear to be so directly and immediately essential to life, as to have been called, figuratively, the tripod on which it rests; yet it must not be understood that they alone are thus essential, for, as in the case of old age, and in that of many exhausting diseases, death evidently commences in the parenchyma of the organs; the nutritive function is then the first to cease, and that, doubtless, because the blood has lost its healthful qualities. In various acute diseases, too, it is impossible to analyse the phenomena of death so as to fix upon the organ in which it originates, and equally so to ascertain the cause of its occurrence. The following account of the modes of death is therefore to be received as the expression of what takes place, in those cases only which are susceptible of analysis, in consequence of all the organs retaining their integrity except the one in which the fatal process takes its rise.

Death commencing *at the heart*, or by *syncope*, is the most sudden form. The pulsations of this organ may be instantaneously stopped, and life extinguished like the light of a taper that is blown out. They may also decline more slowly and gradually. The former happens in wounds of the heart, in ruptures of its tissue, or of an aneurismal sac in its neighbourhood, in mechanical obstruction to the passage of blood through its cavities, and from debility of the organ. In most of these cases the cause resides in the heart itself; its function is destroyed by some remote cause affecting its mechanism or its vitality. In others, however, its function ceases because a sufficient quantity of blood no longer reaches the interior of the organ, as in profuse hemorrhages. The brain in common with the other organs is deprived of its due supply of blood, and sensation and voluntary motion are at once suspended; the lungs cease their movements immediately afterwards, and the changes of the blood necessary even to the functions of organic life failing to take place, those functions can no longer be performed. Dr. Williams and others explain one class of deaths from syncope, by saying that the heart has lost its "irritability," and the other by alleging that it is affected with "tonic spasm," which are nothing more than hypothetical phrases expressive of the two facts, that, on the one hand, the heart is found dilated, and, in the other, contracted, after death. These differences may perhaps be thus explained. When the heart is found dilated with blood after death, it may be presumed that the muscle was either too weak to expel its contents, or was actually dead before the flow of blood into it ceased, which flow would passively distend it. But when the heart is found firmly contracted, after death by hemorrhage, it is evident that at each systole having less blood to propel, the bulk of the organ proportionately diminished until, at last, it failed to propel sufficient blood for maintaining the action of the nervous system, and at that point, and thus contracted, it died.

Death commencing *in the lungs*, or by *asphyxia* or suffocation, is owing to some cause which prevents hæmatosis. Extensive hepatization or induration of the pulmonary parenchyma, tumefaction of the membrane lining the smaller bronchia, or the repletion of these tubes with mucus, false membrane, &c., mechanical obstructions of every kind to the entrance of air through the larynx or trachea, present examples of this cause. Owing to its influence, the venous blood, instead of acquiring, in its circuit through the lungs, the qualities of arterial blood, is returned to the left side of the heart, and thence distributed over the system, still loaded with the excrementitious matters which should have been exhaled, or revived, by contact with the air. Such a fluid is deleterious wherever it moves; in the brain it destroys voluntary motion, sense, and general sensibility, and induces coma; it impairs even the excited movements of the respiratory muscles, thus allowing the lungs, the pulmonary artery, and the right side of the heart, to become gorged with blood; the last-named organ receiving through the coronary arteries so imperfect a stimulus, soon loses its power of contracting, and then death is complete. This is perhaps the most ordinary mode of death in acute diseases, but its progress is often so gradual, and it becomes so involved with declining power of the brain and heart, as well as with the failure of the nutritive function, that to assign to each of these causes its appropriate phenomena is, perhaps, impossible.

Death commencing *in the brain*, or by *coma*, is generally owing to compression, by depression of the skull, or a tumour of the meninges, by an effusion of serum, blood, or pus, in or upon the brain, or by excessive congestion of the cerebral vessels. This latter may arise from a great variety of causes, amongst which may be mentioned alcoholic and narcotic poisons; but these, perhaps, exert, in addition, some injurious impression upon the nervous function. Loss of general and special sensation, of voluntary motion, and of consciousness, follows the action of any of these causes, but not always in the same order. Consciousness is, however, usually the first to fail, and then the several senses cease to perceive impressions distinctly. Such, at least, is the case when death approaches slowly, in consequence of serous effusion; but, when more rapid in its onset, in apoplexy, for instance, all the functions of the brain are suddenly abolished; nevertheless, as was previously remarked, the patient may live internally for many hours, and even days, after the stroke, although he is to all appearance dead. This circumstance is readily explained by the physiological doctrines of the present day. The movements of the organs of respiration, and of the heart, which sustain organic life, depend less upon the integrity of the brain than upon that of the medulla oblongata, for they are instantaneously arrested by pressure upon, or injury to the latter, while, as we have seen, they may continue for a considerable period after extensive disorganization of the cerebral substance. Whether, in apoplexy and kindred affections, the pressure upon the brain extends ultimately to the medulla by means of serous effusion, or whether there is an indirect functional dependence of the latter organ upon the former, is, perhaps, not well determined. Certain it is, however, that in death commencing with the brain, actual dissolution does not take place until the other two of the triumvirate rulers of life have lost their powers. Respiration first becomes embarrassed through paralysis of the respiratory muscles; asphyxia commences, and as it proceeds, the heart becomes gorged, and at last ceases to pulsate.

Thus, it will be observed, that however the act of death may commence, it has one uniform termination, cessation of the heart's movements. When the starting point of the mortal process is in this organ, the result is generally so immediate, that no perceptible derangement either of the brain or lungs precedes it; in the exceptional cases, those in which the patient has lived for some hours after rupture of the heart, or of the aorta within the pericardium, the embarrassment of the heart, on reaching a certain degree, produces syncope, upon which, of course, death closely follows.

SECTION V.

OF THE SEAT OF DISEASES.

In the remarks offered in a previous chapter, relative to forming a general idea of disease, it was stated, that symptoms are, for the most part, to be regarded as evidences of some alteration of structure, or composition in the solids or fluids of the body, and that, consequently, traces ought to be found of such alteration after death. Although this rational anticipation is not always fulfilled, yet it is so frequently enough to create a class of diseases distinguished by peculiar characters, and to give rise to the division of diseases into local and general, or according to their *seat*. As these, and the most important varieties of each, are apt to be spoken of in very indefinite language, it is proper that their real character should be explained.

Local Diseases.—Local diseases are those which are limited to an organ or its neighbourhood. They may be either *structural* or *functional*. In the former case, their nature is demonstrated by inspection of the altered tissues; in the latter, it is inferred from some perversion of healthy action. Local diseases may also be *external* or *internal*. This division corresponds to that between medical and surgical diseases, and although sufficiently real for all practical purposes, inasmuch as the one class calls for manual interference, and the other is usually treated by the agents of the materia medica, yet the distinction is wholly artificial in a pathological view, for the same vital processes are concerned in both ; and equally so in a logical sense, for it would be impossible to determine exactly at what point the limit between internal and external diseases is to be placed. In which class, for example, should be arranged those affections of the fauces, rectum, and other mucous passages which are near enough to be seen by means of a speculum, or to be reached with the finger ?

Structural diseases are often local in a more restricted sense than in that of being confined to a particular organ. Frequently they involve one only of the elements composing an organ. Thus, the lungs, which are made up of bronchial tubes, air-cells, areolar tissue, blood-vessels, and serous membrane, may be diseased in any one of these textures, to the exclusion of all the rest. The termination of the precise seat of the morbid alteration, belongs to the department of diagnosis, together with the nature, degree, extent, and situation of such alteration. Local affections usually occupy a larger extent during their course than at their origin, and not only involve more and more of the tissue or organ primarily affected, but extend to adjacent tissues and organs, as from a mucous lining to the parenchyma, and thence to the investing serous membrane of an organ. Or, a disease may spread and run its course in the same tissue where it arose, as in the case of erratic erysipelas, and other cutaneous inflammations. Gout and rheumatism, which are sometimes as strictly local diseases as ordinary inflammation, may, nevertheless, as we have seen, change their locality, and fly from one joint to another, or to some internal organ.

A local disease is said to be functional, when inspection of the organ presumed to be affected, reveals no anatomical lesion. This presumption rests upon the accuracy of our physiological knowledge. A function is disordered, and we infer that the organ to which it belongs is diseased, and in the absence of those signs which indicate structural lesions, conclude its derangement to be functional merely. Our ideas of this sort of alteration, as distinguished from that which is physical, are limited almost altogether to the conjecture, that all morbid phenomena not directly traceable to some physical change, are to be referred to derangement of the nervous system, and that not so much because this system is ascertained to be capable of producing the diseases in question, as because vital functions and nervous forces are equally mysterious, and the human mind is prone to attempt the solution of one mystery by means of another equally unfathomable.

In a practical view, nothing can be more fallacious than to refer the whole disease of a patient to the organ whose function is principally disturbed. The several parts of the body are bound together by a principle expressed by the word sympathy, and which often causes one to give evidence of another's disease. Practitioners, misled by this equivocal indication, are very apt to address their remedies to the wrong quarter, and quite overlook the real source of harm. We have seen vomiting in the early months of pregnancy treated by acids and alkalies, and other remedies addressed to some imaginary condition of the stomach, without the physician ever inquiring into the real cause of the complaint. This same symptom, so common at the onset of fevers, afforded one of the grounds of Broussais's hypothesis, that all fevers were inflammations of the stomach, and led to his treatment by leeches to the epigastrium, and gum-water internally. Vomiting, too, when a symptom of cerebral or renal disease is often supposed to proceed from gastric disorder. Strabismus and general convulsions are often attributed to disease of the brain, when they really depend upon the presence of worms, or some other irritant in the bowels. The organ which betrays the symptoms of a disease, has frequently as little to do with originating them, as the wires of the electric telegraph have with the characters inscribed by its register. The active cause of the whole phenomena lies entirely out of sight.

General Diseases.—By general diseases, is meant those which show themselves in various parts of the economy at the same time. The modern investigations of morbid anatomists, by demonstrating that in various affections previously regarded as general, there is a local alteration of structure on which the constitutional symptoms evidently depend, and that in several others there are also local lesions, although not proportionate in degree or extent to the severity of the general symptoms, led to the denial of the existence of diseases whose seat is in no one point, but in the entire system. But closer observation, and particularly the examination of the animal fluids, have had the effect of weakening so exclusive a doctrine; and it is now conceded, that since many diseases run their course, even to a fatal termination, without leaving any trace of local textural lesions, they must, of necessity, be regarded as general.

There are others, again, in which it is true, that local alterations are met with, alterations which may be presumed to occasion some of the symptoms of inferior importance, but not those whose degree expresses the gravity of the affection; in this case, also, it must be inferred that the disease is general. A pertinent illustration is afforded by typhoid fever. When the history of this malady was first perfected by Louis, its symptoms were all attributed to the lesion of the glands of Peyer, which this eminent pathologist demonstrated to be the anatomical character of the disease. This lesion consists first in tumefaction, and then, at a more advanced stage, of ulceration of the glands in question. Now it was observed, that in the very worst examples of the affection, in those which proved fatal early in its course, the glands of Peyer were not ulcerated, but only thickened and hardened, showing plainly that some other cause than the condition of the intestinal follicles, rendered the disease fatal; in other words, that it was a general disease. Yet, so completely had a false doctrine perverted the reasoning powers of medical men, that instead of drawing the obvious conclusion just stated, they debated among themselves what there could be in the swelling and hardness of Peyer's glands, to render this condition of them so much more dangerous than their ulceration. The same partial mode of reasoning has still more lately been employed to explain the salutary action of oil of turpentine in protracted cases of typhoid fever, and as furnishing an indication for the use of nitrate of silver in this disease. These agents have been thought curative by means of their healing influence upon the intestinal ulcers; but if the gravity of the disease bears no proportion to the number, depth, &c. of these ulcers, such an explanation must be rejected as unsound.

What has now been advanced respecting typhoid fever, is equally true of the other fevers, eruptive, remittent, and intermittent. The lesions which constitute their anatomical characters, are not the source of their symptoms; they are, themselves, symptoms of some pervading vice of the economy, which all observation, whether by chemical analysis, or by the study of morbid vital phenomena, tends to prove must be in the blood.

There is another class of general diseases in which the lesions are also general, in one sense, and in another, local; general, because found to a greater or less extent in every part of the body; local, because circumscribed wherever found. Such are tubercle and cancer. Their dissemination, their hereditary transmission, and, in the case of tubercle, the impairment of the general health before any disorganization of the local deposit, prove them to be constitutional diseases. Yet, in these, contrary to what takes place in fevers, the danger arises not from the general morbid state, but from the disorganization of its local products. As long as this process is postponed, the patient enjoys comparatively good health; when once it is established, his life is rarely saved.

The division of diseases into local and general is, as we have seen, founded in nature, yet it is not so absolute as might, perhaps, be inferred from the preceding statements. There is hardly any local affection, however slight, which does not affect the economy to a greater or less extent, either by the pain it causes, or through some other and less evident channel. The wound made in a vein by a lancet, though trifling in itself, may produce inflammation of the lining membrane of the vein; pus may become mingled with the blood, poisoning it, and then giving rise to abscesses in various parts of the body. While these things are taking place, and no local disease except that of the vein is visible, the whole aspect of the patient is that of a person very ill of typhoid fever, and he most generally dies. In this case, it is believed that the influence of the local disease in the production of the general symptoms, can be satisfactorily traced to purulent contamination of the blood, but no such connected series of links is to be found in ordinary inflammations, none, for instance, which will explain the connexion between the local lesions and the general symptoms of pneumonia. To say that the latter are produced by sympathy, is to evade the question, or merely repeat it in another form. The problem to be solved is, how is this sympathy produced? Reserving an expression of opinion upon this point for the next chapter, it is sufficient for our present purpose to note the fact, that the division of diseases just discussed, is based upon the *general* features only of the two classes, and that there is neither any malady which remains local throughout the whole of its course, nor any, however general, which does not exhibit its severity in some organs more than in others. So that we are not, on the one hand, to refrain from using constitutional remedies in apparently local affections, nor to omit the treatment of the organs which especially suffer in the progress of general diseases.

Further evidence that the division in question is, to a certain degree, artificial, may be drawn from the ætiology of the two classes. Ordinary inflammations of the internal organs, of the serous membranes, for example, arise equally from strictly local and from general causes; from wounds or other direct violence, on the one hand, and on the other, from the impression of cold upon the surface of the body. In the former case we are accustomed to regard the disease as local, and with apparently good reason; but in the latter, how is it possible for a cause acting upon the skin to excite disease in the pleura or peritoneum, except through the medium of some general morbid condition? Nor is the fact of such intermediate state a matter of conjecture merely. Even in the inflammations in question, and whether they are excited by direct or indirect influences, there are often premonitory symptoms, such as weakness, loss of appetite, chilliness, &c., before any local uneasiness whatever indicates the organ about to be attacked; symptoms which it would be most irrational to attribute to a local disease not yet in existence. When once the inflammation is set up, its course and phenomena are the same, whether it have arisen from direct injury of the membrane, or from exposure to cold; and if, in the one case, we justly refuse to it the title of a purely local disease, it can have no substantial claim to it in the other.

Again, there are diseases, like gout and rheumatism, in which the ordinary phenomena are to a great degree local, but whose course is sometimes such as to prove that they are, in reality, general maladies. Both are subject to metastases, and that not only from one joint to another, but from the extremities to the heart, brain, or other internal organ; and yet gout, shown in this manner, as well as by other reasons, to be a constitutional affection, is often developed by a cause which has a purely local action, such as straining or bruising the great toe. These facts are pregnant with profitable instruction to the reflecting physician, and cannot be too early nor too deeply impressed upon his mind.

Another peculiarity may be noticed relative to the seat of diseases. Some amongst the local affections possess a sort of morbid symmetry; that is to say, they affect opposite points of the body in a similar manner. Inflammation of the brain, of the eyes, of the tonsils, the lungs, and the kidneys, is very apt to involve both halves of a symmetrical, or both members of a double organ. Organic disease of the same parts is to some, though a less extent, amenable to a similar law. Disease of the ovaries, mammæ, and testicles is, on the other hand, usually confined to one of these organs. Rheumatism and gout very frequently attack corresponding joints upon opposite sides of the body, either simultaneously or successively, and it has been ascertained that certain changes which take place in the arterial tunics, either through inflammation or the progress of age, are to be met with chiefly at similar points of this system. A still more remarkable illustration is furnished by several cutaneous eruptions which, although of limited extent, occupy precisely similar situations on the two sides of the median line, and sometimes assume an identical shape, as that of a circle, or of the letter *ſ* reversed.

Besides the two great classes of diseases now considered, there is still another composed of what are called diseases *of uncertain seat.* It is usual to include under this denomination intermittent fever, gout, rheumatism, the plague, &c., but these, it would seem, are more properly ranked with general diseases, because it is evident that they not only disturb various functions of the economy, but leave behind them tangible and characteristic lesions. We would regard as diseases of uncertain seat those only whose symptoms are confined to derangement of the nervous system, whether of the intellectual or instinctive functions, of sense or sensibility, or of motility; such as insanity, convulsive disorders, and idiopathic paralysis. Not but that some of these affections do sometimes distinctly depend upon alterations of structure; the fact that it is not always possible to distinguish the cases where such alteration exists from such as present no traces of it whatever after death, is sufficient to warrant the statement that their seat is uncertain. Physiology, indeed, informs us that it is in the nervous system, but fails entirely to guide us to the exact point of this complicated and mysterious apparatus, whence the morbid influences emanate.

CHAPTER II.

PATHOGENESIS, OR THE THEORY OF DISEASE.

Every observer of the causes and phenomena of disease is irresistibly led to form some conjecture in regard to what takes place between the action of the one, and the origin of the other; to speculate concerning the part of the system where morbid causes first make their impression, upon the manner in which it is made, and that of its propagation from one point to another. It seems not unreasonable to suppose that if this key to the generation of disease were once possessed it would unfold all the secrets which now baffle the penetration of pathologists, restricted, as they are, to the study of the results of morbid processes; and that it would lead to the discovery of some method of counteracting disease in its formative stage, of destroying it in its very germ. Not less natural was it for the alchymists to suspect that metallic substances having so many qualities in common, might also possess some common quality essential to their existence, by the discovery of which it would become possible to convert the baser metals into gold. But the conjectures, and experiments, and reasonings of the searchers after the proximate causes of disease, though they have never ceased during a period fourfold longer than those of the alchymists, have never yet produced anything more substantial than ingenious fables, which have mischievously drawn off the admiration of medical men from the sober but fruitful truths of nature.

It would be a most unprofitable task, so far as regards the acquisition of pathological knowledge, to present in this place, even a summary of the hypotheses which have, in succession, ruled the medical world. But, since no physician can hope to avoid either forming or adopting some general doctrines of disease, it becomes him to know what has been done in this way already, in order that he may not needlessly cherish notions which have long since been condemned and abandoned by his predecessors. To obtain an acquaintance with the splendid or grotesque monuments of folly, which, under the name of medical theories, stud the pathway of medicine from its origin in Greece to the present day, and which served as temples where successive generations of physicians worshipped, the student must resort to some one of the elaborate histories of our science with which learning has enriched it; in them he will find abundant entertainment, and numberless themes for meditation. But in the present work, nothing more can be attempted than to present a brief sketch of several of the most celebrated and permanent of those theories, and which may be said, to a great extent, to include all the rest.

The first broad distinction of doctrine which strikes the attentive reader of medical history, is that between the materialists and the vitalists. In all ages, a certain number of physicians have regarded the human body as subject to the common laws which govern all forms of matter, and to none others. Hippocrates, adopting the Pythagorean doctrine, that fire is the source of all matter, and that from it were generated earth, air, and water, taught that these elements composed the human body; that by their combination with the four qualities, hot, cold, moist, and dry, they produced the four humours, blood, phlegm, bile, and atrabile,—which, in their turn, gave rise to the four temperaments, the sanguine, phlegmatic, bilious, and nervous, according as either humour happened to be in excess; and that by unnatural combinations with one another, the same humours generated various forms of disease. In this theory, which was for a long time almost universally received, there was no recognition of an immaterial soul, and of its influence upon the body; nor even of that principle of life which is common to all organized creatures, and which distinguishes them so completely from unorganized matter. The putridity of the several humours was held sufficient to account for all general diseases, and their excess in particular parts, for the origin of local affections.

The chemical school of the sixteenth century, of which Paracelsus was the great luminary, undertook to explain all diseases by the effervescence of salts, the combustion of sulphur, and the coagulation of mercury, these minerals being, according to their hypothesis, the primary elements of the body. In the following age, Sylvius and his disciples inculcated a somewhat less rude, but equally material pathology. They believed that all diseases depended either upon an acid or an alkaline acrimony, and that the human body was a mere agglomeration of humours in a state of perpetual fermentation, distillation, effervescence, and precipitation; the result of which processes, when influenced by remote morbid causes, was the generation of acrimonious bile or pancreatic juice, and, through this agency, of disease. As the facts of chemistry accumulated, these doctrines became more or less modified; but we have, in the chemical pathology of the present day, the legitimate offspring and representative of the old system, which degraded the most perfect work of the Creator to the level of a laboratory, with its retorts and furnaces, and the physician to a sort of chemical manipulator, whose sole business was to neutralize, with some product of his own workshop, the imaginary acid or alkali of the human system.

The preceding doctrines were all the expression of a sort of chemical idea, grossly, indeed, conceived by the philosophers of Greece and their imitators, and containing a progressively greater amount of truth, as they underwent the modifying influence of modern chemical science. But there was another purely material medical system of a totally different character. This was called the mathematical. It arose in Italy during the latter half of the seventeenth century. According to this hypothesis, "the body was regarded simply as a machine composed of a certain system of tubes; and calculations were formed of their diameter, of the friction of the fluids in passing along them, of the size of the particles and of the pores, the amount of retardation arising from friction and other mechanical causes, while the doctrines of derivation, revulsion, lentor, obstruction, and resolution, with others of an analogous kind, all founded upon mechanical principles," formed the language of physiologists and pathologists, and to the present hour are in common use under new meanings, and, more frequently, with no definite meaning at all.

The belief in a vital principle as the regulator of healthy and diseased actions, is of comparatively recent introduction into medicine. The ancients had, indeed, some indistinct notion of an immaterial principle resident in the body, and Aristotle went so far as to assign to it three modes of manifestation, to wit, nutrition, sensation, and intellection, which correspond precisely with our modern division of life into organic and animal. But, until near the beginning of the last century, the application of this doctrine to the generation of disease, does not seem to have been completely made. Paracelsus, it is true, had recognised an immaterial power, which presides over the digestion and assimilation of food; and Van Helmont attributed to an analogous influence, to which he gave the same name, *archæus*, a control over all the acts of life. This power, which he enthroned in the stomach, he represents as the governor or prince of numerous subordinate *archæi*, residing in the several organs; but he does not well distinguish it or them from that independent spirit which is now called the soul. Both of these physicians, however, considered the proximate cause of disease to consist in some fermentation, or other mechanical change in the fluids of the economy. Stahl, on the other hand, rejected *all* chemical and mechanical reasoning, as inapplicable to vital phenomena, and adopted as their source, a principle which he called *anima*, a term which he, on some occasions, employs in the sense of the rational soul, and on others, in that of the principle of life. According to him, the phenomena of disease are the evidences of a struggle between morbific causes and this *anima*, which thus becomes nearly identical with what the ancients, as well as physicians of the present day, call nature, or the *vis medicatrix naturæ.*

This doctrine, so much more acceptable to Christian faith, than the cold materialism of preceding philosophers, soon became the leading feature in contemporaneous and succeeding systems, and in spite of the flood of infidelity which swept over Christendom during the last and the present century, it has never ceased to exert its influence upon medical doctrine. Hoffman, who was a colleague of Stahl, proved that many of the attributes of the *anima* were in reality functions of the nervous system, and Boerhaave, the modern Galen, while he retained many of the views of the chemical and mathematical schools, adopted also a large portion of the animist creed. His illustrious pupil, Haller, advanced one step farther, and attempted to generalize the phenomena of vitality by referring them all to contractility and sensibility, the latter of which he conceived to belong to the nervous system only, and the former to the muscles. Finally, the vitalist doctrine received its greatest extension in our own time from the celebrated Bichat, who, by a minuter analysis of vital phenomena than had hitherto been attempted, referred them to five distinct properties, which he denominated, animal sensibility, organic sensibility, animal contractility, sensible organic contractility, and insensible organic contractility. In these several systems, which, it will be observed, were little more than successive expansions of that of Stahl, the nervous system was regarded, either as receiving the first impression of morbific causes, or as the medium through which that impression was conveyed from one point to another of the body.

As the two great doctrines of materialism and vitalism led to the explanation of the origin of disease, by referring it, on the one hand, to purely physical, and on the other, to exclusively vital agencies, so the division of the body into fluids and solids gave rise to the two opposite theories, one of which placed the source of all diseases in the fluids, and the other in the solids of the economy. A belief in either of these theories is equally consistent with the doctrines of the materialists and vitalists; for it is evident that whether we hold that the functions of the human body are regulated by chemical, mechanical, or vital laws, we may equally well conceive the departure from these laws, which constitutes disease, to originate either in the solids or the fluids. Hence we find amongst both materialists and vitalists, disciples of the humoral, as well as of the solidist school of pathology.

The humoral pathology, in some form or another, has been every where, and in all ages, dominant in the medical world, if we except the last century and a half, during which the theory of solidism has held a sway, which is fast declining before the discoveries of the chemical pathologists. This latter theory adopting Haller's forces, sensibility and contractility, as the only ones necessary to life, of course denies them to the fluids of the economy, and, by a legitimate deduction from a false premise, concludes that the solids alone can receive or manifest the impressions of morbid causes. All general diseases, or general symptoms arising from local causes, the partisans of this theory attribute to sympathy, an hypothesis convenient for explaining everything, which the system, without it, would leave unintelligible, and which has perhaps done more to postpone the discovery of the laws of morbid phenomena, to encourage mental apathy by seeming to solve all difficulties, and to give more authority to ingenious expounders of a dogma than to laborious searchers after truth, than any other notion which was ever invented by medical philosophers. The solidist doctrine has been well described by Sprengel in the following passage:

"Crises and metastases, which were regarded by the humoralists as peculiarly confirmative of their belief, were pressed into the service of the opposite school. How, say the solidists, can the evacuation of a little blood, urine, fæces, or sweat, explain the establishment of health? for the presence of these substances in the system is incapable of deranging it. There is a transference of action, of irritation, and not of a substance; and the former, they gravely assert, nature is much better able to transfer than the latter. . . . To prove that irritation only is transferred, they cite the numerous instances of crisis and metastasis, which consist only of a change in the seat of pain, or in some other nervous phenomenon. And where there is an afflux of a liquid towards an organ, they insist that this liquid may be of various kinds, and that the only constant phenomenon is that irritation which precedes the afflux, as is shown by itching, pain, heat, &c. All changes of the fluids found after death, or noticed during life, they regard as secondary, and appeal to the more constant alterations of the solids, revealed by dissection, to sustain their doctrine. In the same way they allege that all the symptoms of disease being only so many alterations of functions, must proceed immediately from the solids, because functions are merely the actions of organs which are of course solids."

According to the humoral doctrine, on the other hand, the origin and essence of disease resides in the fluids. "Disease," said Sydenham, "is an effort of nature to expel from the economy a morbific matter. Man, exposed to a variety of external influences is subject to diseases arising from the introduction and admixture with the fluids of noxious particles which diffuse their morbid influence over the whole system by means of the blood, and also to various fermentations, and even to putrefaction, of the humours when they remain too long in the body, and can neither be assimilated nor excreted. The peccant and foreign matter thus generated, and which would otherwise destroy the whole machine, nature has adopted a method of eliminating by means of a series of acts which we call symptoms." According to this doctrine, the process in question consisted of a peculiar elaboration, or *coction*, by virtue of which the noxious particles become capable of assimilation, or else are evacuated by some one of the emunctories, thus forming a crisis.

In the midst of these various theories of the origin of disease, the rational inquirer must be seriously embarrassed, if called upon to adopt some one of them exclusively; but if he has taken as his guide the rule of incorporating nothing into his scientific creed, but what results from a strict induction of facts, his perplexity need not be prolonged. He will then find that each theory rests upon a certain number of truths, but none upon a sufficient number to give it stability. He must speedily recognise the fact that a large number of the phenomena of life are explicable by chemical laws, and by them only, but that, at the same time, these laws are maintained in operation by the superintendence of vitality, a power which thus not only sustains them, but also upon certain occasions subverts them. He must also perceive that some functions are performed according to purely mechanical laws, but that their moving power is the principle of life, a force possessed of attributes different from those of gravity, elasticity, and the other mechanical powers. He must admit that, in some diseases, the starting point is in the solids, as where they are injured by violence; but he must, at the same time, acknowledge that not a few maladies called general, are directly owing to the introduction of some foreign matter into the blood-vessels, and do therefore originate in the fluids. He cannot deny that, even in the first-mentioned case, the blood speedily undergoes an alteration which is proportioned to the local hurt, and must, with better reason, be accepted as the cause of the general symptoms, than the local lesion itself; and that in the second case the original alteration of the fluids is usually followed by a more or less general change of structure in the solids. Finally, he cannot refuse to believe, that some affections commence by an impression upon the mind, the senses, or the general sensibility; but that amongst all of these, scarcely one remains confined to the system where it originated, but sooner or later implicates the rest. In a word, he beholds in man, a machine indeed, but one composed of various materials, which unlike those of other machines, are perpetually acting and reacting on one another; not only an aggregate of reacting elements, but one endowed with life, a power to which the ordinary laws of those elements are wholly subordinated, and whose own mode of being and laws are wrapped in profound mystery; not only a living animal, but a rational one, possessed of a soul, which, with peculiar faculties and susceptibilities, is capable of modifying the usual succession of phenomena resulting from the co-operation or conflict of the chemical, mechanical, and vital laws which govern the merely animal portion of the creature.

CHAPTER III.

GENERAL NOSOLOGY.

In a former chapter the general idea of disease was explained, and the existence of separate diseases pointed out. The latter, as might be expected from the uniformity of the morbid causes acting upon the human organism, and the permanent condition of that organism in the human individual and species, possess many points common to all of them, and at the same time many which are peculiar to a certain number only. It results from universal observation that while the same disease is never found to affect two persons in precisely the same manner, yet that different diseases often display so close a resemblance in certain particulars, as to prove their natural relationship to one another, and to force one to think of them as belonging to the same family. This circumstance has led to various attempts to classify diseases according to their natural resemblances, just as has been done for plants and minerals by botanists and mineralogists. Now it is evident that the principles upon which such a classification may be based are very numerous, as numerous, in fact, as the sorts of resemblance borne by diseases to one another. So in botany there are two perfectly distinct systems according to which plants may be classified; the one derived from the number of pistils and stamens in the several flowers, and the other founded upon the aggregate of the physical qualities of individual plants. It is evident, also, that since the object of all natural science is utility, that arrangement of plants, minerals, or diseases, which regards the relations in which they stand to mankind, must be the most useful and the best.

Anciently diseases were divided into acute and chronic only, but each of these two classes contained a great number of maladies having little or no analogy with one another. The same remark may be made of another division, that into medical and surgical diseases. It was not until 1763 that the first systematic classification of diseases, or nosological system, was published by Sauvages, of Montpellier, a system which formed the basis of those of Cullen and Pinel, the former of which appeared in 1775, and the latter in 1798. The nomenclature of diseases established by these writers is now so thoroughly interwoven with medical language and literature as to require at least a passing notice in a work like the present.

In each of the systems just alluded to there was a class of *fevers*, or *pyrexiæ*, which, according to Pinel and the prevalent doctrine of the present day, includes all the forms of acute disease attended with frequency of the pulse, heat of skin, and derangement of the functions, without local lesion sufficient to account for these symptoms. The different forms of continued, remittent, intermittent, typhus, bilious, and yellow fever, belong to this class. The next is the *phlegmasiæ*, or *inflammations*, comprehending all affections characterized by local pain, heat, and redness, with or without fever, and whether internal or external. Then follow *hemorrhages;* and then *neuroses*, or disorders in which the functions of the entire nervous system, or of the nervous element of particular organs, are deranged. In the class of neuroses are included all disorders of intellection, sensation, and motion, and all deviation from the normal action of an organ not dependent upon structural lesions. Finally, according to the system of Pinel, there is another class, which contains all organic diseases, whether these result from inflammation, from local and accidental injury, or from some pervading vice of the constitution. Those arising from the last-mentioned cause have so close a resemblance to one another, as to call for their being arranged in a separate class, as was done by Sauvages and Cullen, under the name of *cachexiæ*. The various forms of chronic tubercular disease, phthisis, marasmus, scrofula, rickets, with scurvy, the advanced stages of constitutional syphilis, and cancer are comprised in this class.

The advantages of some nosological arrangement are manifold. It lightens the labour of the teacher, as well as of the student of medicine, by enabling the former to illustrate his descriptions of any disease by comparing it with others of the same natural family, and by affording to the latter numerous points upon which his memory can fix itself, and which thus recall to his mind the image, not of one disease only, but of all those which he has been accustomed to see associated with it in the lessons of his instructor. It inspires both with a desire to know more intimately, the analogies which bind together different morbid states, and thus leads to a more minute and accurate observation of the phenomena of disease. It also renders valuable assistance in therapeutics; for it suggests, that in affections not before treated, the physician should apply a treatment similar to that which he has found available in others of the same nosological class. It is, in a word, the fruitful source of many of those discoveries in pathology, and improvements in the cure of diseases, which arise out of the perception of their analogies, a perception which would be far less frequent and distinct, were it not for some such arrangement as that in question.

Yet, it should not be forgotten, that every nosological system is, to a great extent, artificial; and that it is rather an instrument for discovering truth, than in itself an expression of truth. None that has ever yet been devised, and it may safely be asserted, none yet to be invented, can so arrange diseases, that all shall be included in perfectly distinct groups. Some will be found which have an equally close relationship with several classes, and cannot, therefore, be included in a particular one, without a violation of the first principles upon which the classification is formed. "The different parts of the body," says Chomel, "are subject to very numerous maladies, some of which are common to them all; as for example, inflammation, organic diseases, atrophy, hypertrophy, alterations of secretion and innervation, and the results of chemical or mechanical injuries. Others are peculiar to certain organs, depending upon their very structure, and have, with diseases of other parts, only a remote analogy, if any. Amongst the latter may be mentioned the various cutaneous eruptions, aphthous and diphtheritic affections, rheumatism, emphysema, rachitis, invagination, varices, aneurisms, calculous disorders, and some in which the fluids are primitively deranged, as anæmia, diabetes, &c., all of which diseases are as different from one another, as the structure or composition of the solids or fluids where they have their seat, and cannot be made to enter into our classifications, which, on the other hand, are profitably applied to disorders which may affect all parts of the economy."

While these circumstances, with those previously mentioned, are carefully borne in mind, it will be seen that they do not, in any wise, militate against the utility of nosological systems, but ought merely to prevent that blind reliance upon them, which an irrational confidence in the authority of their inventors has, sometimes, inspired. With the progress of pathological knowledge, diseases which have, from some striking analogies, been placed in a certain class, have, by the discovery of some more important relationship, been transferred to another class, and thus, every system must be regarded as approximative only, to reality, and but temporary in its completeness. Still, the classes themselves may, perhaps, remain permanent, because each contains a certain number of diseases well understood, strongly marked, and linked together by unequivocal affinities. This point has been admirably illustrated by our philosophical countryman, Dr. Bartlett, from whom we borrow this concluding passage:

"Nearly all diseases will be found to dispose themselves, at different distances, in what may be called *natural*, or *family* groups, round certain common centres, each centre, or the circle nearest to it, being occupied by one or more of the type species of the family to which it belongs. As the affinities between these *type species* and other diseases, diminish in number and importance, the latter will recede farther and farther from the neighbourhood of the former, until they finally fall without the extreme boundary-line which circumscribes the class, and are carried, by new affinities, within the limits of some other family. The affinities which determine these arrangements, constituting the attractive principle, in virtue of which, the individual members of each group find their appropriate positions, will consist in *all* the phenomena and relationships of the several diseases, and not in any limited or arbitrarily chosen portion of them; those which are most constant, characteristic, and essential, exerting the strongest power. Each class or family thus constituted, will be natural and perfect, just in proportion to the number and importance of the affinities which bind its several members together."

CHAPTER IV.

DIAGNOSIS.

EVERY case of disease presents to the physician two grand problems to be resolved: 1st, to discover its nature, and 2d, to devise its cure. The department of medicine which relates to the former, is called *diagnosis*. This term, derived from the Greek δια, γινωσκω, implies a knowledge of differences; of those, namely, which distinguish the affection from all others; a knowledge, therefore, of the disease examined, as well as of those with which it may be confounded. Diagnosis lies at the very foundation of the practice of medicine; for it is not possible to discourse about a disease, nor even to conceive an idea of it, without knowing in what it consists, nor to be sure that the remedies applied to remove it are appropriate, without being able to distinguish it from all others which it resembles; nor yet, to be able to prognosticate its course and termination, without an acquaintance with its normal course, its most frequent deviations from that course, the complications to which it is liable, and the modifications of character which various accidental influences may impose upon it. To diagnosticate diseases, —to separate them from one another according to their peculiarities,—presupposes such a critical knowledge of them, as only can be obtained by making them the subjects of repeated and accurate observation. To this process two parties exist,—the physician and the patient; that it may result profitably, the former must be qualified for his duty, and the latter be in a condition to render his assistance. We propose to discuss, as briefly as possible, the several points involved in the important relation between the physician and the patient, so far as it has for its object the elucidation of the history of disease.

SECTION I.

THE QUALIFICATIONS OF A MEDICAL OBSERVER.

Strange as it may seem, the fact is perfectly demonstrable, that good observers are quite as rare as good reasoners. In science, as in religion, there are many " who having eyes, see not, and having ears, hear not." From the beginning of time to the present day, the same material phenomena have been presented to the senses, but in medicine, with comparatively little profit, until a recent date. This stationary, or even retrograde condition of medicine, is attributable, as was explained in the Introductory Essay, to erroneous views entertained respecting science in general, and particularly medical science. An inferior value has been attached to observation, as a means of discovering truth ; and, consequently, the partial observations actually made, were generally conducted without method, and in a spirit wholly opposed to sound philosophy. It was reserved to modern times to lay anew, and with imperishable materials, the foundations of medical science, and if the labourers in this work have frequently employed the stones belonging to the old edifice, they have dressed them over again,—laid them with a more accurate line and rule, and united them with a far stronger cement.

But while the mechanical part of observation is, to a considerable extent, a matter of method and training, and is that in which later observers have principally excelled, it is not to be overlooked, that a sound and liberal education is the best introduction to the exercise of this art. This should include, if possible, an acquaintance with the Latin and Greek languages, especially the former, since it furnishes versions of most of the Greek medical writings, besides containing a fund of scientific treasure, which has never been converted into any of the idioms now spoken. How large this collection is, may be inferred from the fact, that until within one hundred and fifty years, almost the entire literature of our science was preserved in the Latin and Greek tongues, and that even during the last century, many medical works of great value were published in Latin, and remain untranslated to this day. An acquaintance with modern languages is even more essential to the object in question, which is not the mere acquisition of a right to the title of learned,—for however respectable this name, it cannot enhance the dignity of that which belongs to the successful observer of Nature's laws,—but a knowledge of what is already known, or believed to be so, and which will serve as a guide towards paths which lead to truth, and away from those which conduct to error. By such preparatory studies, the investigator learns the methods pursued by his predecessors,—perceives their defects and advantages, and corrects the former, while he enhances the latter.

It is not the treatises on medical theories, which it is intended to recommend to the diligent perusal of the medical investigator, but chiefly those which profess to describe disease, or to state general propositions in the form of aphorisms. It is true, that until the time of Morgagni, cases of disease were recorded with such meagreness of detail, that little use can be made of them by way of comparison with cases observed according to the minute and methodical system now pursued. Writers contented themselves with giving in a few bold touches of the pencil, such an outline picture of a malady as was just sufficient to insure its recognition, leaving out all those details which would have enabled us, even at this distance of time, to examine their cases from other points of view than those assumed by themselves. The study of such collections of cases as are contained in the works of Morgagni, Andral, Louis, and Abercrombie, is one of the best preparations for the personal observation of disease, and, if profound and meditative, it will stand in the stead of no small amount of actual experience. The advantages of following the clinical instruction of such a teacher as either of these enlightened pathologists, must, of course, be much greater than are afforded by the perusal of books alone. If practicable, both methods should be adopted, for they will be found to afford mutual illustration; but no one who has not made the experiment, can form an adequate idea of the knowledge to be acquired by the analytical study of a series of well-recorded cases. The most diligent and attentive perusal of a general treatise, however well written, cannot furnish one-half the pleasure, nor a tithe of the profit that may be derived from this exercise.

The acquirements and preparation mentioned in a preceding paragraph are the more strongly insisted upon, because very generally neglected in this country, where the art of observing is ignorantly supposed to consist in a mere passive experience; although every one knows that there are members of the medical, as well as of other professions, whose experience does not increase their knowledge, because they lack certain original or acquired powers, which others possess.

It is taken for granted that every physician comes to the active duties of his profession with a thorough understanding of anatomy, physiology and pathology in all its branches, and a competent acquaintance with the physical methods of exploration, and chemistry. No pains need be taken to prove that these branches are quite indispensable. Whoever hopes to observe disease profitably, without such aids, will be most painfully disappointed.

In addition to such preparatory training, it is essential to correct observation that the physician be without prejudice or prepossession; that he abandon every hypothesis, however respectable for its antiquity, or dazzling and attractive in its novelty; that he shall be willing, for the time, to lay aside the pride of reason; to forget the conflicts that are going on in the scientific world; to bury all enmities, except his hatred of error; and to employ all his faculties in discovering and recording the phenomena of disease. But to these negative qualifications he must add much positive preparation. Much of the information he is in search of, is to be acquired by means of the senses; and these must be educated. Sometimes, it is true, no education can overcome certain natural or accidental defects; the near-sighted are of secondary authority in all subjects to be investigated by the eye, except where the microscope is employed; the partially deaf can never become good auscultators, &c. This is self-evident. But there are other minor defects which render a cultivation of the senses almost fruitless, defects of which the subject of them is not always conscious, or of which self-love would dissuade him from admitting the existence. Many persons can form no accurate estimate of size, especially of relative size, or of symmetry, and thus fail to perceive very considerable distortions. Others have but little perception of shades of colour, and are quite unfit for describing the details of morbid anatomy; and others, without being dull of hearing, have so little ability to distinguish sounds from one another, that they profit nothing by the lessons of the most accomplished auscultator.

A medical observer, then, should have all his senses perfect, and have so exercised them as to be sure of their accuracy, and also of their defects, if they have any, in order that he may know not only in what respects their testimony is trustworthy, but in what others it should be received with hesitation. This, of course, demands a degree of moral courage greater than falls to the lot of every man. Yet it is, comparatively speaking, a small trial to the sincere and honest investigator of the works of nature; for his only object is the discovery of truth, and his errors can therefore never be voluntary. To cling to one of them, or seem to do so, would be contradicting the whole tenor of his principles and conduct; it would be setting up an obstacle in the very path he is striving to make plain.

The observer must not only be willing to relinquish error, but must exercise that caution and patience which are best adapted to prevent his falling into it. The process he is compelled to adopt is a long and tedious one, beset with many difficulties, and prolific in disappointments; he is but too often tempted to abandon it, and follow out some one of those short cuts to knowledge, with which metaphysical subtlety, the dreams of genius, or the frauds of charlatanism, have in all ages deluded the indolent and unwary; but he is cheered by the conviction that nature is consistent in her operations, and that however obscure they may at first seem, the study of them will infallibly conduct to nature's laws.

The physician, thus fortified by knowledge and principle, when he undertakes the investigation of a case of disease, enjoys a great advantage over one whose mind is preoccupied by a theory, and who is more faithful and ingenious in defending it, than in searching after truth. If his object were to distinguish himself by the brilliancy of his speculations, his proper place would be in the closet, and not at the bedside of the sick; but as he aspires to the higher glory of interpreting the laws of nature, he feels that her secrets are to be detected only where she is in action; he watches and records her operations patiently and laboriously, and feels sure that an ample reward will ultimately crown his toil.

Besides these intellectual and scientific qualifications, the physician should also be endowed with a spirit of gentleness and kindness, with such dignity of manner as will insure the confidence and respect of his patient, and lead to a full and candid disclosure of all the particulars of the case. Whatever interest he may take in it as a matter of science, he should impress the subject of his care with the conviction that he feels for him the sympathy of a man. Especially must the young practitioner, and the physician of public institutions, be careful to cultivate this feeling: both are too apt to forget that the poverty, the stupidity, the obstinacy, the ingratitude, and to some extent, even the vicious habits of their patients, are more frequently misfortunes than crimes, and that however annoying or revolting in themselves, they cannot absolve him from the obligation of showing kindness to those under his care; for an act of beneficence is never so meritorious as when conferred upon those who are not in a situation to command it.

SECTION II.

THE MODE OF INVESTIGATING A CASE OF DISEASE.

The study of a case of disease comprises the inspection and the interrogation of the patient. The first of these is performed by the physician alone, and comprehends a minute survey of all the external physical characters of the patient, his height, size, colour, and expression; the warmth, sensibility, and motility of the different parts; his posture, peculiarities of formation, &c. The second requires the concurrence of the patient, (who may be more or less capable of giving an intelligible account of himself,) or the information furnished by his family or attendants, must be accepted in its stead. Medical questioning is a difficult art, as much, if not more so, than that test of legal dexterity, cross-questioning. The object of the latter is to elicit answers favourable to an assumed view of a case, but of the former to learn as accurately as possible the naked truth. Its only aim should be to obtain a complete history of the case from the date of the first deviation from health, up to that of the examination ; to learn what has actually occurred, and not what the physician conjectures *ought* to have happened. A long experience and the closest attention are requisite, in order that nothing essential may be omitted, that answers may not be suggested by leading questions, and that those given at random, and out of weariness, be not mistaken for accurate and candid statements.

If the patient be intelligent, he will often be able to furnish a clear and detailed narrative of his illness, and in that case the physician has little to do but to listen patiently, and afterwards inquire about such points as have been omitted. More commonly, however, it is necessary to propound questions, and obtain an answer to each in succession.

The first question should relate to the commencement of the attack, and tend to fix the date of the earliest symptom as accurately as possible. If the patient be left to do this, he will usually assign the first decided change, such as a chill, a fit of vomiting, of epistaxis, &c., as the starting-point of the malady ; but in nearly every instance, it will be found that other less palpable symptoms preceded these ; that there was debility, languor, loss of appetite, or restless sleep for several days previously.

He will also, very probably, be inexact in naming the day on which he was taken sick, unless the physician happen to see him immediately upon the appearance of the first symptoms. Hence, it is well not only to inquire on what day he was attacked, and how long he has been ill, but whether on such or such a day immediately preceding the one mentioned by him, he attended to his ordinary business, and if not, what was the last occasion of his attending to it. In this manner, the events of each succeeding day, or week, according to the duration of the disease, should be recalled, including the disorders of each function in its turn; besides which, all possible information should be procured, relative to the hereditary tendencies of the patient, his previous diseases, and his state of health and habits for some time immediately preceding the last attack. These circumstances once definitely ascertained, the physician knows upon what ground he is walking; he feels as if his patient had all along been under his own supervision, and he enters with alacrity and confidence upon the investigation of the disease he is presently to treat.

In order to be useful, this investigation must be conducted methodically. There is a faculty called *tact*, which appears to be almost an intuitive perception of the nature of a patient's disease, like that singular power by which some individuals arrive at the solution of complicated arithmetical problems, without following the rules which other men must employ to obtain the same result. It is a quality which physicians of large experience sometimes possess in astonishing perfection, and which, like judgment and common sense, is a natural gift, but like them, also, susceptible of high cultivation. However valuable to its possessor this faculty may be, it is still liable to great abuse, for it encourages a neglect of the ordinary modes of reaching conclusions, and is too apt to be relied upon as an unerring guide, which it is far from being, even in the most remarkable examples of its development. Being, from its very nature, incommunicable, it can never be regarded as a means of scientific inquiry, but only as a powerful helper to those men of science who are so fortunate as to be endowed with it. If, then, some physicians, by the aid of this sixth sense, have been able to perceive relations among symptoms, and to predict the results of disease, without the necessity of resorting to tedious and laborious investigation, it does not by any means follow, that such circuitous methods ought to be neglected. They are the only ones by means of which scientific truths can be proven, or communicated to another person, or kept on record for the instruction of posterity.

After having learned the history of a medical case from its origin up to the moment of examination, the actual condition of the patient is next to be inquired into. The first question should be directed to ascertain the seat of his suffering. In local diseases, this will usually be the region of the affected organ. In fevers, and other general diseases, the most painful part is often that in which there is the greatest danger of local complication. All of the symptoms furnished by the affected part are first to be noted, and then each system, and its functions, claim attention in their turn; but all the particulars relating to each should be exhausted, before entering upon the examination of another system or apparatus, so that no details of importance may be overlooked.

The following table of the points to be noted in every thorough examination of a medical case, will be found useful as a guide. Indeed, without some such provision against repetitions and omissions, it is difficult, if not impossible, to obtain a satisfactory result.

A. *Preliminary Inquiries.*

a.	Age.	Profession, and social condition.
	Sex.	Habits of living.
	Temperament.	Diseases of Parents Relations and Children.
	Constitution.	
	Idiosyncrasies.	Previous diseases.
b.	The probable or attributed cause of the illness.	
	The mode and period of the attack.	
	Premonitory symptoms present or absent.	
	The course of the disease.	
	The previous treatment.	

B. *The present condition of the Patient.*

a. The Exterior.	General appearance.	
	Colour of the skin and complexion.	
	Expression.	
	Degree of muscular development.	
	Decubitus.	
b. The Muscular System.	Strength.	Voice.
	Movements.	Convulsions.
	Paralysis.	Spasms.

c. The Nervous System.	General and special sensibility.	Pain, its characters and intensity.
		State of all the senses.
	The Intellect.	Activity.
		Delirium.
		Illusions and hallucinations.
		Coma.
	Sleep.	Duration.
		Dreams.

d. The Digestive Apparatus.	Appetite.	Degree. Perversions. Thirst.	
	The Tongue.	Size and shape. Colour. Coat. Moisture.	
	Salivation, Mastication, Deglutition.		
	Abdomen.	Nausea. Vomiting. Pain. Sensibility on pressure. Stools, { Their frequency, quality, &c. Piles.	Matters vomited. Size of abdomen. Tumours. Effusion. Dimensions, &c., of liver, spleen, kidneys, and bladder.
e. Respiratory Organs.	The signs revealed by	Inspection. Mensuration. Auscultation. Percussion.	
f. Circulatory Organs.	The Heart. . .	Physical examination.	
	The Arteries. .	Pulse. Sounds.	
	The Veins. . .	Development. Murmurs.	
g. The Skin.	Colour. Dryness, Temperature. Sensibility. Eruptions.		
h. The Excretions.	Perspiration. Sputa. Urine. Fæces. Menstrual fluid.	Inquire, where appropriate, into their Quantity, Colour, Peculiarities of form, Consistence, Specific gravity, Mixture, Odour, Taste, and Reaction with chemical tests.	

In conferences with the sick, the plainest language should be employed, to the complete exclusion of all technical terms; to use the latter, is a miserable affectation, of which few are guilty besides those who think it of more consequence, by sounding phrases to gain a reputation for wisdom, than to deserve it by a profound study of disease. It sometimes happens that a patient, in replying to learned questions which he does not understand, in emulation of his interrogator makes use of words absolutely without meaning, and thus the whole inquisition becomes supremely ridiculous. It is often quite impossible to extract a sensible answer from an uneducated man, unless he feels at liberty to employ the idiom he is most accustomed to. A physician has to learn by experience, the meaning of many strange expressions used by the vulgar, and especially by foreigners, for in these terms alone is the patient able to communicate an idea of his sensations.

It happens, now and then, that after a close examination of a patient in a military hospital, or almshouse, the physician cannot discover with what disease he is affected, for the reason that he is feigning disease to avoid duty, to obtain privileges, or excite compassion and charity. Impostors of this sort are careful to represent affections to whose symptoms physical tests cannot be applied. Convulsive and other functional disorders are their ordinary models. "To detect the knavery of such persons," says M. Rostan, "a dexterous physician may employ various methods. After ascertaining that the apparent disease is capable of being simulated, and how far it is so, he should endeavour to learn what motives the patient may have for playing such a part. His intelligence should be gauged, and the accordance of the disease with the age, sex, habits, condition, &c., of the patient examined. But the chief dependence must be upon well-directed questions, for the impostor is rarely so familiar with the symptoms of his assumed malady, as not to betray himself, when asked if he does not feel certain symptoms foreign to his case, or to contradict himself when questioned at different times, regarding the course of his disease. His embarrassment is likely to be much increased, when he is catechised respecting the causes of his sickness, and the remedies he has employed. However, he must be closely, but secretly watched. Perhaps, the strongest light is thrown upon these cases by an examination of the involuntary functions. In diseases in which the pulse ought to be affected, (and there are few which do not affect it,) its condition will often lead at once to a detection of the imposture."

If the entire history of a case cannot be obtained at a single visit, and especially if the patient betray signs of weariness, it is better to postpone further inquiries until the following day. Much harm may be done by an untimely, or a protracted examination.

The young practitioner should be forewarned, that there are many persons, even amongst the educated classes, who grow very restive and impatient under the examination which is here insisted upon; for, they cannot comprehend why so close a scrutiny should be necessary, when certain popular practitioners form their opinion from little more than inspecting the tongue and feeling the pulse. They imagine, and not without some plausibility, that the ignorance of the physician must be proportioned to the number of inquiries he makes; they conceive that it is his business to inform them, and not they him. Nothing is so mortifying to a just pride, as depreciation of the very qualities or attainments on which a claim to merit is founded, and every one who addresses himself to the arduous task of investigating disease, must expect such mortification in the early part of his career. But if he wisely prefers being thought incompetent, to being really so, he will rarely fail in overcoming prejudice at last, and of receiving the applause to which he is justly entitled.

It is not pretended that every case should be subjected to rigid analysis; there are many which demand no such process that they may be prescribed for intelligently. Our remarks refer principally to those which are somewhat obscure, and especially to all which are intended to be recorded. The state of the patient, also, frequently requires that the examination should be as brief as possible, leaving, for the time at least, many things to be conjectured; for his suffering may call for instant relief, or his exhaustion be so great as to demand almost undisturbed repose. These are plainly exceptional cases. There are others of a different sort. Thus delicacy prohibits a very free and direct mode of inquiry in regard to many diseases of females, and especially those of an age which should be preserved unsullied by the slightest breath of impurity. In such cases all communications should be made through an elderly person of the same sex, the mother, or some near relative of the patient; and even in the lower walks of life, questions in regard to the sexual disorders of the female, should, as far as possible, be addressed in the presence of a third person. On the other hand, a physician has no right to insist upon the proofs of a well-marked venereal affection in the presence of persons from whom every motive of honour and humanity would prompt its concealment; nor should this proof be exacted, even from the patient himself, when he seems unwilling to admit its reality, or appears pained on account of the suspicion. It is no excuse for the infringement of such rules, that there have been some practitioners, of distinction too, who have habitually disregarded observances which were too delicate for their gross powers of appreciation.

In cases of extreme gravity, certain questions are liable to excite the apprehensions of the patient and hasten the fatal result of his disease, even if they do not sometimes turn the balance against him. The implicit confidence of a patient in his physician is certainly a tribute to be coveted by every man of feeling, but is one susceptible of the most cruel abuse. The slightest word of encouragement will sometimes arouse the energies, and cheer the drooping spirits of the sick; hence every remark or question which even insinuates the incurable nature of the patient's malady, should be so indirectly made, and so carefully guarded, as to excite neither suspicion nor dread. For a like reason, it is generally prudent to decline examining by percussion the chest of a professional brother, for his ear will assuredly detect, or seem to perceive, shades of difference in the sounds of the two sides, which entirely elude the hearing of the operator, and to which the patient will attach an importance they do not deserve. It need hardly be added to the cautions that have now been given, that no zeal in the cause of science will palliate or excuse the needless exposure or fatigue of a patient during an examination of the chest, or any other manipulation, the rude or repeated handling of painful parts, or laying the cold hand upon the abdomen or other sensitive portion of the body.*

* The last-mentioned offence against propriety is not one of modern origin. It was severely satirized by Martial in an epigram upon his physician:

SECTION III.

THE MODE OF RECORDING AND GENERALIZING MEDICAL CASES.

The study of disease, pursued in the manner of which an outline has been given in the preceding sections, cannot fail to confer scientific knowledge and practical skill; but to be rendered in the highest degree available, both for the individual observer and the medical profession at large, it must be supported by extensive and accurate records of medical cases. The main principles on which this necessity rests have been sufficiently elucidated in the introductory portion of the present work; on the present occasion reference will be chiefly made to the method of noting individual cases, and that of extracting from them general truths.

The value of a written case depends altogether upon its being an exact transcript of nature, not merely of the more striking phenomena presented to the observer, but of all which are brought to light by the interrogatory above proposed, and chronicled as nearly as possible in the order in which they occurred. In acute diseases the record should be made twice a day, and on both occasions the symptoms noted in precisely the same order, so that in making the subsequent analysis, each may be found without difficulty, and none omitted by the observer. For this purpose, it is convenient to adopt a uniform order in noting the condition of the several functions and organs. In chronic diseases such frequent records are unnecessary; and, indeed, whatever may be the form

Languebam; sed tu comitatus protinus ad me
Venisti centum, Simmache, discipulis:
Centum me tetigere manus aquilone gelatæ;
Non habui febrem; Simmache, nunc habeo.

I sickened, Simmachus; to my house you fly
And bring a hundred students: each in turn
With ice-cold hand on me his touch must try:
Till then I had no fever, now I burn.

of the affection, the degree of their frequency must be measured by the steadiness or variableness of the symptoms. In addition to symptoms, properly so called, must be noted all those circumstances connected with the origin of the disease, the age, sex, social condition, habits, constitution, &c., of the patient which have been enumerated as subjects for examination, as well as the issue of the attack, and if fatal, the results of the dissection.

After having collected according to this plan a large number of cases of a given disease, the most important part of the work still remains to be done. The materials out of which the edifice is to be built are indeed obtained. but how to use them for this purpose remains to be learned. Not many years have elapsed since medical philosophers were unable to give any rule for proceeding further; they could only say that facts were to be generalized by reasoning, but did not teach in what manner reasoning was to be applied to facts in order to elicit truth. While they felt that but one conclusion could be legitimately drawn from a given series of facts, they plainly saw that different reasoners would deduce from it conflicting inferences.

M. Louis was the first to solve the difficulty. Recognising the force of Rousseau's sentiment, already quoted, that truth is in things, and not in him who observes them, he perceived that the first step towards discovering medical truths was the collection of medical facts. Having gathered these he proceeded to extract the truth from them. Taking a large number of cases of a disease, he dissected them, by arranging their phenomena in a tabular form. Making a separate table for each case, he registered in one column the state of the pulse, in another that of the respiration, in others all the remaining symptoms in succession, according to their periodical occurrence, throughout the attack. It became easy for him, therefore, to determine how often a given symptom had presented itself in the series of cases, at what epochs, and what other symptoms had preceded, followed, or accompanied it; and treating every symptom successively in the same manner, it is evident that the result could not fail to present an exact representation of the disease investigated, so far as the cases made use of were true specimens of that disease. So prëeminently successful did this method prove in the hands of its inventor, that his works on phthisis and typhoid fever stand as monuments of his fidelity, and of the uniformity of nature; for scarcely a single statement or conclusion in either has been impugned, during the many years that have elapsed since their first publication. For a more complete illustration of the numerical method the reader is referred to the several works of M. Louis, and to the now numerous treatises which have been executed upon the same plan. He cannot fail to be convinced by them, that any mode of arriving at the laws of disease can be successful only in so far as it approaches to that which consists in the application of induction and numerical analysis to medical facts.

SECTION IV.

MODES OF PHYSICAL EXAMINATION.

In the preceding remarks allusion has been made to several aids to mere inspection and questioning. They consist partly in the methodical use of the senses of touch and hearing, as palpation, and immediate auscultation; partly in the employment of certain instruments or expedients adapted to assist or improve the senses, as mensuration, succussion, percussion, stethoscopic auscultation, microscopy, and the use of specula; and partly in the application of chemical reagents to detect the composition of the animal tissues, fluids, products, and excretions. The use of these several means is far from being easy; they can only be perfectly learned from a competent teacher. But as very few students of medicine or practitioners enjoy the advantage of such instruction, they should all the more diligently obtain, from written precepts and explanations, the light and guidance which are essential to their employing these methods with even a moderate share of satisfaction and success. In the ensuing description we shall first consider the application of the sense of touch to the investigation of disease, including pressure and palpation, and the touch or *toucher*.

Pressure, which determines the *resistance* of a part by means of the hand, and palpation, or the act of handling, whereby is received whatever information the sense of *touch* can communicate, may be considered together, because usually associated in practice, although the one may be employed without the other. *Pressure* is applied with the whole hand, or with one or more fingers only, according to the extent of the surface examined, and the rapidity of the intended movement. It is employed to ascertain the degree of hardness in inflammation and œdema of the cellular tissue; the resistance of the walls of the abdomen, when distended by tumours, liquids, or gas; their relaxation after the evacuation of the contents of this cavity; and the presence of a solid body within a liquid abdominal effusion. An example of the sort last mentioned is presented by enlargement of the liver in ascites. By no other means can the projection of this organ below the false ribs be so well determined. The hand, or the ends of the fingers are pressed firmly over the point examined, and then thrust inward with a short quick movement; if the liver lies near the surface, the layer of liquid between it and the integuments being suddenly displaced, the fingers impinge upon the solid viscus beneath. A similar movement communicated to the patella, in effusions within the knee-joint, will cause it to strike the condyles with a smart shock, and thus indicate the degree of the effusion.

Pressure renders valuable assistance in determining the seat and degree of pain, and often detects its existence where the patient does not anticipate that it will be found. Some sorts of pain, those which depend upon inflammation, are aggravated by pressure in whatever manner it may be made, but others of the neuralgic and spasmodic kind are increased by pressure made over a small space, and usually soothed by the steady weight of the whole hand. The pain of abdominal inflammation, and that of colic, are with much certainty distinguished in this manner. Pressure, in like manner, may show a loss of sensibility in the part to which it is applied; pinching the integuments is the best mode of employing it for this purpose. It is also a valuable means of ascertaining the activity of the circulation in the extreme vessels; for when the blood moves languidly the pinkish colour of the skin returns but slowly after pressure made by the end of a finger is removed, while in scarlet fever, erysipelas, and other active cutaneous inflammations, the eye can scarcely follow the movement of the blood, so instantaneously does it efface the white spot made by the finger. When blood is effused by points in the skin, it is sometimes difficult to distinguish them from certain papular eruptions; but the latter always disappear on pressure, while the former become more distinct, from their contrast with the surrounding surface, which is rendered pale by its momentary loss of blood.

Palpation, when employed to detect superficial departures from a normal state, consists merely in passing the hands gently but accurately over the affected part, as over the scalp or tibia, for instance, in search of nodes. When this, or any other sort of tumour, has been encountered by means of the expedient in question, it is to be further examined by the fingers so as to determine its seat, size, shape, consistence, &c. The abdomen more than any other region calls for the frequent use of this method, for determining alterations in the form and size of its various organs, and the formation of morbid tumours within its cavity. When it is examined, the patient should lie upon his back, with his limbs and trunk so disposed as to relax the abdominal muscles as much as possible. The pressure should not be made rudely and forcibly, nor with cold hands, for then the muscles become rigid, and effectually prevent handling what lies behind them; but the hands, previously warmed, should be spread out upon the surface of the body, and with a sort of waving motion press steadily but not heavily. If, in spite of these precautions, the muscles continue rigid, they may sometimes be made to relax by withdrawing the patient's attention from what is going on, either by questions or by some remarks unconnected with himself.

Palpation should always be employed upon the naked skin; but as this is not allowable in the case of some females, the physician must be content with acquiring an imperfect knowledge of their complaint; for the thinnest possible garment interposed between the hand and the patient blunts the delicacy of the sense of touch. It is true that long experience under these difficulties diminishes their evils to some extent.

If the organs to be examined by palpation are deeply seated, or of large extent, like the liver and spleen in certain states, and the uterus when gravid, the palm of the hand and the fingers do not always suffice to indicate their limits. The use of a sensitive surface which is not accustomed to contact with hard bodies is in these cases to be preferred, and none answers the purpose better than the inner or ulnar edge of the hand. Pressure is first made with the open hand upon the abdominal walls, at some point where they oppose only their normal resistance, and then gradually nearer and nearer the organ to be examined, until the edge of the hand comes in contact with it, when it is usually felt with much greater distinctness than by means of the fingers alone. When once the position of an enlarged organ, or of a tumour, is thus ascertained, its hardness, movability, &c., may be more readily estimated, and its limits be accurately marked out by means of percussion.

The common act of feeling the pulse is a mode of palpation. To perform it properly, the physician should take the patient's hand so that his own index finger shall rest upon the artery, next to the wrist, the ends of the other fingers being ranged along the vessel, while the thumb presses upon the back of the fore-arm. In this manner the hand receives a steady support, and the volume and strength of the pulse can be estimated, by using gentle or more forcible pressure with the several fingers successively, and then with all of them together. It is only by such manipulation that a full strong pulse can be distinguished from one that is both full and soft.

Fluctuation, by which the presence of pus and other fluids is discovered in abscesses and cavities bounded by soft parietes, is produced by a sort of palpation. The hand or several fingers should be applied to one side of the tumid portion, while a few smart taps are given to the opposite side, in the case of large collections, or repeated and quick pressure made when the cavity is small. In the former instance, a sort of undulatory movement is felt in the liquid beneath, when it is thrown into agitation, and in the latter the fingers are sensibly raised through the displacement of the fluid by the pressure. This sign should always be sought for in distension of the abdomen; where it cannot be produced by the method just described, the following plan will sometimes succeed. The left hand being firmly pressed against the side of the abdomen, the middle finger is raised by the opposite hand, and allowed, in its descent, to strike the abdomen smartly; the vibrations of the fluid are then perceived by the part of the hand which remains at rest.

When a diseased part is to be subjected to pressure or palpation, the corresponding part on the healthy side of the body ought first to be examined, in order to obtain a standard of comparison; for, otherwise, it is possible to regard really normal conditions as morbid. It is well, also, to leave the examination of the seat of pain until the close of the visit, so that immediately afterwards the patient may enjoy repose; and even then, it should be conducted with all possible gentleness, not only that the patient's feelings may be spared, but that he may not contract a dislike for his medical attendant. It is cruel, and always unnecessary, to test the extremity of the patient's power of endurance; and it is not always unattended with danger, for rude and prolonged handling of inflamed parts aggravates the original disease, or may cause the bursting of an internal aneurism or abscess, and so destroy the patient.

Yet the use of palpation upon a single occasion is of little value compared with that of its repeated employment in the same case. For as its chief utility is in determining the physical characters, the number, form, volume, consistence, surface, movableness, and contents of tumours, or enlargements of natural parts, it is evident that unless the progress of the swelling, its change of consistence, its attachments to adjacent parts, its fluctuation, &c., can be estimated from time to time, the knowledge at first obtained will be of little service, either in pointing to the probable period of the termination of the disease, or in regulating the kind and activity of the treatment.

The *touch* or *toucher* is a mode of palpation applied almost exclusively to the vagina and rectum. The fore-finger is usually employed in this operation, and the physician ought early to learn to use that of either hand with the same facility. Although the vaginal touch is more frequently employed by obstetricians during labour, than by any other class of practitioners, yet every physician must constantly meet with cases where he cannot dispense with the information it is adapted to convey, cases, for example, of urino-genital disease, of tumours within the pelvis, &c. Every one, therefore, should be acquainted with the mode of practising it.

The patient may either stand or lie down, and before submitting to the examination, should see that her bowels and bladder are empty. The finger of the operator ought to be without scratch or abrasion, lest he contract syphilitic disease, for it is often met with where least expected, and sometimes exists without the knowledge of the patient. The finger-nail ought to be short and smooth, and the finger well coated with oil, cerate, mucilage, or soap, which serves as a guard against absorption, as well as facilitates the introduction of the finger. If the female is lying down, it should be upon her back, near the edge of the bed, with her limbs drawn up; the operator should sit facing her, so as to use his right hand, unless he is equally adroit with the left. If the patient stands, and indeed it is sometimes necessary that the examination be performed in both positions, she ought to lean against some firm support, and separate her feet from one another, while the physician, placing one knee on the ground, supports upon the other the arm which he intends using. Whatever be the position of the patient, the fore-finger, flexed, is to be passed between the thighs until it reaches the perineum, the knuckle is then carried forward, and by its means the labia separated, and the finger extended into the vagina. Another method is to separate the labia by means of the thumb and middle finger, while the index enters between them. This finger is then carried backwards and upwards, gradually turning until the thumb is in a position to rest upon the pubis, and the other fingers are in contact with the perineum. To reach as far as possible, the ulnar edge of the index must press strongly against the fourchette, and the remaining fingers be flexed and held down by the thumb.

The finger introduced must now carefully and accurately explore the entire surface of the vagina, noting its inequalities, temperature, sensibility, moisture, and dimensions; must measure the size, consistence, position, and irregularities of the neck of the uterus, with the state of the os tincæ, its degree of dilatation, and whether it contains any substance within it; it must also determine the bulk, mobility, and weight of the uterus, and at the proper time execute the movement of *ballottement;* and, finally, touch in every direction the surrounding parts, in order to ascertain the condition of the bladder and rectum, and whether any tumour exists within the cavity of the pelvis, or whether there is any deformity of its bony walls.

Touching the rectum is much less frequently employed, but, however repugnant both to patient and physician, is often quite indispensable. The patient having prepared for the examination by evacuating the bowels, should lie on his left side, with the leg of the same side extended, and the right limb flexed. The operator then anoints his finger, and the anus of the patient, and very gently, but firmly, presses the point of the finger upwards, and backwards. Prolonged and firm pressure is sometimes necessary to overcome the resistance of the sphincter ani, which is usually increased when the parts are rendered sensitive by piles, fissures, or a fistula. The examination should here be of the same sort as in the vagina; search is especially to be made for strictures and pouches, where either of these conditions has been suspected, and also into the state of the prostate gland and bladder in the male, and of the body of the uterus, of the recto-vaginal septum, and of ovarian and other tumours, in the female. The introduction of the finger into the rectum is of great utility in many cases requiring the use of the catheter. Very frequently, indeed, catheterism is quite impossible, owing to the point of the instrument catching in the membranous portion of the urethra, until the finger being partially introduced affords it support, when it passes readily into the bladder.

Sounds and probes are instruments adapted to aid the sense of touch. They indeed convey the most valuable information respecting the cavities into which they are introduced; but as they are used by the surgeon almost exclusively, a consideration of them here would be going beyond the purposed scope of the present work.

A notice of *specula* (*speculum*, a mirror) may appropriately follow that of the "touch," inasmuch as these instruments are chiefly intended to render visible what by the other method is made tangible. There are three in common use, the *speculum auris*, the *speculum ani*, and the *speculum vaginæ*. They all consist essentially of a hollow metallic cone or cylinder, polished on the inside, which being introduced into the ear, the vagina, or the rectum, separates the sides of the passage from each other, and throws the light upon whatever object presents itself at the further extremity of the tube. For the sake of convenience the tube may be formed of a single piece, or of several, which can be made to diverge after the instrument is introduced, and thus offer a larger field for inspection. Its diameter is of course proportioned to that of the canal for which it is intended.

The vaginal speculum is an instrument of ancient origin. One has been found in the ruins of Pompeii, and Paulus Ægineta tells us that abscess and ulceration of the uterus may be detected by means of an instrument which he calls *dioptra*. It seems, however, to have fallen into disuse, when it was revived by Recamier, who employed a simple conical tube. More recently it has been modified by dividing the tube longitudinally into two or more segments, joined together by means of hinges near the base. By this arrangement the further end of the instrument can be expanded, so as greatly to enlarge the field of view, while the pressure made upon the vulva is not materially increased. The addition of handles, and of a screw adapted to maintain the further end of the instrument open within the vagina, form the only important improvements which it has received.

As the information to be obtained by using the speculum is only supplementary to that derived from the "touch," the latter ought in all cases to be employed first, for it will often determine the necessity of resorting to the other mode in addition, as well as direct attention to those parts which especially require examination, and those which may be in danger of laceration or abrasion by the contact of the speculum.

The female to be examined should lie upon her back, the hips near the edge of the bed, and the feet placed upon chairs far enough apart to permit the movements of the physician between them. A sheet, or some garment, with a vertical slit adapted to the vulva, and through which the speculum can be passed, should entirely conceal the person of the patient. The instrument having been warmed to the temperature of the body by immersion in warm water, is then to be well anointed with oil, and the labia being separated by the finger and thumb of the left hand, it is presented to the orifice of the vagina, and its extremity gently insinuated into this canal, in a direction at first downwards and backwards, and then horizontally until the neck of the uterus is reached. If a branched speculum is employed, it is then to be slightly opened so as to bring into view the *os tincæ*, a manœuvre often attended with difficulty, but which can generally be accomplished by repeated trials made with steadiness and gentleness. The instrument may then be still further dilated, and the parts examined, after being carefully wiped with a piece of soft sponge or a wad of cotton attached to a handle of proper length. When the light of the sun cannot be obtained, that of a candle may be used instead, and its effect increased by a bright silver table-spoon held behind it, which acts as a concave mirror. Besides permitting the inspection of the deep-seated parts of the vagina, the speculum offers the most convenient channel for the introduction of caustics, and other agents intended to be very limited in their action.

The *speculum ani* differs from that just described, in being smaller; and, as the lesions which it is intended to explore are situated upon the side of the rectum, such as fistulæ, fissures, piles, vegetations, &c., it is usually formed of a continuous cone or cylinder, having a lateral slit near its base, by which one-eighth or one-tenth of its circumference is removed. The utility of this instrument is very limited indeed; it affords but little information not equally well learned through the sense of touch, and its introduction nearly always gives rise to severe pain.

The *speculum auris* is chiefly useful as a means of inspecting, more accurately than is possible with direct light only, the state of the tympanum, and of the deeper portions of the auditory canal, and the character of its obstructions by cerumen, tumours, or foreign bodies. It is convenient, also, because when once introduced, the attention of the operator is not distracted, as in the ordinary mode, by the necessity of holding the external ear in an unvarying position, in order to get even a partial view of the recesses of the meatus.

Mensuration is a method of estimating size, which has been employed in the study of disease chiefly since the necessity of greater accuracy in describing morbid phenomena became generally felt. By it may be learned how far the dimensions of one side of the chest exceed those of the opposite side, or what increase or diminution of bulk has taken place in a part within a given time. The progress of emaciation, the increase or subsidence of effusions, the growth of tumours, the return of parts to their normal dimensions, and the like, may thus be determined with great precision. A correct and practised eye can indeed judge of a smaller departure from symmetry than can be determined by linear measurement; but it is well to have some scale by which such departure, when considerable, can be ascertained, and translated into words, so as to avoid, as far as possible, the errors into which defective vision, immature judgment, or preconceived notions, lead many men who have the sincerest desire to be exact. Such a scale, too, facilitates the record of the observation, as well for comparison with subsequent observations in the same case, as for the use of other observers in similar cases.

The measurements in question are usually made with a tailor's tape, or other inextensible band, divided into inches, and tenths or twelfths of an inch. In order to be comparable with one another, they must always be made, as nearly as possible, under the same circumstances. Thus on taking the semi-circumference of the thorax, it must not at one time be measured at one level, and at another time at another level, on one day during inspiration, and on another when expiration is complete. The same points must be selected on each occasion. In the chest, the most convenient is the nipple in the male, and the lower edge of the mamma in the female. The semi-circumference at full inspiration, and that on complete expiration, should both be measured; it is evident that the mean between the two will represent the average capacity of the chest on the side examined. This is the measurement of the thorax most commonly employed in practice, because the changes effected by disease in the whole of either side always affect its capacity, and therefore its circumference. Local enlargements of the chest, such as depend upon effusion into the pericardium, upon emphysema of the lungs, on aneurism of the aorta, &c., are not readily susceptible of measurement, but the practised eye detects them without much difficulty.

In measuring the chest, it is to be remembered that there are certain departures from perfect symmetry, which yet do not necessarily indicate the existence of disease. Thus, the right side of the chest is usually more capacious than the left, and its circumference may measure half an inch more ; lateral curvatures of the spine, projection of the ribs of one side near the lower part of the sternum, contraction resulting from a former attack of pleurisy, and some other partial deformities, are all to be taken into consideration in estimating the value of thoracic measurements.

Mensuration may be advantageously applied to diseases of other parts ; as to various alterations in the length and volume of limbs, to hydrocephalus, and to ascites. In measuring a dropsical abdomen, the level of the umbilicus is the most convenient. The facility with which gas forms in the intestinal canal deprives the method under notice of much confidence in estimating the progress of abdominal effusion, unless, at each measurement, percussion shows that there has been no material increase of gaseous distension, and unless, also, the measurements repeated on several successive days indicate a progressive augmentation or subsidence of the abdomen. In this, as in all other applications of the measuring tape, the patient should assume the same posture at each repetition of the operation, and one which, when a muscular part is to be examined, places it in a state of complete relaxation.

Various instruments have been contrived for measuring other parts of the body, and especially the interior of the female pelvis. Many of them are exceedingly ingenious, but by far too complicated for ordinary purposes. As to pelvimeters, they are regarded by competent authorities as inferior to the hand. The index finger, in antero-posterior contractions of the pelvis, can reach with ease from the arch of the pubis to the promontory of the sacrum, and the distance between these two points can be marked on it with the thumb, or with a finger of the opposite hand.

Succussion consists in shaking a patient by means of the hands applied on each side of the chest, at its base, so as to cause the fluid contained in the pleural, or other cavity, to be dashed against its sides, and thus produce a sort of gurgling, which may be heard at the distance of several feet, or, more distinctly, by applying the ear to the chest. It is evident that such a commotion in a fluid can only occur when the cavity containing it is also partially filled with air, for, if the liquid filled the whole cavity, its motion could generate no sound. There can be no vacuum in the body. The cases to which this method are applicable, are, therefore, few in number, such as hydro-pneumo-thorax, and large tuberculous cavities. These conditions are readily enough distinguished without a resort to so rude a manipulation as succussion, and this method, in spite of its antiquity, which is equal to that of medical history, is now completely abandoned as a means of diagnosis.

Percussion, or the act of striking various parts of the body with a view of determining the physical changes which have taken place in them, is an art of modern invention. It is true that the ancients distinguished tympanitis from abdominal effusion by percussion, but to this application the method was restricted until it obtained a new inventor in Avenbrugger of Vienna, in 1761. His treatise was translated by Corvisart in 1808, and its precepts were soon put to the test and approved, its directions modified, and more extensive and accurate applications of the method proposed successively, until it has been brought to a high degree of perfection, and may be considered, along with auscultation, to be quite as essential to the successful practice of medicine, as any subordinate department of the science whatever.

The most ignorant vender of wine or beer knows how to estimate the gradual falling of the liquor in a cask, by the different sounds elicited on striking it above and below the level of the liquid. The carpenter and the upholsterer know very well whether the wall into which they wish to drive a nail, is of brick, or of lath and plaster, and in the latter case whereabouts are the studs supporting the wall, merely by the peculiar sounds which these several substances render on being struck. Every substance, when thrown into sonorous vibration, produces a sound, the tone of which is peculiar to itself, and every change which takes place in the composition of that substance, or in the arrangement of its component parts, is accompanied by a corresponding change in its tone. In like manner every part of the body when struck, emits a certain sound, and always the same sound under the same circumstances. Whatever modifies the vibratory power of the part, will also modify its tone. But so far as ordinary percussion goes, it has less concern with alterations of musical tone than with degrees of intensity of sound, or the number of vibrations performed by a part in a given time; in other words, with degrees of sonorousness or resonance, and its opposite, or what is technically called dulness or flatness of sound. The least possible sonorous vibration is obtained from percussion of a relaxed muscle, or mass of muscles, as of the thigh or buttock. The sound thus produced may be regarded as the type of perfect dulness. The greatest possible vibration, the most perfect type of resonance, is obtained by striking the walls of the chest when distended with air, as in pneumo-thorax, in which case the sound resembles that of a drum.

There are infinite degrees between this excessive resonance on the one hand, and this absolute dulness on the other. If a part, the præcordium for example, emit more sound than natural, on being percussed, it is said to be resonant; not *positively* as regards the most resonant regions, but *comparatively* as regards its own ordinary capacity for generating sound. In like manner, if the chest below the clavicle emit less sound than in its natural state, it is said to be dull, although more resonant than many other parts of the body.

The inventor of percussion restricted its use to the examination of the chest. To elicit sound, he struck the parietes of this cavity gently with the ends of the fingers; Corvisart subsequently employed for the same purpose the open hand. This was called *immediate* percussion. It answered very well when an extensive surface, like one side of the chest or abdomen, was in a condition to generate a morbid sound, but was of little value when the space occupied by dulness was only an inch or two square, and consequently could not be applied to the accurate measurement of solid organs, tumours, &c.

The great improvement in the art of percussion was that introduced by Piorry, and which consisted in interposing, between the fingers and the part to be percussed, a solid body, whose vibrations should accord so nearly with those of the human frame, as not to obscure sounds generated by the latter. This body, which Piorry termed a *pleximeter*, (πλησσω, I strike, and μετρον, measure,) was made of a thin plate of cedar, about two inches in diameter, for which an ivory plate of the same form was afterwards substituted. Percussion, with a pleximeter, is called *mediate* percussion. The sharp sound emitted by wood, and still more by ivory, when struck with the ends of the fingers, renders these instruments ineligible; besides which, their hardness bruises the hand of the operator. Both of these inconveniences are obviated, in a great measure, by using, as a pleximeter, a piece of caoutchouc about two inches long, by an inch wide, and half an inch thick. But superior to all of these is the middle finger of the left hand, because it is soft, elastic, and not sonorous; because it is adapted, by its shape and size, to all the inequalities of the surface of the body; and because it is always at hand. The finger possesses another advantage, which is that of being able to regulate the degree of pressure required, according to the resistance of the parts percussed, and the distance from the surface of the solid body to be examined. This is of great consequence in percussion of the abdomen. The finger, too, can be more accurately applied to the integuments, than an artificial pleximeter, which is an important consideration; for the presence of air between this instrument and the skin entirely alters its sound when struck.

The fingers of the right hand are generally used to percuss; but, except when the dulness is great, a single one of them, the medius, is quite sufficient. The fingers should be flexed nearly at a right angle at their middle joint, and their ends brought accurately to the same line. In striking the pleximeter, the force of the blow should never exceed what is necessary for bringing out fully the characteristic sound; whatever is more than this fatigues the patient, and is painful to the physician's hand. On this account, the blow must be short and quick, and the fingers raised as soon as it is given. The whole movement of the right hand should be from the wrist downwards, the forearm remaining quite motionless, and placed in the most convenient position for affording a proper support to the hand. This movement is not readily acquired by every one, but its acquisition is quite as essential to the delicate and satisfactory performance of percussion, as a similar control of the hand is to accurate and brilliant execution upon keyed instruments of music. Nearly all who are expert in this art succeed in eliciting clear and loud sounds by a very slight, and apparently gentle, movement of the hand, and, in a great majority of cases, percuss with one finger only.

The value of percussion, in disease, depends altogether upon a knowledge of the sounds which the same method produces in health. Hence a preliminary step in its study is the percussion of perfectly healthy persons at various ages, by which will be learned the numerous modifications in its results, imposed by the progress of life, the sex, and the *embonpoint* of the patient, and yet perfectly compatible with a normal condition. For a similar reason, in examining a case of disease, percussion should be practised first upon parts presumed to be sound, and a gradual approach made to the supposed seat of the disease. In the chest, for example, the side which is free from pain, &c., should first be examined, and percussion made, comparatively, at exactly corresponding points of the opposite sides, until the whole extent of each is explored. In health the sounds furnished by the opposite sides of the thorax are, for the most part, identical; the heart destroys this equality in a small space in front. Hence the slightest disparity should lead to a more minute and careful examination of the parts where it is detected.

The surface examined should either be quite naked, or covered only with thin flannel or linen. Cotton tissues are said by Andral to deaden the sounds. But in this country they are so universally worn, that the physician is constantly obliged to receive the results of percussion as modified by them. We have not found a cotton garment to interfere seriously with percussion, when the precaution is taken to stretch it tightly and smoothly over the skin. Moreover, the region of the body in which more than in any other it is important to detect the slighter shades of sound, that bordering upon the clavicles, is nearly always accessible, even in the most delicate females, without the intervention of any garment whatever.

During the examination strict silence in the chamber should be enjoined. The patient should assume an easy posture. If the front of the chest is to be examined, he should sit upright, leaning against the back of a chair, or else lie upon his back in bed; if the posterior part, he should either sit up in bed, resting his folded arms upon his knees, or, if able to do so, and a male, sit astride a chair, leaning with his arms crossed upon its back; if the side, the corresponding hand should be placed upon the top of the head, or supported at the proper level by an assistant, and that, whether the patient be able to sit up, or can only turn upon the side opposite to the one percussed, while in a recumbent posture. When the strength of the patient permits, it is sometimes important that he should go upon his hands and knees, in order to ascertain whether effusions in the abdomen and chest obey the laws of gravity, and therefore whether they are limited by adhesions, or contained in a sac, &c.; and where debility, or any other cause, prevents this posture from being assumed, the patient should, in the cases referred to, be required to change his position from side to side, in order to permit the change of relation between the liquid and the part percussed to take place.

Auscultation in medicine is the art of listening to the different sounds produced within the body. Its object is to determine the condition of an organ in which the natural sounds are altered. It is, therefore, a method of diagnosis. The chief applications of this art are to the study of diseases of the respiratory and circulatory apparatus. It is also employed in obstetrics to determine the existence and position of the *fœtus in utero*. For the discovery of this precious art, as applied to the heart and lungs, we are wholly indebted to Laennec. Not only did he lay the foundation of our knowledge respecting it, but his indefatigable industry and ardent zeal, the best evidences of his exalted genius, brought it very nearly to that degree of perfection which it has now attained, and which renders it one of the most valuable instruments ever devised by the skill of man for bringing light out of darkness, and harmony out of confusion.

Laennec thus describes the accident which led to its discovery. "In 1816, I was consulted in the case of a young lady, who presented general symptoms of disease of the heart, but whose *embonpoint* prevented any satisfactory results from being obtained by percussion and the application of the hand. The age and sex of the patient rendering it improper to apply my ear to the chest, I happened to remember a well-known fact in acoustics, that if the ear be placed against one end of a beam, it can distinctly hear even the scratching of a pin at the opposite end. It occurred to me that this property of bodies might be made available in the case before me. I accordingly took a quire of paper rolled up very tightly, and setting one end of it against the præcordial region, applied my ear to the other. I was not less surprised than delighted, when I heard the pulsations of the heart more clearly and distinctly than I had ever done before by the direct application of the ear to the chest. I at once conjectured that this expedient might become an useful method, and applicable to the study of the sounds of the heart not only, but of all movements capable of producing sound within the cavity of the chest, and consequently to the investigation of the respiration, the voice, the different rhonchi, and perhaps even to the fluctuation of a liquid effusion in the pleura or pericardium."

Laennec soon submitted this conjecture to the test of experiment; he believed that his surmise might be an interpretation of nature, and to nature he betook himself for its confirmation or disproval. Every trial he made of it strengthened the demonstration of its truth, and he soon arrived at what was then naturally regarded as an astounding result, that his new method "was capable of rendering the diagnosis of nearly every disease of the lungs, the pleuræ, and the heart, more certain, and more minute, than perhaps even those surgical diagnoses established by means of the sound, the probe, or the finger."

The value of auscultation might be illustrated by innumerable instances, but in this place a few of the more general examples of its utility will suffice. It serves to distinguish at once, organic from functional and sympathetic disorders of the respiratory organs and of the heart; to detect serious lesions in the former of them, while yet their functions seem almost unimpaired; to unmask such diseases when hidden by some other affection, such as coma, delirium, &c., and reveal them when existing in children, and other persons incapable of describing their sensations; to determine the precise situation of the lesion, its stage, and extent; to indicate the proper place for applying certain therapeutic agents, as well as to prevent error in their selection, by establishing that essential preliminary to all rational treatment, a correct diagnosis; and in consequence of conferring this superior accuracy in other respects, to improve and perfect prognosis.

If auscultation is of itself so fruitful of good, how much more valuable is it when combined with percussion, and all the other physical methods, as well as functional signs, which elucidate, or are furnished by, diseases to which it is applicable. In this combination it should always be judged of and employed, and never isolated, and set up as an infallible oracle. It is to be respected as one of the greatest of those counsellors, "in the *multitude* of whom there is safety."

Auscultation may be either *mediate* or *direct;* that is to say, may be practised by means of a stethoscope, or by the direct application of the ear. The former was the plan adopted and recommended by Laennec, to the exclusion of the latter, which is now employed, unless in exceptional cases, by nearly all good auscultators. The advantages of the stethoscope are chiefly these. It can be applied to the clavicular, axillary, and intra-scapular regions, and over arteries, where it is difficult, if not impossible, to adjust the ear; it conveys the sound generated within a very limited space, and therefore answers very well for localizing many pulmonary and cardiac murmurs, much better than the ear, which receives sounds not only from the part immediately beneath it, but from a considerable portion of the region with which the side of the head is in contact, because the bones of the head form an excellent conductor of sound; it prevents the necessity of such an approach to females, as, in some instances, offends their delicacy, and it enables us to avoid immediate contact with filthy persons, and those labouring under contagious diseases.

On the other hand, the sounds heard by direct auscultation, and especially the moist ronchi, are more distinct; if by this method individual murmurs are not so perfectly isolated as by the stethoscope, the ear of the skilful auscultator can distinguish between the near and the remote, and is able to listen to a single one to the exclusion of such as are associated with it; direct auscultation is more applicable to infants than the stethoscope, which usually alarms them; and the objection to its employment with scrupulous females and filthy patients, may generally be obviated by interposing a thin garment or a clean napkin between the ear and the skin.

On the whole, although direct auscultation conveys all essential knowledge of most cases of pulmonary or cardiac disease, yet there are cases in which the other method gives a superior precision and certainty to that knowledge. Such are those of valvular disease of the heart, in which the stethoscope, and especially the flexible one introduced by Dr. Pennock, of this city, leads to a much more accurate diagnosis of the particular orifice affected, than can usually be obtained by the unassisted ear. Excepting infantile cases, this instrument is applicable to all in which direct auscultation may be used, and to some, as we have stated, where the latter method is inexpedient or unsatisfactory. If then, it were necessary to choose the one and reject the other, the stethoscope should be retained, but since physicians are not reduced to this alternative, they ought to learn to employ both, so as never to be embarrassed by the peculiarities of a new case.

Although it is preferable that the part ausculted should be naked, yet this is not an essential condition, except for the learner. Experience teaches what allowance must be made for the influence of the several sorts of garments worn next the skin, in obscuring and altering the sounds; but were a beginner to receive his first notions of respiratory, and other murmurs, through such media, he would ever afterwards be at a loss what portions of the mixed sounds to refer to their respective sources. His first essays should always be upon the naked body, first of healthy, and then of diseased individuals. So long as the garment is of close texture, and applied smoothly to the surface, its thickness does not seriously interfere with the transmission of sound, but when starched or otherwise stiffened, so as to admit of the entrance of air between it and the skin, or of much motion, it occasions noises which may entirely mask those generated within the body.

In order to auscult satisfactorily, the physician should accustom himself to use either ear, so that if both are sufficiently acute, he will be ready to proceed with the examination on whichever side of the patient he may happen to stand. He will generally find, however, that he hears better with one ear than with the other; hence whenever he feels doubtful in regard to a sound he should always listen to it with his best ear. If a stethoscope is employed, it should be held between the finger and thumb, its larger extremity resting firmly upon the surface of the body; when steadily placed, the fingers may be withdrawn, and the instrument supported by the pressure of the head. Without these precautions it is impossible to obtain a clear perception of stethoscopic sounds. It is equally necessary that the auscultator should not place himself in such a constrained position as will cause an accumulation of blood in his head, in the stooping posture for instance; this caution is very important to be observed after meals.

The general rules suggested for practising percussion in all that relates to the posture of the patient, the order in which the sound and diseased parts are to be examined, the accurate comparison of opposite sides in pulmonary affections, &c., are equally applicable to auscultation. But since there are several kinds of phenomena appreciable by auscultation, they should be studied in regular order, according to an uniform plan. Thus, in examining the thorax, the respiration first, then the rhonchi, and then the voice, and each as modified by a fuller, faster, or slower breathing, by speaking and coughing more or less loudly, &c., ought to be passed in review. When the condition of the heart is investigated, there must be estimated, besides its impulse, the seat, the intensity, the extent, the rhythm, and other peculiarities of the natural sounds, and then the same qualities of those which are abnormal, and finally all of these as influenced by the state of the respiration, and the movements or repose of the patient. So in obstetrical auscultation; the placental murmur, the sounds of the fœtal heart, those produced by the movements of the child, &c., all require to be examined in succession, and in various conditions of posture, excitement, &c., of the mother.

Auscultatory Percussion.—In ordinary percussion the vibrations of the part which is struck, reach the ear through the intermediate air, and the sound produced is not more particularly characterized than as either dull or sonorous. But two ingenious physicians of New York, Drs. Cammann and Clark, have invented a method by which the sound of percussion is conveyed to the ear by a solid stethoscope, and in which every organ is considered as emitting, when percussed, a sound peculiar to itself. Thus, when the stethoscope is applied, and percussion is made upon the body, near the further end of this instrument, a different sound is perceived according as the stethoscope is placed over the heart, the liver, the lung, a collection of fluid in the abdomen, a bone, &c. In marking out the limits of an organ, it is alleged that the sound peculiar to that organ, can be heard beyond the line at which ordinary dulness ceases, and, consequently, that its boundaries can be more accurately determined than by the usual method. It is also claimed that this combination of percussion and auscultation is capable of determining the precise line of separation between two solid organs which press against one another, as when a solidified lung is in contact with the heart, or is separated from the liver by the diaphragm alone. This very ingenious method, of which an account was first published in 1840, we were lately assured by one of its inventors, continues to be practised by them with success; but it does not appear to have been extensively employed as a means of physical diagnosis, because, perhaps, simple percussion has been found so generally sufficient, that pains have not been taken to test the value of the proposed substitute.

In conclusion; the object of percussion and auscultation being to discover the degree and extent of the solidity of a part, and the actual condition of, or the changes that have taken place in, the natural cavities, and the contents of organs, by means of the sounds which they are capable of producing, it follows that whatever expedients are best adapted to develope these sounds and render them more distinct, are those most apt to lead to the desired results. A clear apprehension of the mechanical principles on which the rationale of auscultation rests, and some degree of ingenuity on the part of the observer, will readily suggest to him many variations in the mode of applying this art, and as his experience increases, he will attain to greater ease and rapidity in his examinations, and precision in his diagnosis.

The use of the *microscope* in pathological investigations is an art so difficult, that none but those who have especially, and for a long time, cultivated it, can depend upon the correctness of their observations, or estimate justly the phenomena they witness. On this account it can never become, like the methods heretofore discussed, of habitual employment in ordinary practice, even were the points of pathology which it is capable of elucidating much more numerous than they really are. The sphere of usefulness of the microscope is almost entirely limited to distinguishing the proximate elements of the body from one another, where these latter actually possess marked characters; but, according even to some of those most expert in its management, it is incapable of showing any differences between the particles of some very dissimilar bodies, such as pus and mucus, or tubercle and cancer. Without granting that such difficulties exist in the degree alleged, or that they are insurmountable, it must still be admitted that the value of the microscope is less questionable as a means of detecting crystallizable products in the urine, when they exist there in such small quantities as to elude chemical analysis; or animalcules in the sperm; or, when employed in the simple form of an ordinary magnifying glass, as a mode of detecting, or identifying, the various minute insects and entozoa which infest the human body. Whatever pathological results have been obtained through the microscope will be mentioned hereafter.

Reflections similar to the above may be made in regard to the application of *chemistry* to the study of disease. Chemical methods, properly so called, those, namely, which consist in subverting the natural affinities of organic compounds, are of very limited utility in revealing morbid phenomena which escape the senses. It is true, that of late years many theories of disease, or of particular diseases, have been proposed as the results of chemical investigation; but none has yet been advanced which could long stand the test of experience. It may even be possible that a general and true theory of disease is destined to grow out of organic chemistry; but, up to the present time, this science has contributed but sparingly to the elements of medical diagnosis and prognosis. It does, indeed, furnish the means of ascertaining whether certain normal constituents of the secretions are in excess, or deficient, and whether or not certain abnormal constituents of these fluids, and of the blood, are present. Thus it shows by very simple processes, whether they are acid, alkaline, or neutral; whether the urine contains sugar or albumen, or uric or phosphatic salts, or the colouring matter of the bile; but this knowledge, useful as it is, falls far short in value, of that obtained by an analysis of the blood, not that analysis which destroys the substance it examines, and is in the true sense chemical, but that which by a purely *mechanical* operation separates from one another, and weighs, the proximate elements of the blood, its fibrine, globules, water, and albumen, and shows which of them preponderate, and which are deficient in particular diseases. The processes and operations here referred to are easily learned, and may be practised by any physician of moderate attainments. The destructive processes, on the other hand, can only be conducted by professional chemists, and require a degree of skill and accuracy in manipulation, and a measure of scientific attainments which very few possess.

CHAPTER V.

PROGNOSIS.

Prognosis is the foreknowledge of the course, events, or terminations of disease. It is not, in one sense, essential to the treatment of disease, because it relates only to the future; but its incidental value is often very great, inasmuch as it affects the domestic and civil relations of the patient, inspires him with a hope of recovery, or by assuring him of the impossibility of such an event, disposes him to make those preparations for his change which religion enjoins, and affection demands. Upon no other subject is the opinion of a physician so often required. It makes but little difference to the patient whether his malady is of one nature or another, or is called by one or another name, except in so far as a knowledge of its name and nature gives him some notion of its gravity, duration, and probable issue. The physician is concerned with the present, the patient looks constantly to the future. All the questions that the former asks, relate to what has happened, or is taking place; all the inquiries of the latter refer to what he may expect to suffer or escape. From the very commencement of the attack, the friends of the patient are less concerned to know his disease, than the probable duration of his confinement, and some opinion upon this point the physician can scarcely avoid expressing. In proportion to the positiveness of his prognosis, and the accordance with it of the result of the attack, is the honour in which he is held, and certainly with good reason, if his opinion have been anything more than a lucky guess. For if diagnosis be difficult, and therapeutics uncertain, prognosis is both, and in a twofold degree. That it is found to be so in practice is shown by the extreme wariness and hesitation of men of sound experience in predicting the issue of a disease, and the readiness and confidence of young and ignorant practitioners, in foretelling the event of every affection they have to treat.

It is peculiarly unfortunate, that nearly all positive indications are of a fatal tendency; such as have a contrary meaning, are lamentably few and obscure; so that whoever will undertake to promise, without qualification, a cure even of the mildest disease, is possessed of more boldness than the occasion warrants. A physician, therefore, who is sensible of the many difficulties that environ this subject, ought rather to prefer relinquishing all claims to being thought a prophet, that he may enjoy the credit due to his candour. While he points out the symptoms that appear to him propitious, he will impress it, at least upon the friends of the patient, that his utmost skill does not extend beyond the indication of probabilities; and this he is bound to do without in the least impairing that hope of recovery which has sometimes, even in apparently desperate cases, been sufficient to overcome the disease. There are, indeed, not a few instances in which the medical tact which has been spoken of, may stand the physician in good stead. He may perceive, in certain symptoms, a significance which he cannot account for nor analyze, and often his predictions may be verified. But such a quality is more frequently possessed by nurses and old women, who have long been used to watch the sick by night and day, than by the physician who sees his patient but for half an hour, perhaps, in the whole twenty-four hours. This faculty, moreover, is peculiar to the individual, and cannot be taught; its objects and operations, consequently, cannot be regarded as belonging to medical science.

Scientific prognosis, on the other hand, is founded on diagnosis; the disease under observation must first be made out, before anything can be predicted of it with tolerable certainty, at least during its stage of increase. Yet prognosis demands greater skill and experience than diagnosis; for often it is very easy to determine the nature of a disease, but quite impossible to foresee its termination; because, one that is mild in the beginning, may, during its course, become violent or malignant. No human sagacity can anticipate the numberless influences for good or for evil, which may come into play, increasing the activity of a disease, or causing its extension to an important organ, or changing its type from one capable of supporting active treatment, to one in which no treatment will be serviceable. A long and true experience is necessary for learning all the forms of a given disease, all its tendencies, all the accidents which may alter its course; a whole lifetime is hardly sufficient for accumulating a mass of facts adequate to the solution of many such complex problems which daily arise; and the physician, however sagacious and prudent, is constantly exposed to seeing his most rational anticipations disappointed.

It is evident that the principal sources from which the elements of prognosis may be derived, are, 1st, the disease itself; 2d, the peculiarities of the patient; 3d, the external influences modifying both of the foregoing;—for it must be admitted, that some affections are in their very nature more dangerous than others; that some patients are remarkably susceptible of morbid impressions; and that diseases vary according to climate, season, epidemic influence, &c.* None of the circumstances relating to a case of disease are indifferent in forming a judgment respecting its probable course and issue; its causes, mode of invasion, symptoms, and duration; its seat, nature, severity, complications, and its tractability under treatment, must all have their appropriate influence.

The *causes of disease* are not, in general, of much value in prognosis; yet they are, sometimes, of great importance in this connexion. Thus, inflammation of the peritoneum has a very different degree of gravity, according as it is idiopathic, or tubercular, or produced by perforation of the intestine, or some other abdominal viscus, or occurs immediately after parturition. Tetanus of traumatic origin is infinitely more dangerous than when it arises from exposure to cold. A bubo proceeding from syphilitic infection will suggest a very different prognosis from one caused by an excoriation of the heel. The rapidity or slowness of action of a cause, and the extent of surface upon which it acts, when it is of a chemical or mechanical nature, must also be taken into account. Poisons present an apt illustration of several of these points; and privation of air by immersion in water or an irrespirable gas, or by strangulation, affords examples of the remainder.

The *mode* in which an attack of sickness *commences*, is not

* J. H. Bell, *Thèse de Concours*, &c. 1838; M. M. Hardy and Béhier.

without significance, particularly during the prevalence of an epidemic. The severity of the initial symptoms is then a pretty fair index of the subsequent gravity of the disorder. At other times the symptoms of invasion are of very uncertain value in prognosis. Many attacks of variola, of the mildest type, commence with as violent reaction as those of the confluent variety, and after two or three days of high fever, intense headache, and perhaps delirium, the eruption appears, and thenceforth the disease runs gently on towards cure. On the other hand, as was before remarked, many attacks of sickness are so mild at the commencement, as to excite no apprehension whatever, and yet daily grow worse and worse, until all hope of curing them is lost. The invasion of many is marked by severe paroxysms of nervous disorder, especially in women and children. In such subjects, this occurrence ought not to occasion particular alarm, unless followed by serious symptoms of another kind, such as coma and delirium. In old persons, on the contrary, every disease involves danger, no matter how mild its onset may be; they can neither bear the debilitating effects of the disease, nor the treatment requisite for its removal when its symptoms grow alarming.

Under the head of semeiology, the value of individual symptoms in prognosis will be duly set forth; in this place some general considerations only will be presented. The elements of prognosis admitted by the ancients, and confirmed in a great degree by the subsequent observation, not only of modern physicians, but of non-medical persons in habitual attendance on the sick, are drawn almost exclusively from the general symptoms. They consist of particular symptoms supposed in themselves to be of good or evil augury, and quite independent of the disease in which they occur. Such are extreme debility or emaciation, the Hippocratic countenance, great frequency or irregularity of the pulse, fœtid exhalations from the skin, &c. Those which have been added by the researches of later times, are chiefly local, and discoverable by the several methods of physical exploration which have been described. By these means it is frequently possible to ascertain the existence of extensive organic disease, where the general symptoms give no indication of peculiar danger. This is singularly true of diseases of the heart, of aneurisms of the aorta, and sometimes of pulmonary tubercles. The same methods often show whether a more or less dangerous lesion exists in a given case. For example, palpation enables us to distinguish between cancerous and other enlargements of the liver; chemical tests applied to the urine indicate, under certain circumstances, whether renal disorder is attributable to Bright's disease, which is incurable, or to chronic inflammation, which may terminate in recovery. In a word, the prognosis in these cases depends wholly upon the accuracy of the diagnosis. If the latter be doubtful, the former will necessarily be uncertain; but if the diagnosis be well established, the ultimate termination of the disease may confidently be predicted, for the diseases to which allusion has here been chiefly made, are all beyond the power of medical art to cure, however much it may prolong their course by palliative treatment.

Certain maladies, amongst which may be mentioned eruptive fevers and acute inflammations, are, for the most part, regular in their course, the symptoms succeeding one another in an established order; certain others, on the contrary, such as nervous affections and chronic disorders in general, are very irregular in the succession of their morbid phenomena. Hence, any marked departure of the former from their accustomed course, must be interpreted as unfavourable to their cure. It usually indicates some serious but latent complication, which interrupts the natural progress of the attack. If the disease proceeds without amendment, beyond the period when it should begin to decline, or when, from the commencement, the graver symptoms assume an unwonted severity, there is reason to apprehend the worst. An opposite interpretation, it is plain, should be given to the unusual duration of diseases in their nature incurable; in them, every day added to the disease is one gained by the patient. All sudden changes, whether for the better or worse, have a less important bearing upon the prognosis, than if they took place gradually, for they often last but a very short time. If the patient has, on former occasions, experienced the same disease as that for which he is under treatment, a knowledge of any peculiarities it may then have presented, will aid materially in forming an opinion in regard to its present course and probable issue, and of the importance of those peculiarities, should they again appear.

Although, as a general rule, the longer a disease continues, the more unfavourable the prognosis, yet there are some exceptional cases, besides those already mentioned, of incurable affections. In certain acute disorders which are apt to be fatal within a limited period, their prolongation beyond that point is favourable. This has been shown by Mr. Farr to be true of epidemic cholera. He found that, after twelve hours, the proportion of cures to deaths was as 1·3 : 1 ; after twenty-four hours as 2 : 1 ; after two days as 3 : 1 ; and after three days as 4 : 1. In other words the longer the attack the greater hope was there of its cure. It is probable that this proposition holds in regard to all epidemic disorders.

The *nature of the disease* must evidently have great weight in the formation of a prognosis. Neuroses, or functional nervous disorders, are essentially less dangerous than inflammatory diseases, and inflammation less so than gangrene, or an organic affection. Specific diseases are, for the most part, more dangerous than analogous ones of the ordinary type. Hydrophobia is uniformly fatal ; and syphilitic, more obstinate than simple eruptions of the skin, if the influence of treatment be left out of the question.

The *seat* of a disease is of capital importance in prognosis. It is clear that the more essential to life is the organ attacked, the greater will be the danger. Affections of the brain, the heart, or the lungs, are infinitely graver than those of the liver, the spleen, or the limbs. So, too, the portions of a vital organ most essential to its functions are most apt to endanger life when diseased. Affections of the pons varolii, and of the crura cerebri, are more rapidly fatal than those of the hemispheres, because they are in more immediate connexion with the nerves by whose action life is maintained ; for a similar reason, lesions of the cervical portion of the spinal marrow involve greater danger than those of the inferior divisions. Valvular disease of the heart, and cancer of either orifice of the stomach, are more serious than corresponding alterations of other parts of these organs. Artificial anus, when its seat is in some portion of the large intestine, exerts but little injurious influence upon the health, but if the same injury affect the superior portion of the alimentary canal, the food is discharged without being thoroughly digested, the supply of nutritive matter is cut off, and rapid emaciation, and death by inanition soon follow, unless the endeavours to close the opening prove successful.

It is unnecessary to insist upon the value in prognosis of the *extent* and intensity of diseases. It is evident that, other things being equal, the danger of a disease is in proportion to its magnitude, in physical extent, and in the development of its symptoms. Yet there are often apparent exceptions to this plain proposition. The concomitant circumstances may really be very different in two apparently similar cases; and thus may be explained the fatal termination of the one, and the recovery of the other, when the mere extent and intensity of the disease seemed to be the same in both.

The *complications* of a disease render its prognosis unfavourable. Thus, articular rheumatism, when simple, proceeds steadily towards cure, but when complicated with pleurisy, and more particularly with pericarditis, it is very apt to have a fatal termination, or to result in permanent unsoundness of the heart. Inflammation of the lungs or of the brain is of frequent occurrence in eruptive and other continued fevers, and uniformly aggravates the situation of the patient.

Finally, the influence of *treatment* must be considered, in estimating the probable course and event of a case of disease. In those affections which experience has shown to be intractable to any form of treatment, the most unfavourable prognosis must of necessity be made. Yet even here it were unsafe to hazard an opinion entirely without qualification; for it occasionally happens that well-marked cases of phthisis, cancer, ovarian dropsy, &c., undergo a spontaneous cure, or remain quiescent under the influence of certain hygienic measures. If in a given case, and near its commencement, no treatment whatever has been employed, a rational hope of cure may be founded upon the proposed use of the means which have generally been found effectual in diseases of a like description. Much, however, will depend upon the real value of the ordinary treatment. If, as happens in a very large majority of instances, the treatment is settled only in general terms, but admits of, or requires, considerable modification in particular cases, the element of prognosis under notice is of little value; for a slight change in the measures previously adopted may produce a decided amelioration of the symptoms; but if, on the other hand, the treatment in question be definitely fixed, as, for example, cinchona in malignant intermittent fever, and yet has been tried unavailingly, the chances of the patient's recovery are extremely small.

The *circumstances of the patient* constitute an important element of prognosis. Their action, as causes of disease, has already been considered; from what was said of them in that connexion it will be readily understood that if capable of engendering or preventing, disease, they are also capable of aggravating or diminishing its severity. In this relation they often exert a paramount influence, and are therefore full of interest to the practitioner.

The mere *age* of a patient must modify the prognosis based upon other considerations. Both extremes of life are exposed to peculiar dangers. Thus, it appears from the statistical tables of mortality in Sweden that more than one-fifth of all the children born, perish during the first year of their existence, and that of those who are living at the age of eighty, about the same proportion die in each year. It results, further, from extensive statistical tables, that nearly one-half of those born at a given time die before the age of puberty. Hence in cases of disease occurring before this age, there is a stronger presumption against recovery than at any subsequent period of life, except the most advanced, and this presumption increases in strength in proportion as the patient is younger. As might be expected the exceptions to this rule, when they do occur, partake almost of the marvellous. They may well have given rise to the proverb that "while there is life there is hope;" they are examples of escape from death which no sagacity could anticipate, and which, it must be confessed, are usually accomplished when medical art has expended all its resources in vain. The diseases of childhood are generally severe, and the more prone to a fatal issue from the fact that the subjects of them will not bear vigorous treatment. The inflammatory affections of the three great cavities then assume a more aggravated form than at any later period. Some affections which at other ages are of trifling consequence are peculiarly dangerous in infancy. Coryza in a nursing child may prove fatal by suffocating it during its attempts to take nourishment, or the little patient may die of inanition from the impossibility of swallowing and breathing at the same time.

After the first dentition is complete, the diseases of childhood diminish in severity. They, as well as other diseases, run their course at this period with singular rapidity, and are apt to be accompanied by nervous disorders, delirium, convulsions, and coma; but these symptoms are not then by any means, of as fatal significance as in subsequent years, for they often arise in connexion with a very moderate degree of fever. Youth and adult life offer no peculiar prognostic signs. Energy and regularity are the general characters of their functions, whether normal or diseased. In the decline of life, as at its commencement, the predominant character of disease is feebleness; but in the latter there is a constant tendency of the organism towards a more perfect development, a fund of vigour which often, as we have seen, withstands the exhausting attacks of disease, while in the former there is a constant tendency to decay, and but little recuperative power. In the maladies of old age, therefore, it is evident that the prognosis must commonly be unfavourable. They are, for the most part, obscure in their origin, and often so insidious in their progress as scarcely to offer any external sign of their existence, until the destruction of the affected organ is far advanced. The treatment, too, which would have been appropriate to them at earlier epochs, then becomes inapplicable, and what would at one time have called for the antiphlogistic method, may now obtain its only chance of cure, from the employment of tonics and stimulants.

The *sex*, if the state of pregnancy and its consequences are left out of the question, has but little influence in the prognosis of disease. It is true, however, that urinary calculus is a much less serious affection in the female than in the male, on account of the readiness with which calculi escape from the urethra of the former. Hæmoptysis, which, in the male subject, is so uniformly a sign of commencing tuberculization of the lungs, is of very inferior importance in women, provided it coincide with derangement or suppression of the catamenia. Pregnancy has a marked influence upon accompanying diseases, because either through their violence, or the means used to counteract them, miscarriage with all its dangers may result. Eruptive fevers, even of a mild type, in this manner become extremely perilous to the pregnant female; they are very apt to be followed by the expulsion of the contents of the uterus, and in that case are nearly always fatal. On the other hand, it is commonly believed that pregnancy suspends the progress of certain chronic diseases, and especially pulmonary consumption. But, as already pointed out, (page 122,) some of the most accurate observers have failed to find facts in confirmation of this opinion. Occasionally, also, pregnancy puts an end to mania and hysteria.

Labour in certain cases of disease, or of morbid tendency, is a source of augmented danger. Such are aneurisms of the great vessels which may be ruptured; herniæ of the bowels, which may become strangulated; organic lesions of the uterus, which may induce its laceration; and plethora, which may occasion apoplexy or convulsions, during the throes of parturition.

The *puerperal state* stamps with peculiar gravity every affection which arises to complicate it. It greatly facilitates the injurious action of epidemic causes; it is subject to its own peculiar maladies; including inflammation of the womb and its appendages, the peritoneum, and the cellular tissue of the pelvis; it hastens to a promptly fatal issue all eruptive diseases, and renders far more mischievous than usual, inflammation of the lungs or pleura, the pericardium, or the membranes of the brain. A knowledge of these facts should render the physician cautious in promising a rapid recovery, even after an easy labour, and vigilant to mark every change in his patient, and to detect every infringement of the directions he has laid down for her management.

The *hereditary tendency* of a patient to the disease under which he labours, must nearly always render its prognosis unfavourable; for it indicates a constitutional proclivity to such disease, which medical treatment can rarely arrest, although it may succeed in curing the individual attacks even of such hereditary diseases as proceed steadily to a fatal issue. The different forms of insanity, epilepsy, and other nervous disorders, gout, and scrofula, rarely admit of a perfect cure under these circumstances.

Much depends upon the *strength* of the patient at the period of his attack. That a feeble constitution, or the debility entailed by previous sickness, should exert an unfavourable influence, is self-evident, and is only alluded to in this place to enforce the propriety of making strict inquiries in regard to the patient's former health, in order that the physician may become possessed of all facts which can assist in maturing his judgment in regard to the case before him.

The *disposition* of a patient, and his habitual cheerfulness or dejection, control to some extent, the issues of disease. Many bear pain with fortitude, become resigned to the prospect of a long confinement, and the interruption of their ordinary pursuits, and are gay and hopeful in the midst of imminent perils. Others no sooner fall sick than they grow peevish, irritable, unreasonable, and impatient of restraint; they are disposed to brood over the evils of their situation, and to entertain the most gloomy apprehensions. It is apparent that the same disease must affect these two classes of persons very unequally; that it will, very probably, fail to exhaust the good spirits of the former, and will acquire additional gravity from the despondency of the latter.

Habits and occupation are not without influence upon the character of diseases. It is a familiar fact, that drunkards are amongst the easiest victims of disease; they readily succumb under injuries and surgical operations, and during severe epidemics, very few of them escape alive. There are, indeed, exceptions to this rule; cases in which intemperance seems to produce insensibility, and a power of passing unscathed through the severest trials of the constitution, resembling that of the lower animals. But in a large majority of instances, habitual indulgence in alcoholic drinks creates an inability either to resist disease, or to sustain medical treatment. All other debilitating causes have a like effect, such as prolonged abstinence, the exclusive use of vegetable food, over-fatigue, loss of sleep, immoderate study, venereal excesses, the indulgence of any of the emotions, and particularly those of a gloomy character.

Amongst the external influences which modify the course of disease, and consequently the opinion to be formed of its gravity, none is more efficient than the prevalent medical, or epidemic constitution. It sometimes imparts a singular gravity to the milder sort of affections, deprives the more dangerous ones of their accustomed severity, or causes some one organ to suffer in nearly every malady, and thus obliges the physician to form a prognosis different from that he would adopt under ordinary circumstances. In illustration of these points, it will be sufficient to mention the typhoid type, which, at times, every acute disease assumes; the very mild epidemics of the eruptive disorders which occasionally occur, and the tendency to cerebral, pulmonary, or intestinal inflammation, which, now and then, seems to form, as it were, a parasitic attachment to all forms of disease. The prognosis in epidemic diseases varies according to their period; at the commencement of the epidemic, it is not uncommon for nearly every person attacked to die; the relative mortality begins to decline along with the positive mortality, and towards the conclusion of the epidemic, very few cases of it are fatal.

The *social condition* of the sick has a large share in determining the degree of their suffering, and the chances of their recovery; and this influence is not always in favour of those who are most amply provided with the comforts of life. This is strikingly shown by the results of the treatment of insanity. Occupation, and particularly manual labour, which is of more value in the management of this affection than all the other means combined, is generally so repugnant to those who have never been accustomed to toil with their hands, that they cannot be induced to pursue it, and hence they but too often remain unimproved, while their less delicate fellow-patients work out their salvation from the direst of all human calamities. The poorer classes, those which do not possess even the comforts of life, and at the same time furnish the greatest number of instances of vice, suffer most heavily from disease. From these classes come the inmates of hospitals and almshouse infirmaries, who have long continued to be the principal models from which scientific writers have drawn their descriptions of disease. But the prognosis which is applicable to their diseases, differs essentially from that of the same affections in private practice, and amongst persons in less straitened circumstances. By nothing is this so clearly proven, as by the excess of mortality amongst the sick in public institutions, over that in private practice, and especially as regards young persons and children. On the other hand, the poor, who at their own lodgings can neither command the best medical attendance, nor proper nursing, food, or medicine, have an infinitely greater chance of recovery by being removed to an hospital, where all these elements of a good treatment are bountifully provided. The improvement which those of them suffering under chronic disorders, experience by the mere residence in a well-conducted hospital, and before they are subjected to any medicinal treatment, attests the favourable influence of their change of circumstances.

The preceding remarks must not be understood as in any degree disparaging the published labours of hospital physicians. Without them, medical science would scarcely exist. But their highest value is derived from the light which they throw upon the department of diagnosis. In prognosis and therapeutics, their results must be modified by the study of disease in other classes of society distinguished by peculiarities arising out of their social position and luxury, or their various pursuits, as agriculture, manufactures, &c.

PART III.

SEMEIOLOGY.

SYMPTOMS AND SIGNS DEFINED. VARIETIES OF SYMPTOMS. VALUE OF SEMEIOLOGY.

SEMEIOLOGY is that part of pathology which treats of the *signs* of disease. It differs from symptomatology, which treats only of *symptoms* in the abstract. The terms sign and symptom are very commonly, but erroneously, employed by medical writers as synonymous. This leads, as do most other inaccuracies of language, to a misconception of things, to confounding together an actual phenomenon, and an operation of the mind, and prevents a clear apprehension of the place which symptoms should occupy in the investigation of disease. Before entering, therefore, upon the department of semeiology, it is proper that the meaning of the terms just mentioned, should be strictly defined.

The phenomena of disease are symptoms. All that instructs us in regard to what is hidden or obscure in the past, present, or future state of a disease, is a sign. *Signum est id quo cognito alterius ignoti notitiam inducit*, is the definition of Galen. Hence, every symptom may become a sign, but every sign is not a symptom; thus the character of the cause may be a sign of the nature and probable course of the disease, but it is not, therefore, a symptom. A quarter-dollar may be described by enumerating its colour, specific gravity, &c.; these, its qualities, are to it, what symptoms are to a disease. But if the white colour and weight of the coin be employed to distinguish it from a half-eagle, which it resembles in form and impression, and its value in cents is declared as indicating what it will buy, the colour, weight, and numerary value, become so many signs; diagnostic signs distinguishing the piece of money from another one, prognostic signs determining how much food or other commodity a tradesman will give in exchange for it. Symptoms, therefore, are converted into signs by the mental act of the observer. A patient may be more familiar with the symptoms of his complaint, than the physician; yet his knowledge is useless, for he cannot convert them into signs; he is unable to learn what they signify. This it is the physician's province to do, and this he must do, as a preliminary step to any rational judgment in regard to the nature of the disease, or the treatment which it calls for.

Symptoms are of various kinds. An important division is into *local* and *general;* the former manifesting themselves in some particular locality, the latter in nearly every part of the economy at once. To these may be added *sympathetic* symptoms, which are indeed local, but developed at some point distant from that primitively affected, and dependent upon its disorder for their existence. Thus in inflammation of the testicle, pain, redness, and swelling, are local symptoms, fever a general, and tumefaction of the parotid gland when it occurs, a sympathetic symptom. But, in strictness, there is no real difference between general and sympathetic symptoms, except that the former take place in systems which pervade the whole body, as the skin, the blood-vessels, &c., while the latter are evinced by organs of more limited extent. The connecting link between a local malady and its general symptoms is quite as obscure, as that which gives rise to the sympathetic disorders peculiar to any disease.

Premonitory symptoms are those which usher in a disease, and which indeed form part of it; but, as several amongst them, such as chill, fever, debility, headache, &c., are common to the invasion of numerous maladies, they are usually spoken of as if they did not belong to the attack which is about to follow.

A *Pathognomonic* symptom is one that is characteristic of a disease, and, although alone, indicates its nature, because it exists in no other affection. Symptoms of this sort are very few indeed, and in every case, perhaps, consist in some *physical* accident or attendant of the malady. The discharge of worms is of course a certain sign of verminous disorder; that of false membrane from the larynx, of croup; that of calculi from the bladder, of lithiasis; the detection of the acarus scabiei is conclusive of the itch; &c. But there are, in each of several affections, a few symptoms which taken together may be regarded as characteristic, or so strongly indicative of a particular disorder as to leave but little room for doubt. An acquaintance with these is all-important in practice, since it at once leads the physician to a probable diagnosis, and directs him to the particular points upon which his subsequent examination should chiefly bear. Thus if he find that there is cough, stitch in the side, rusty and tenacious sputa, and crepitant rhonchus, he can have but little doubt that the case is one of pneumonia; or if he observes fever, præcordial oppression, and a rubbing or to-and-fro sound over the heart, he may feel assured that he has before him a case of pericarditis. Just in proportion to the minuteness with which symptoms are studied, and the accuracy of the value assigned to them, will these characteristics of disease become more and more certain, and diagnosis be divested of its difficulties.

It is customary to speak of functional phenomena only as symptoms, and of those revealed by physical exploration as signs, as if the latter were *par excellence* significant. Besides being, as already shown, an abuse of language, such a phraseology is founded on a purely arbitrary division. For it surely constitutes no essential difference between two phenomena, that one is perceived by the sense of hearing and the other by that of sight. A pulmonary rhonchus is appreciated by the senses neither more nor less than paleness or emaciation. No one denies that the character of the pulse is a symptom, yet this is quite as much a physical phenomenon as the dulness of the chest in pleurisy; and it is perceived by the very same sense, that of touch, which measures the size, and estimates the consistence of an abdominal tumour. The only difference is that the last two phenomena are supposed to require a more careful, prolonged, and difficult examination than the first.

In the ensuing chapters the symptoms furnished by each of the systems of the body will be studied; not by an enumeration of them merely, but also by a review of their relations to diagnosis and prognosis. Semeiology is thus shown to be the key to the language of symptoms; to be the interpreter of disease. When once well learned, the history of particular diseases seems like illustrations of settled principles, and is divested of most of the difficulties and apparent contradictions which so often, and with such good reason, discourage the student when he first reads a treatise, or hears a course of lectures on "the Practice of Medicine." He is then as apt to be bewildered as one who should study chemistry without preliminary notions about heat, light, electricity, and affinity; the descriptions of action, reaction, and combination which fill his text-book, would seem to him little better than a barbarous jargon. The elements of disease, the individual symptoms, must be presented to the student's mind in their simplicity, before he can comprehend them in their natural combinations. By dissecting a disease, as it were, by considering its symptoms separately, and comparing each of them with analogous ones in other affections, he arrives at what is essential to constitute each symptom, to examine it as disentangled from those which ordinarily accompany it, and hence to form a correct notion of its importance under whatever circumstances it may afterwards be observed.

CHAPTER I.

SIGNS FROM THE EXTERIOR OF THE BODY.

ALTHOUGH, for the present purpose it matters little what part of the body is first examined, in relation to the diagnostic and prognostic signs furnished by it in disease, yet it seems most natural, and it accords with the best usage, to consider first that which first presents itself to the observation of the physician, in the body taken as a whole; then to examine, in due succession, its cutaneous surface, the several portions of this latter which are especially connected with internal organs, and the several systems which are charged with distinct functions.

The condition of the exterior of the body is very intimately connected with that of the vital organs, and presents many points from which their degree of energy may be inferred. The posture assumed by the patient, the development of the whole frame, the colour, temperature, and secretions of the skin, the muscular strength, are, all of them, circumstances which it is important to observe. Some one of these, or several of them united, frequently communicate to the physiognomy of the patient an expression which reveals to a practised eye the nature of his disease. Indeed they have to such an observer a significance far beyond what he is able to explain by their analysis, just as those most expert in reading a man's character in his face, are often the least capable of describing the form or feature which is indicative of a particular passion or propensity.

SECTION I.

THE POSITION AND SIZE OF THE BODY.—COLOUR, TEMPERATURE, ETC., OF THE SURFACE.

A patient's attitude presents some valuable indications, whether he stands, or sits, or lies down. In the erect position, if one shoulder is higher than the other, it may arise from lateral curvature of the spine, from contraction of the lower side of the chest after pleurisy, from dislocation of the shoulder joint, or be owing merely to the habit of writing in a sitting posture. If the body is thrown very much backward, it may depend upon the feeling of insecurity which attends commencing paraplegia. The greater or less vigour of the movements of one side of the body in walking, the dragging of the foot, or loose swinging of the arm, are observed in partial hemiplegia. Irregular and rapid twitching of the limbs and trunk in different directions are characteristic of chorea; more violent movements of the muscles belong to the several forms of convulsion; that condition in which a limb retains any position which is given to it indicates catalepsy; and the rigid contraction of the muscles upon the anterior or posterior part of the trunk, bending it in the form of an arch, is a symptom peculiar to tetanus.

In most diseases the ability to maintain the erect position is of good augury, provided the patient has not, immediately before, been confined to bed, or that he has regained this power after regular convalescence. But when the disease itself forces the patient to stand, or sit up, it is a very unfavourable sign. This occurs in most of the affections of the thoracic and abdominal cavity in which the function of respiration is directly or indirectly impaired, for in any other position the patient cannot so readily breathe. Yet, as a general rule, the relief afforded by it in organic disease, is only partial and temporary, besides which it exposes to sudden death by syncope. This danger is, however, much more imminent in diseases attended with great debility; in these the desire of the patient to stand or sit indicates mental aberration. The hazard is still greater if the individual is at the same time distinctly delirious. The immediate cause of death in many cases of phthisis, dysentery, uterine hemorrhage, typhus fever, &c., is syncope, induced by sitting up to obey the calls of nature, or for the sake of change.

Decubitus is the position assumed by a patient while lying down. It affords numerous and valuable signs. A healthy person in bed usually lies upon the right or left side, with the limbs semi-flexed, the head bent somewhat forward, and the whole body in an unconstrained and easy posture. The nearer the position of a sick person corresponds to this, the less grave, in general, is his disease. In most affections there is some departure from this mode of lying; but since there are individuals who, even when perfectly well, take a very different posture from that just described as the ordinary one, their habitual position should be learned before any inference is drawn from the peculiarity of their decubitus in sickness.

The supine position, or dorsal decubitus, is that which belongs to nearly every disease of debility; it is the one which gives the greatest support to all the limbs, and leaves the freest play to the lungs and heart, and is therefore instinctively assumed when exhaustion is extreme. It is also, however, met with when the pain attending motion is so intense as to force the patient to remain perfectly still, as in acute peritonitis, and in general articular rheumatism. Its different degrees indicate those of exhaustion. The patient may simply lie motionless without the power of turning upon his side, or he may have his knees drawn up, or, in spite of all the efforts of the attendants, he will slide down towards the foot of the bed; or his arms may be thrown to a distance from the body, and the lower limbs widely stretched apart; if he lies thus and still slips downwards in bed, with the head thrown far backwards, the neck prominent, or the chin resting upon the chest, it may be concluded that he has not long to live. Some of these symptoms, as will readily be understood, may occur in paraplegia, without bearing so unfavourable an interpretation; the condition of the lower extremities disposes the patient to lie upon his back, and prevents him from resisting the force of gravity which carries his trunk downwards.

It is unusual for a sick person to lie prone, or on the abdomen, and it either indicates that he is suffering from an attack of those colicky or cramp-like pains in the belly, in which pressure affords relief; or that he is hemiplegic and has accidentally turned upon his face, and is unable to resume his previous posture; or, finally, that he is threatened with delirium.

Lying upon the side, or upon one rather than the other, has no importance in prognosis, but is regarded by many authorities as having a real value in the diagnosis of diseases of the chest. Some, however, have maintained that the patient prefers lying on the affected, and others on the sound side, when one lung or pleura is alone diseased; while others believe that the sign in question is of no value whatever. It must indeed be admitted that its value is not constant; nevertheless, there is a true relation between the lateral decubitus and the side of the chest affected. In the forming stage of pneumonia and pleurisy, when the stitch in the side is felt, this part is usually sore if handled or percussed, and the suffering is increased when it is pressed beneath the weight of the patient's body. So long as this pain lasts, he avoids aggravating it, and lies upon the opposite side. After a day or two, the severity of the pain gives way to dyspnœa; as the hepatization of the lung proceeds, or the pleural cavity is distended with serum, the patient instinctively takes the best means in his power of giving a large expansion to the healthy lung by lying upon his back, or upon the affected side. Hence, it may be received as pretty generally true, that the patient lies upon the sound side only when it gives him pain to lie upon the other. Such at least is the case as regards thoracic affections; in hemiplegia, on the contrary, there is a constant tendency to turn upon the weaker side, which, as already pointed out, may become a source of danger. When both cavities of the chest are diseased, the dorsal decubitus is nearly always preferred.

The sitting position has already been mentioned as the one generally assumed in cases of great difficulty of breathing, attended with structural or inflammatory disease of the lungs, heart, or abdomen. The recumbent position growing intolerable as the disease advances, the patient first has his head raised by pillows, and then gradually assumes a more and more erect posture, until he sits upright, or upon the side of the bed, grasping his knees, the back of a chair, or some other article, by which means the shoulders become fixed points, and the respiratory muscles attached to the upper extremities, act most favourably in expanding the chest. This posture is assumed in orthopnœa, from whatever cause it may arise. When the trachea is the seat of a physical obstruction, as in membranous croup, the patient not only sits up and grasps some steady object, to aid the action of the respiratory muscles, but usually stretches out the throat by throwing the chin upwards, and the head backwards.

In most cases of extensive palsy, and of that dulness of intellect which is apt to accompany softening and tumours of the brain, and the commencement of dementia, the patient often obstinately maintains the same position, and if disturbed, will soon relapse into it. There are other diseases, however, which are marked in some part of their course with great agitation and restlessness. The patient tosses about in bed, or is perpetually rising up or lying down, or will not be persuaded to remain in bed, all of which shows either the presence or imminence of a severe febrile attack. It is a state of things which very commonly precedes the appearance of the eruption in the exanthematous fevers. In this connexion it is of subordinate consequence, for it does not form an index of the subsequent gravity of the attack ; but when it arises in the course of an acute or chronic disorder, it must be viewed with alarm, for it usually announces some serious complication, or marked aggravation of the original disease. Tremor, which is a sort of subdued agitation, is the usual concomitant of low typhus fever ; it is also one of the prominent symptoms of a disease, to which, indeed, it has given a name, *delirium tremens ;* and of an affection peculiar to old persons, and one whose organic causes are not well understood, to wit, *paralysis agitans*,—the shaking palsy.

Size or volume.—These qualities of the body demand consideration in connexion with the present subject, for its increase or diminution in size is produced by nearly every disease. The former is due to one of four causes; an accumulation of fat, or obesity; an afflux of blood or other liquids to certain parts; the effusion of serum in serous cavities or cellular tissue, constituting the several forms of dropsy; and the introduction of air into, or its generation within the body.

A moderate development of adipose matter is indicative of health, but that excess of it which is known by the name of obesity, or polysarcia, is in reality a disease. It is a condition most frequently observed in middle life, and amongst the indolent and luxurious of both sexes, but especially of females. In the latter it is very apt to come on after child-bearing has ceased, and in males who have relinquished the active and anxious pursuits of commerce and trade, for the serene occupations of the *bon-vivant;* but men engaged in laborious and active employments rarely grow fat. In obesity, the adipose matter is not always equally distributed over the body, but is more apt to be inordinately developed in the walls of the abdomen, and the great omentum, than elsewhere. It has been known to reach a thickness of fourteen inches in this situation.

Corpulent persons offer very little resistance to the attacks of disease. No sooner are they laid on a bed of sickness, than their fat seems to lie like a vast incubus upon them, oppressing their breathing, preventing a change of position, and rendering the parts in contact with the bed very liable to inflammation and gangrene. Such persons, too, are usually of feeble constitution; their muscles becoming atrophied while the weight of their body increases, they grow more and more unable to take exercise, and readily sink under disease. In general, too, they are short-lived, as well from the direct influence of their obesity, as from the affections to which it gives rise. Such are congestion of the brain, apoplexy, and gout; attenuation, softening and rupture of the heart, and syncope from the feebleness of the cardiac muscles, which are replaced by large masses of fat, all of which conditions may become causes of sudden death. It is not uncommon after acute diseases, typhoid fever for instance, for an individual to grow fat, and this, if it accompany a good appetite, and a sense of general well-being, indicates a beneficial change in the character of the constitution. In the gloomy forms of insanity, which are, like the depressing passions generally, attended with loss of flesh, increase of size is a most favourable sign, provided that at the same time the mental condition improves; but there is no more conclusive indication of the incurability of insanity than improvement in flesh, while the mental disorder continues unabated.

A general augmentation of the bulk of the body from the abnormal distribution of its fluids, is, of course, impossible. The real or apparent fulness which exists during the first stage of febrile affections, and especially of the exanthemata, is in all probability owing to the suspension of the excretions from the skin and bowels; it is nearly always accompanied with redness and heat of skin. Local tumefaction from the cause in question, may depend upon the presence in the vessels of a part of more blood than natural, as is seen in erythematous and erysipelatous inflammations; or upon an effusion or deposit of serum or other substance, in the cellular parenchyma, or in some membranous cavity. In the large serous effusions constituting dropsies, the local tumefaction is always attended with general loss of flesh, as is well shown when the fluid contained in a dropsical abdomen is removed by tapping. General dropsy of the cellular tissue is called anasarca; the same affection when local, œdema; and serous effusions into different cavities, have received appropriate names, as hydrothorax, water in the chest; hydrocele, dropsy of the *tunica vaginalis testis;* hydrarthrosis, dropsy of a joint; &c. Some of these forms of tumefaction are very important in diagnosis. Œdema about the ankles may arise from any cause of general debility, such as chlorosis, convalescence from acute disorders, or simply remaining for a long time in the erect posture; but, aside from these connexions, it is one of the first evil signs of valvular disease of the heart. Œdema of the eyelids and face, which may also proceed from the same debilitating causes, is, in their absence, a strong indication of Bright's disease of the kidney. Ascites may form as a part of general dropsy, but when it occurs primarily, it is nearly always due to structural changes in the liver or spleen. Hydrothorax and hydropericardium, (not pleurisy and pericarditis,) are usually incidents of general dropsy. Hydrocephalus, ovarian dropsy, hydrocele, and œdema limited to a part of one side of the body, are nearly always owing to strictly local causes, the last, generally, to obstruction of a venous trunk leading from the swollen part.

Local or general enlargement of the body may arise from *emphysema*, or a puffiness of the skin from air confined in the cellular tissue beneath it. When general, it almost always proceeds from penetrating wounds of the chest. The rising and falling movement of the ribs acts like that of a pump, and forces air into the cellular tissue upon the edges of the wound, whence it is disseminated over the whole body, and to such a degree, sometimes, that the skin becomes as tight as a drumhead, and may render incisions in various parts necessary, to give exit to the air. The distended integuments do not, as in anasarca, pit upon pressure, but feel elastic under the finger, and give the sensation, and sometimes the sound, of crepitation. Local emphysema is observed in the neighbourhood of gangrenous wounds. It is often met with in dissections, but is then usually the result of decomposition after death. Air is occasionally generated or liberated in the cavity of the pleura, independently of any connexion between it and the lung or the surface of the body, forming a rare variety of pneumothorax. Very frequently it distends the abdomen, by collecting within the intestinal canal. This condition is known as *tympanites*. It is an ordinary incident of hysteria, and in that case is unattended with danger. But when it arises in consequence of inflammation of the peritoneum, it portends a disastrous result. It is said, also, to be capable of destroying life when it takes place in a female recently delivered, and exhausted by loss of blood, through the impediment it creates to the descent of the diaphragm, and the dyspnœa and syncope which thence result.

Cellular emphysema, even when general, is not commonly attended with serious results. The affection is very annoying while it lasts, but is of short duration, for the effused air is gradually removed by absorption. Cases are, however, recorded by Larrey, and P. Frank, in which the swelling of subcutaneous emphysema was so great as to produce asphyxia and apoplexy, by compressing the air-tubes and jugular veins. General anasarca is rarely dangerous, unless it depends upon organic disease; in that case, it, as well as all other forms of dropsy of similar origin, are with difficulty, if at all, curable.

Loss of flesh is, perhaps, the most unfailing of all the symptoms of disease, and varies so much in degree, and the circumstances under which it occurs, as to constitute a valuable sign. It may depend upon some general cause affecting nutrition, such as sorrow and anxiety, loss of rest, over-fatigue, insufficient food, prolonged lactation, habitual excesses in the use of alcoholic drinks, old age, &c.,—causes which are not properly diseases. When progressive emaciation is observed without any apparent physical cause, these influences ought to be taken into consideration.

In acute diseases, unless accompanied with profuse discharges, there is little or no emaciation during the active stage; but in such affections as cholera morbus, a few hours may suffice to reduce the size of the body to a wonderful extent. In other acute disorders, the subsidence of fever corresponds to the commencement of emaciation, which proceeds from day to day, until convalescence has fairly set in, and nutritious food may be taken, without the risk of renewing febrile reaction. Such temporary emaciation is to be regarded as a favourable sign, in so far as it indicates the decline of disease; but if, instead of being temporary, the loss is constant and progressive, and that in spite of the most nutritive and even stimulating diet, there is good reason to suspect the existence of some latent organic disease, such as tubercles, whose development has been hastened by the accidental acute disorder. Many cases of fatal consumption may thus be dated from the occurrence of pneumonia, pleurisy, or typhoid fever; not that these diseases have any especial tendency to generate tubercles in the lungs, but that they so weaken these organs as to prevent their resisting any longer the hereditary or acquired proclivity to tubercular disease.

When acute diseases are prolonged greatly beyond their ordinary term, emaciation ceases to be a propitious sign. Its progress indicates the gradual exhaustion of the powers of life, the imperfection of the assimilative function, and the supervention of a degree of debility which mere medicine is powerless to remove. Such cases usually owe their cure to change of air or diet, a visit to the sea-shore, to the mineral springs, &c. The most striking examples of emaciation cured by such means, are presented by children with enteritis, (summer complaint,) and, more rarely, by adults labouring under chronic intestinal fluxes. Every one accustomed to see infantile diseases in this country, must have met with many instances of children in the last stage of emaciation, (marasmus,) and looking almost too feeble either to swallow or cry, who have begun to revive, immediately on being removed from the city, and in a few weeks gained a ruddy complexion, and plump, firm flesh.

But it is in chronic diseases of a slow and insidious nature, that emaciation is most considerable, and of most evil augury. It is often, for a long time, the only sign of pulmonary tubercles, and may even be well marked before the deposit of these bodies can be detected by the aid of auscultation and percussion. This is peculiarly true of the cases in which the tubercles are not, as more commonly happens, confined to the summit of the lung at the commencement, but are disseminated throughout the whole extent of both lungs. In them the occurrence of hæmoptysis with progressive emaciation, is quite sufficient to determine the character of the disease, and foreshadow its fatal issue. Cancer does not, in general, exert so marked an influence upon nutrition, until it reaches the stage of softening, unless it be so situated as to form a mechanical impediment to the performance of an important function. This is what takes place when a cancerous deposit is formed around either the cardiac or the pyloric orifice of the stomach, causing the rejection by regurgitation or vomiting, of a large part of the food, and, as a consequence, rapid and extreme emaciation.

The great loss of flesh which occurs in several affections is usually attributed to the profuse discharges which attend them; thus in pulmonary phthisis the loss by sweating and diarrhœa is very considerable; in uterine cancer by hemorrhage and suppuration; in diabetes by a discharge of urine, &c.; but this explanation is not applicable to all cases. Fever, without any remarkable loss by excretion, is always followed by emaciation, but its mode of action is not well understood. In chronic diseases the supervention of fever, without inflammatory complication, generally indicates that the attack is about to commence its downward course.

The *colour of the skin* depends partly upon the race, age, temperament, and degree of exposure to light and heat, and partly upon the state of health of the individual. The latter concerns us chiefly at present. *Paleness* of the skin may arise from whatever causes repel the blood from the surface of the body; or so diminish its amount as to leave the superficial capillaries unfilled; or alter its composition, by diminishing its proportion of red globules, or increasing that of water. Hence cold baths or damp cold air, depressing mental emotions; hemorrhage, vomiting and purging; chlorosis, scurvy, Bright's disease, &c.; render the skin pale. Long confinement in badly-lighted rooms, even without positive disease, has a similar effect.

Paleness occurring at the commencement of the decline of acute diseases, is, like emaciation, a normal occurrence, and therefore a favourable sign; but when it takes place suddenly at an earlier stage, particularly if the skin has just before been red, it is of evil augury. In chlorosis and anemia there is not a pure paleness of the skin, but a hue like that of imperfectly bleached wax, or a light straw-colour with a shade of green. In cancerous affections this hue is modified by a slight admixture of lead-colour, forming an olive or earthy complexion which is very characteristic. A *livid hue* approaching to blackness is observed in parts about to become gangrenous, and especially in dry gangrene, which sometimes affects a whole limb at once. A less intense colour, a bluish, or as it is called, *cyanotic* hue, is frequently met with in new-born infants and others in a state of asphyxia, when any obstacle to hæmatosis exists in the lungs, causing a stagnation of blood in these organs; in severe attacks of cholera; and, above all, in the disease whose principal symptom is blueness of the skin, and which is hence called cyanosis. In all of these examples, the cutaneous discoloration is due entirely to congestion of the venous capillaries, in consequence of some obstacle to the return of the blood to the heart. This explanation of the phenomena of cyanosis is not that which has generally been accepted. It has for a long time been taught that in all cases of congenital cyanosis, the foramen ovale of the heart remains open, and permits the dark venous blood of the right side of the heart to mingle with the bright arterial blood of the left side. This admixture, it has been alleged, forms a dark-coloured fluid which communicates to the skin a cyanotic hue. Louis was the first person of recent times to call this doctrine in question; and, as early as 1826, he showed that a communication between the two sides of the heart might exist without the concurrence of cyanosis, and that on the other hand this colour might arise without any malformation or disease of the heart whatever. He further stated the conclusion that many cases of the affection were owing to congestion, produced by an obstacle to the venous circulation. These views were more or less fully adopted by several distinguished medical men in France; but the doctrine previously taught continued to prevail. In 1843 Dr. Moreton Stillé, in his inaugural thesis, proved by the analysis of a large series of cases, that the cause of cyanosis was *uniformly* either contraction, obstruction, or imperforation of the pulmonary artery, or else some physical impediment to the natural course of the blood possessing a similar mode of action, such as concentric hypertrophy of the right-ventricle, singleness of the heart with contraction of the auriculo-ventricular opening, &c. This conclusion has since received ample confirmation, and especially from the investigations of Dr. Norman Cheevers of London.

It is remarkable that the explanation given by Morgagni of a case of cyanosis witnessed by him, and which tallies precisely with the results of the laborious analyses above alluded to, should have, for so long a time, failed to convince pathologists of their error in attributing to admixture of arterial and venous blood the phenomena of cyanosis. Morgagni, after describing the case, and the dissection which he made upon the patient's death, disclosing a contracted and ossified pulmonary artery, declares this lesion to have been the cause of the symptoms; for, he remarks, "the contraction of the pulmonary artery allowed a very diminished quantity of blood to pass through it and the corresponding vein to the left side of the heart, so that less blood than natural was circulated through the body; and on the other hand, it caused the blood to accumulate and stagnate in the right ventricle, then in the right auricle, and finally in all the veins, *whence resulted the discoloration of the skin*, the dilatation of the right cavities, and the opening of the foramen ovale whose valve was pressed by more blood upon the right than upon the left side." The confirmation of this ingenious statement by the result of an analysis of all the cases of cyanosis that could be collected, is a beautiful illustration of the uniformity of nature's laws, and a proof of the rare sagacity of the great founder of the pathological school.

Nitrate of silver, when administered internally, is very apt to produce an indelible slate-colour of the skin, and even of the viscera, in persons long subjected to its use. Not many years ago this agent was much employed in the treatment of epilepsy, but unfortunately its influence was much more distinctly marked upon the patients than upon their disease. This discoloration is of course readily distinguished from all others by its peculiar shade, as well as by a knowledge of its cause.

Redness of the skin is never general, except in some acute eruptions, such as scarlatina, measles, and small-pox; in the greater number of diseases it is either limited to the face, and is marked only during the early stage, as in fevers of an active type, and inflammations of internal organs, or is local in a more restricted sense, being confined to portions of the surface upon or near which the inflammatory process is going on. Thus it attends inflammation of the skin, whether this results from direct injury, or arises from some constitutional cause. There may, however, be a redness which is not inflammatory, but due to the extravasation of blood into the cutaneous tissue, as in low forms of fever; or to congenital dilatation of the capillary veins, as in *nævus maternus;* or simply to some temporary impediment to the circulation through a part, as where a limb is tightly encircled with a band. In the former class of cases, the colour is bright or almost scarlet, but in the latter it approaches more nearly to the hue of venous blood. When the livelier colour suddenly disappears, leaving the skin pale, or is exchanged for the darker shade, the prognosis becomes highly unfavourable. This is strikingly true of the colour of the skin in exanthematous fevers.

Jaundice, or yellowness, is another important alteration of colour. It is of various shades between bright lemon and dark olive, depending a good deal upon the natural complexion of the individual; it is lighter in the young and fair, and darker in the old and tawny. The icteric tinge is not only seen upon the surface of the body, in the skin and conjunctiva, but also in the serum of the blood, in the urine, sweat, and the excretions generally, and in nearly all the tissues of the body. Yet it is remarkable, that the mucous membrane, with its secretion, and the saliva, are scarcely ever stained of this colour. This difference may, perhaps, be accounted for by the fact, that the skin and kidneys are excretory organs, whose principal office it is to separate from the blood, substances which are unfit for the purposes of nutrition, while the mucous membranes and the salivary glands are destined principally to form new compounds, which have important purposes to subserve in the economy. The bile pigment, therefore, circulating in the blood, where it does not naturally belong, at least in any notable quantity, is more likely to be eliminated with the sweat and urine, than with any of the true secretions.

A notion formerly prevailed, that every object appears yellow to jaundiced persons, and the idea has been incorporated into poetical and popular language. It is not, however, correct. The disorder of vision in question, exists only in a small proportion of cases of jaundice, and is caused by yellowness of the vitreous humour and cornea.

The immediate cause of yellowness in jaundice is the deposit of the colouring matter of the bile in the skin, and other tissues and fluids. This substance must be presumed to exist in the blood of jaundiced persons, and has indeed been found there, by the greater number of competent chemical analysts; but it ought not to be concealed, that some even of the most distinguished, have declared themselves unable to detect its presence. Others claim even to have demonstrated it in healthy blood; and it cannot be denied, that without the admission of this claim, its existence in icteric blood must be accounted a mystery. The prevalent belief is, that the bile pigment is absorbed, after having been secreted by the liver, an opinion founded upon the most ordinary cause of jaundice, the obstruction of the ductus communis, or one of the branches of the hepatic duct, by a gall-stone, by the pressure of a tumour, &c. But amongst the cases of most intense jaundice, are those of an acute kind, attended with comatose symptoms, in which it is alleged that the secernent cells of the liver are wanting, and in which, therefore, no biliary secretion can take place. Jaundice, in these cases, does not seem explicable upon the same principle as in the former, and in order to obtain an explanation at all satisfactory, and which will apply to all cases, there seems to be no other alternative than to admit that the colouring matter of the bile, and it may be, other constituents of this fluid, exist originally in the blood, and there accumulate, whenever the liver becomes gorged with bile, in consequence of the closure of its outlets, or of the destruction of its secernent cells. Yet this mode of accounting for jaundice does not remove all difficulties; it does not explain how the symptoms should be so different between suppression and retention of the bile, and obliges us to look further into the states of the system accompanying these two conditions. From such an examination, it will probably appear that the difference in gravity of the two affections depends, not on the presence of more or less of the elements of bile in the blood, but, in the one case, in suppression of bile, upon a radical alteration of the latter fluid, a *poisoning*, as it has been called; and in the other, upon the nature of the affection, whether inflammatory, mechanical, or malignant, which produces the retention.

However these things may be, jaundice, as a symptom, is valuable in diagnosis. It is a phenomenon of several fevers prevalent in tropical and adjacent regions, the remittent, bilious, and yellow fevers; but it is chiefly useful, by the mode of its accession, in distinguishing from one another, several affections which interest the liver. When it comes on with indigestion, slight fever, sluggishness, and uneasiness in the right hypochondrium, and after a week or two disappears under the influence of diet and purging, it must be regarded as depending on a disorder, which, if not absolutely functional, is, at least, not purely inflammatory. When it follows violent and spasmodic pain in the region of the liver, it is attributable to the arrest of a gall-stone in the biliary passages; when it precedes delirium and coma, or convulsions, it indicates disorganization of the hepatic cells; when it comes on slowly, lasts a long time, and acquires a very dark tinge, it commonly depends upon some organic disease of the liver, or the adjacent organs, capable of obstructing the discharge of bile from the ducts; and finally, when it succeeds a fit of violent passion, it is neither attended nor followed by any other symptoms.

From this sketch, it is plain that jaundice is of but little consequence in prognosis, since the symptoms with which it is associated declare much more positively than itself, the gravity of the affection in which it occurs. Alone, it involves no danger; it is often found in persons who, apart from their yellowness, appear to be in perfect health. Examples, even, are known of children who were jaundiced, and yet thrived well, and in whom, after death from some accidental affection, the gall-ducts were found impervious, or even entirely absent.

Allusion has already been made to the red spots which appear upon the skin, in consequence of dissolution of the blood. These may be comprised under the general title of purpura, which includes the eruptions without fever, and the petechiæ, which accompany certain febrile diseases. In the non-febrile disorder, the spots may vary in size, from a line to an inch in diameter, and are always below the surface of the skin; but in petechial fevers, the eruption consists of small points resembling flea-bites, (*petechiæ*,) except that they have not around them a light-red disk, but like these latter, they project slightly above the surface. Neither form, however, disappears under the pressure of the finger. The shoulders, and other parts where a fold of the skin has been pinched by the weight of the patient, often present a line of minute extravasations, looking precisely as if caused by a blow with a whip-lash, whence they are called *vibices*. Petechiæ are met with in all diseases in which the proportion of fibrine in the blood is very much diminished. In typhoid fever they are rarely seen, but they are characteristic of that form of typhus which is most common in Great Britain and Ireland, and which has recently prevailed so extensively among the emigrants from the latter country.

The *temperature* of the human body is subject to a great many variations, even in a state of health. It is lowest at the two extremes of life, and highest at the middle of the period between them, but is constantly changing under the influence of external temperature, food, clothing, exercise, &c. Its average degree, as measured by Fahrenheit's thermometer, is about 100°. In disease it seldom rises more than two degrees above this point, although it has been observed, in a case of tetanus, as high as $110\frac{3}{4}$°. The depression of temperature in certain cases, is much more considerable, for in the cold stage of Asiatic cholera, the thermometer applied to the skin has fallen to between 70° and 80°.

But the thermometer is seldom employed in pathological investigations, except when the deviation from the natural standard of heat is very striking. Ordinarily, the sensations of the patient, and those received by the hand of the physician, furnish much more important indications; for it is not the temperature of the skin alone considered, which is the object of inquiry, but certain feelings, also, of dryness, moisture, pricking, and clamminess, which can only be appreciated by the touch.

The patient may also feel very cold or warm, without its being possible to detect any departure from his natural temperature. This appears to depend upon the morbid sensibility of the nervous system, for it is most frequently observed in nervous and hysterical females, and in those who suffer from irregularity of the catamenia. A person of this description may even be shivering all over, while the skin retains its usual heat. The writer has also seen a young man who had over-fatigued himself with a long walk, shaking as violently as if he were in a fit of the ague, although his skin was even warmer than natural. In speaking, then, of coldness and heat of the body, it will be understood that they are referred to as sensations, rather than states indicated by the thermometer.

Coldness is an important pathological sign. It may exist in various forms and degrees, either as a sense of simple loss of temperature, attended with stiffness, pallor, and corrugation of the hands and feet, or other parts of the body; or as a shuddering or horripilation, with a sensation of creeping in the back, accompanied, or not, with coldness of the extremities; or, finally, as a chill or rigor, in which there is, at the same time, loss of heat upon the surface of the body, and a more or less violent quivering or agitation of the muscles, chattering of the teeth, and paleness of the skin.

Either of these conditions may last for a few minutes only, but the most violent are also of the longest duration. Sometimes the chill constitutes the whole disease, and continues until its fatal termination, as in the more malignant cases of Asiatic cholera, of intermittent fever, of peritoneal perforation, &c.; but it, for the most part, forms the first decided symptom of the invasion of febrile and inflammatory diseases. It may occur once, or more frequently, during the attack, and either irregularly, or at regular intervals; and it may occupy the whole body, or affect one part alone, as the chest, the lower part of the trunk, or a single extremity. It has even been known, in certain paroxysmal fevers, to be confined to a still narrower region, as one finger, or a circumscribed spot upon the face or trunk. Habitual coldness of the hands and feet is very common amongst nervous females, in persons of sedentary habits, and in those who are troubled with indigestion and constipation. Not a few suffer from it exceedingly, during the first hour or two after eating a full meal, particularly if they remain at rest. Coldness is not unfrequently felt in a part about to become paralysed, in chronic affections of the spinal marrow, but in that case is generally accompanied with some loss of power, or with a tingling sensation, which indicates still more clearly the character of the threatened attack. This symptom belongs to all states in which the activity of the circulation in a part is diminished. Thus, it nearly always attends cyanosis, and other instances of cardiac disease, retarding the movement of the blood; it is also produced in obstruction of arterial trunks, whether by ligature, as in operations for aneurism of a limb, or by a fibrinous clot, as in arteritis.

A chill occurring in the course of a disease which is not paroxysmal, is generally a sign, either of an intercurrent inflammation, or of the occurrence of suppuration in a part already inflamed, and is, therefore, of evil augury. Thus, in the progress of continued fevers, such an occurrence renders it probable that an attack of pneumonia, pleurisy, pericarditis, endo-carditis, or meningeal inflammation, is about to take place; during the decline of typhoid fever, a severe chill is usually accompanied with abdominal pain, and is then a sign of peritonitis from perforation; in the puerperal state, this phenomenon may accompany the establishment of the lacteal secretion, or, if the abdomen become tender at the same time, metro-peritonitis may be anticipated; at a somewhat later epoch, it is more likely to threaten an attack of phlegmasia dolens, or the formation of an abscess in the mamma. After wounds, a rigor may precede the appearance of erysipelas, or inflammation of the veins, or the ordinary consequence of traumatic phlebitis, the formation of purulent deposits in the lungs, brain, liver, or other viscus. In the course of all parenchymatous inflammations, a chill denotes the advent of the suppurative stage. This is seen in simple phlegmon, and in pneumonia. A like occurrence in phlegmasiæ of the serous membranes is said to announce that pus instead of serum has begun to be secreted. The daily recurrence of a slight chill, followed by fever and sweat, when it takes place in a chronic affection marked by debility and wasting, is called *hectic* fever, (εκτηκω, I consume,) and if it attends organic disease, shows that the fatal issue of the attack is approaching. It does not, however, follow that hectic is always a fatal omen. It may occur in chronic bronchitis, in empyema, and in large external suppurations, and yet the patient recover.

Heat, like coldness, may be general or partial, continuous, irregular, intermittent, and of various degrees of intensity. It is partial in most local inflammatory affections of the skin; nervous individuals frequently complain of heat, confined to very narrow limits. Phthisical patients are subject to a burning sensation in the palms of the hands and the soles of the feet; but not they alone; it is common in all affections attended with progressive emaciation and exhaustion. It is alleged that in consumption, a more intense heat is felt in the cheek or palm of the hand corresponding with the affected lung, than in those of the opposite side. This is certainly not an ordinary occurrence, but the writer has met with it in a young lady of highly nervous temperament, who died of pulmonary tubercles at the age of nineteen. For many months before the tubercular deposit could be detected by physical signs, and while she was under treatment for chronic follicular pharyngitis, the left cheek was, upon the least excitement, marked by a large and well-defined red spot, glowing with heat, while every other part of the face was very pale. The tubercles throughout their whole course were almost exclusively confined to the left lung.

The following varieties of morbid heat may be admitted. 1*st.* Simple increase of temperature (*calor urens*), with a dry, or moist and pliant, state of the skin. It is equably diffused over the whole surface of the body, is accompanied with a pulse at least above the natural standard, with increased frequency of the respiration, and usually with some local pain. It is characteristic of inflammatory diseases and fevers of an active or sthenic type. 2*d.* Acrid heat (*calor mordax*), which gives to the hand a certain undefinable stinging sensation. It is most frequently met with in fevers of an adynamic type ; in petechial typhus, scarlatina anginosa, and hectic fever. 3*d.* Nervous heat, which to the perception of the patient has the same qualities as the first variety, but is not attended, usually, with any increase of temperature sensible to the hand of the physician. It is not febrile heat. It comes in flushes, and, when felt in the face, is sometimes accompanied by temporary redness of this part. It is common in persons of an irritable temperament, and in females generally, about the cessation of the menses. This symptom appears to be caused by sudden and momentary determinations of blood to various parts of the body. Its mechanism is thought to resemble that of blushing.

Perspiration.—In health there is a large amount of fluid discharged from the skin in the form of an invisible vapour, or insensible perspiration : when the quantity of this fluid is increased by exercise, heat, &c., or the state of the atmosphere retards its evaporation, it accumulates upon the skin in the form of sweat. The varieties which it presents in quality, amount, and the circumstances under which it appears in disease, are of considerable importance in prognosis, for it will be remembered that of all the critical discharges, that by perspiration is the most common.

When perspiration comes on during the decline of an acute attack, and occupies the whole surface of the body, and at the same time the pulse grows fuller, softer, and slower, and the patient feels relieved, it may be looked upon as critical. Such phenomena always attend the resolution of a paroxysm of regular intermittent fever.

General sweats are more favourable than local ones, inasmuch as the former alone are critical; but the latter occur, in general, over the affected organ, and sometimes indicate the passage of inflammation into the suppurative stage. The perspiration which is so commonly observed upon the face in diseases of much prostration, or as a result of severe pain, has no particular significance. In some persons there is an habitual discharge of perspiration from the feet, the armpits, or the neighbourhood of the genitals, and its suppression, whether occurring at the onset, or during the course of a disease, is much to be dreaded. In the gouty this event has been immediately followed by an attack of gout, and in the plethoric by apoplexy.

Critical sweats take place more frequently between midnight and morning than at any other time, and although sometimes very copious, are oftener moderate in quantity, and followed by a marked sense of relief. Profuse perspiration is an ordinary attendant of acute articular rheumatism, but in that affection, rather add to than diminish the discomfort of the patient. The same observation holds good in regard to sweating with hectic fever, and all diseases marked by great debility. In these latter the fluid discharged is very apt to be cold. The night-sweats of phthisis are amongst the most unfavourable symptoms of the complaint. Frequently they alternate with diarrhœa, so that the suspension of the one by medical treatment re-establishes the other, and no benefit accrues to the patient. These discharges when they are attended with rapid loss of flesh and increasing debility, are termed *colliquative*.

The ordinary *colour* of the perspiration is that of water, but it is altered by the admixture of various substances which give it their appropriate hue. Thus, as already noted, it may become yellow in jaundice, and, more rarely, it is seen tinged with blood. Bloody sweats are not to be confounded with those vicarious sanguineous discharges from the skin which are occasionally met with in suppressed menstruation. These latter are always confined to a very narrow space, and are periodical. A case of bloody sweat is related by Boivin of a woman who was seized with hæmatemesis after receiving a blow on the pit of the stomach; this hemorrhage was stopped, but an exhalation of blood from various parts of the skin, continued to take place at irregular intervals for at least twenty years afterwards. Its appearance was preceded by itching and burning, and then drops of bright-coloured blood exuded from the pores of the skin wherever these sensations had been felt. The patient menstruated with perfect regularity. Other cases are mentioned by Fournier, and by Gendrin. In one the cutaneous hemorrhage followed excessive mental application, and a night of inordinate venery; in another it appeared to be owing to a drinking debauch, and a fit of anger; the subject of it was a person who had previously enjoyed good health and led a sober life. Putrid fevers, so called, do not produce exhalation of blood from the skin, but *into* this tissue, and from the surface of mucous membranes.

The natural *odour* of the perspiration is somewhat sour. This quality is exaggerated in rheumatism and in gout; in low forms of fever it sometimes exhales an ammoniacal odour. Scarlatinous and variolous eruptions emit a peculiar mouldy smell; typhoid fever one which is said to resemble that of mice; favus has a pungent odour, compared by some writers to the smell of cat's urine. Fœtor of the cutaneous exhalation is always an unfavourable sign in acute disorders; it is of less consequence when it occurs along with obstinate constipation, as it sometimes does in the insane who refuse food for the purpose of self-destruction. The habitual food, or the air generally breathed by the patient, may impart an odour to his perspiration. This is observable in persons who are accustomed to eat garlic. Chomel relates that an ostler whom he was treating for a high bilious fever, smelled so strongly of the stable that every one who approached him became sensible of it, although he wore none of the clothes he had on before his illness.

The sensibility of the skin furnishes important information; but, as its various conditions relate entirely to affections of the cerebrospinal axis, they will be considered in the section devoted to the semeiology of the nervous system.

SECTION II.

SIGNS FROM THE HEAD, FACE, AND NECK.

The *position* of the head in diseases deserves a passing notice. It is inclined to one side in luxation of the cervical vertebræ, hemiplegia, and wry-neck, by a wen or glandular swelling on one side, or by dense cicatrices of the skin covering the cervical region. In many cases of tetanus, and of spinal meningitis of the upper portion of the cord, which is frequently mistaken for tetanus, the head is rigidly flexed or extended. It takes the latter position, also, whenever there is difficulty of respiration arising from an obstacle in or near the windpipe or larynx, as in croup, œdema of the larynx, chronic ulceration, cancer, &c., of this organ.

The *size* of the head is increased by internal as well as external agencies. In hydrocephalus and hypertrophy of the brain, both of them diseases of childhood, this condition is remarkable. Inflammation of the integuments causes a considerable swelling of the head. This is met with, almost exclusively, in erysipelas of the scalp and in small-pox.

Although the diagnostic signs drawn from the *face* relate chiefly to its own diseases, it furnishes more, and better, indications on which to found a prognosis than any other part of the body. The physiognomy of men in health is universally held to be an index of their feelings, and mankind cling to a belief in its accuracy, notwithstanding the perpetually recurring instances of deception which they encounter. Physicians have much better reason to trust the physiognomy of the sick. It tells no lies. The patient knows that he has nothing to gain, but much to lose, by concealing the truth from his medical attendant; and if even he misleads him by false declarations, he generally sets him right by the involuntary testimony of his countenance. The healthy may for dishonest purposes feign disease, and so successfully, now and then, as to impose upon the most practised judgment, but the really sick do not often attempt to simulate health. Disease gives to them an expression which cannot be mistaken, and which the experienced physician learns, at last, to interpret with wonderful precision, discerning not only that the individual is ill, but where and what is his peculiar malady. This art can only be taught by pointing out in detail the significance of each particular alteration impressed upon the face by the action of its muscles, its colour, its fulness or emaciation, and the condition of the individual features. When these details are once known, it is comparatively easy to judge of the indications furnished by any number of them conjoined.

Amongst the most remarkable changes which the face undergoes, are those which are owing to irregular or unequal *muscular contraction.* Infantile convulsions are usually attended with great distortion of the features. In severe cases of chorea, all the movable parts of the face are seized with intermittent spasms; the eyes and mouth are drawn first in one and then in another direction, producing a succession of grimaces which no one could possibly imitate. The features are also horribly distorted in the epileptic paroxysm, and in general tetanus. Spasm of the facial muscles often accompanies neuralgia of the fifth pair of nerves, especially in that terrible degree of it called *tic douloureux;* but it is not necessarily caused by intense pain, nor always accompanied by it; occasionally the spasm takes place without any evident cause, jerking the mouth violently to one side, or making the eye wink rapidly, without the patient being in the least degree able to control these annoying movements.

A complete loss of power on one side of the face may exist as a part of hemiplegia, and also as a distinct and local affection. In the former case suspicion must be entertained of cerebral or spinal disease; but in the latter the palsy is nearly always due, either to the direct influence of cold, or to some disease of the bone, or of the soft parts, in the course of the portio dura of the seventh pair. On the paralysed side the face loses its natural expression; the mouth is no longer symmetrical, the commissure of the affected side is drawn towards the median line; the cheek hangs loosely, the upper eyelid droops, veiling the cornea entirely, and no wrinkles are to be seen on that side of the forehead. It is important to note the earliest development of these symptoms, in the progress of diseases of the nervous centres, and in persons subject to a determination of blood to the head, because they not unfrequently indicate the approaching danger before any loss of power is experienced in either of the limbs.

The *colour* of the face is extremely variable, even amongst healthy persons; in many the complexion has a florid, or almost crimson hue; in many it is pale, almost to whiteness. The degree of plethora, however, which the former state reveals, tends to the production of apoplexy, unless relieved by epistaxis, or some other salutary hemorrhage. In all of those affections in which it has been stated that the skin grows red, the face is tinged more deeply than any other part. Upon it, too, and because, probably, of the great development of its capillary vessels, inflammatory eruptions are peculiarly frequent; and those of them which cover the whole surface, are usually more developed upon the face than elsewhere. The confluence of variolous pustules upon this part, while the rest of the body is but moderately attacked, presents a familiar instance of the sort. The vividness of the colour, whatever may be its cause, is nearly always proportioned to the acuteness and activity of the disease. In diseases of a low form, the face is of a dusky red colour; in those of a chronic type, attended with exhaustion and fever, there is generally a bright and circumscribed redness of the cheek, which contrasts strikingly with the cadaverous pallor of the rest of the face, and is familiarly known as a "hectic flush." It is said that in pneumonia the redness is often confined to the cheek of the same side with the affected lung, a circumstance which probably depends upon the patient's usually lying upon that side. Grisolle found in his observations upon this disease, that where the patient lay upon his back, the reddened cheek corresponded with the inflamed lung no oftener than with the sound one; that very often there was no increase of colour at all in the face; and that when it existed, it was, as a general rule, upon both sides, and appeared only during the active stages of the disease. Lividity of the face indicates that some impediment exists to the return of venous blood to the heart. The usual seat of the obstruction is either in this organ, or in the lungs. It is in the face that nearly all the alterations of colour which have been pointed out first become manifest.

Paleness of the face is a very constant mark of disease. It is met with at the commencement of nearly every acute disorder, and accompanies the stage of coldness or depression which precedes that of reaction and fever; in chronic complaints it usually goes on increasing with the advance of the disease; and it always attends the period of convalescence. It is most strongly marked after profuse hemorrhage, and immediately before dissolution, whenever death is owing to exhaustion. It is greatly modified by admixture with the other shades of colour which have been indicated as belonging to various morbid conditions, particularly with the lividity of venous congestion, and the yellowness of jaundice.

The general *expression* of the countenance cannot be too carefully studied. While the mind is sound, a serene or hopeful countenance presages well; for although it is often only a sign of resignation to an inevitable fate, it even then indicates a spirit which tends greatly to prolong life, and where the issue is more uncertain, one that may turn the balance in favour of recovery. A morose, peevish countenance is a sign of abdominal disease, and contortion of the features an indication of abdominal pain. The latter condition, with continued shrill crying, distinguishes the colic of infants from most of the other pains to which they are subject. A wild or fierce look is characteristic of maniacal delirium, and mania; one of sadness or anxiety is said to be worn by persons suffering from hepatic disease,—it is also the habitual expression of insane melancholy; a vacant, heavy, or silly countenance belongs to the idiotic and imbecile, and is not unfrequently observed during convalescence from typhoid fever, and other severe diseases attended with cerebral disorder. It is then very apt to be a prelude to incurable dementia.

But the most dangerous of all the signs furnished by the countenance, is that condition of the features known as the *facies hippocratica*, and so called after Hippocrates, who thus describes it. "The nose is sharp, the eye-brows knitted, the eyes hollow and sunken, the ears cold, contracted, and their lobes shrivelled; the skin about the forehead is hard, tense, and dry, and the face pale, or of a greenish, livid, or leaden hue. If the patient has been excessively fatigued, or has suffered from diarrhœa or starvation, this sign is less untoward; but arising from any other cause, and so continuing without change for twenty-four hours, a speedy death may be predicted." It would scarcely be possible to render this picture more perfect, or add anything to the caution which is given in regard to interpreting it. The *facies hippocratica* may be seen in many cases of great and rapid exhaustion, without its betokening a fatal issue; but if within twenty-four hours reaction does not take place, and it rarely does so in diseases which have already extended beyond a week, there is not the least ground on which to build a hope of cure.

The eyes and their appendages.—The eyelids, like other muscular parts, are feebly moved in low fevers, and nearly conceal the ball of the eye: they not only hide it, but strongly oppose being opened in those forms of ophthalmia which are attended with intolerance of light. In paralysis of the portio dura, the orbicularis ceases to contract, the lids remain open, and expose the parts beneath to the irritation of the air and dust, which soon excites severe inflammation. Paralysis of the third pair deprives the upper lid of motion, and effectually shuts out light from the eye. If this condition coexist with loss of power on the opposite side of the body, cerebral disease may be inferred. Otherwise it may be owing to a blow upon the superciliary ridge, or to rheumatism of the levator muscle, or to a tumour or other disease within the orbit. An open state of the eyelids in sleep may be owing to spasm of the levatores; some writers have attributed it in children to verminous disease, but many individuals in perfect health habitually sleep with their eyes half open.

The tears, instead of being absorbed by the punctæ lachrymales, may run down upon the cheek. This indicates, usually, obstruction of the lachrymal duct. It occurs at intervals, when the nerves around the eye are attacked with neuralgia; commencing inflammation of the conjunctiva, also excites a profuse flow of tears. The accumulation and hardening of the palpebral mucus upon the edges of the lids indicates an extreme degree of prostration.

The expression of the eye, and its changes in position, form, colour, brightness, and power of vision, possess a very decided interest in connexion with the present subject. The eyes are unusually bright during high fever with maniacal delirium, but dull and hazy in low fevers, and all affections in which there is sluggishness of the intellect or stupor. The cornea becomes still more completely clouded upon the approach of death, and often flakes of mucus partially obscure its surface. Immobility of the eyes may depend either upon paralysis of their muscles, or upon nervous spasm. It rarely happens that both eyes are paralyzed, except from extensive disease within the brain; cerebral disorganization, whether occurring near the orbit, or in the neighbourhood of the roots of the third, fourth, and sixth nerves, is more apt to paralyze the muscles of only one eye. Fixedness of the eyes is observed in some inflammatory affections of the brain, along with rigid and open lids, and constitutes what is called *extasis;* in cataleptic fits the eyelids remain open, and the eyes, like the rest of the body, are immovable. In epilepsy, chorea, and other true convulsive diseases, the movements of the eyes are rapid, irregular, and often distorted.

Squinting, or *strabismus*, besides being natural, or acquired by imitation, and so far of no importance as a sign, may depend upon disease within the cranium, or in the orbit. Conjoined with cerebral symptoms, it is of most unfavourable significance in adults, but far less so in young children, in whom squinting may arise from various causes unconnected with disease involving life. Tumours &c., of the orbit often produce strabismus either by pushing the ball of the eye to one side, or by paralyzing a portion of the muscles. Rheumatism of these parts occasionally induces squinting. In a case of the sort under the writer's care, the eye did not regain its natural position for several months.

Morbid prominence of the eye depends upon the turgid state of structures lying behind it, and often conveys a deceptive impression of the size of the organ. Protrusion of the eye, when gradual and permanent, is a sign of a tumour developed behind the eyeball, as enlargement of the lachrymal gland; encysted, fatty, bony, or cancerous tumours; aneurisms, and other tumours extending from the cerebral, nasal, or maxillary cavities, into the orbit; an effusion of blood behind the ball; and finally, inflammation of the cellular tissue at the bottom of the orbit. The eyes are hollow and sunken in all cases of general emaciation, owing to the removal of the layer of fat at the bottom of the orbit, and is of no further significance than as it marks the progress of emaciation. It is frequently very striking after sudden and exhausting discharges, such as diarrhœa and venereal excesses, although the general bulk of the body may not seem to be diminished.

Vascularity of the conjunctiva frequently accompanies inflammation and congestion of the brain, but is more strongly marked when the membrane is itself inflamed. The sclerotic coat is usually the part which first becomes yellow in jaundice; in phthisis it acquires a pearly whiteness. In rheumatic ophthalmia and iritis it is marked by a radiated redness around its junction with the cornea. Ulcers of this latter tissue are most apt to occur in scrofulous persons, either from direct injury or after small-pox, and to leave behind them opaque cicatrices. Discolouration of the iris, and a fibrinous deposit upon it, with irregularity of the pupil, are signs of iritis. In the syphilitic form of this inflammation the pupil is said to be drawn upwards and inwards.

The humours of the eye undergo a real or apparent change of colour in several diseases. The aqueous humour may be mingled with pus; the crystalline become opaque and of a white or buff colour; and the vitreous humour sometimes appear green. The last-named hue is merely apparent, and is believed to be caused by the reflection of the blue of the choroid coat through an amber-coloured lens, these two colours by their union producing green. The pupil is generally dilated when sight is impaired by imperfection of the visual power, or by central opacity of the lens. The former state attends the various forms of amaurosis, and many cases of diseased brain without active inflammation. Exaltation of the functions of the brain and of the retina, most commonly occasions contraction of the pupil. The action of certain medicines on the pupil should be kept in mind. It contracts under the influence of opium, but is widely dilated by stramonium and belladonna.

The *forehead* is the seat of headache in fevers, and is then hotter than other parts of the surface. It is an ordinary seat of pustular syphilitic eruptions, and of syphilitic affections of the periosteum and bones. The *nose* is commonly blunt and clumsy in scrofulous persons, but thin and pointed after exhausting disease. The nostrils expand forcibly in difficult respiration ; in hemiplegia, the nostril of the paralyzed side is apt to be closed during strong inspirations. Itching of the nose is one of the most ordinary signs of worms, or rather of that disorder of the digestive functions which is frequently accompanied with intestinal worms. It also precedes epistaxis. This hemorrhage, like the others, may be merely a sign of repletion, and is frequent during adolescence ; but it is also amongst the earliest symptoms of some diseases, and particularly of typhoid fever. It also coincides with diminished fibrin, and with other morbid states of the blood, as in scurvy and purpura.

The *lips*, and the upper one especially, are swollen in persons of scrofulous constitution, and are subject to chronic eruptions. In cerebral congestion and apoplexy they are loose, and are alternately puffed out and drawn against the teeth as the patient breathes. When one side only of the face is paralyzed they incline to the sound side. In inflammation and in sympathetic disorder of the brain, or nervous centres, the corners of the mouth are frequently retracted, so as to imitate a smile. This is a common occurrence during the dentition of infants, who are thought to be smiling in their sleep, while they are in reality undergoing a slight convulsion. The movement in question is called *risus sardonicus*. A tremulous movement of the lower lip occurs in ataxic fevers, and, as indicating great exhaustion, is of evil augury. The lips are blue or livid in cyanosis and other extreme venous congestions ; they are dry and incrusted in typhoid affections ; and become cold and colourless upon the approach of death.

The *lower jaw* is firmly set against the upper in tetanus ; is fixed and extended in dislocation of the bone ; it rattles against the upper jaw in violent chills ; and generally falls by its own weight when dissolution is near at hand. The *ears* are, in the last-named circumstance, pale, pinched, and cold. A purulent discharge from the auditory canal, when of an offensive smell, is a sign of caries of the middle ear, and when to it are superadded cerebral symptoms, fatal inflammation of the brain from caries of the petrous bone is indicated. A discharge of blood from this canal, after violence to the head, warrants the suspicion of fracture of the base of the skull.

The *hair* very commonly falls out after eruptive diseases and typhoid fever, and after erysipelas and eczema of the scalp. Alopœcia in consequence of these affections is not irremediable, but *favus*, which destroys the hair-bulbs, produces incurable baldness. Prolonged or violent grief may turn the hair white, and the same is true of insanity. Severe febrile attacks have occasionally a similar effect. Cases are now and then met with in which a single lock of hair becomes white at an early age, and so continues through life. A writer mentions having seen brown hair become red during an attack of chlorosis, and subsequently regain its original colour. Another records a similar case, except that while the chlorosis lasted the hair was perfectly white, or rather the part of it which had grown meanwhile ; on the patient's recovery every hair was brown at each end and white in the middle.

A long, thin *neck*, with a narrow chest, is generally regarded as a sign of constitutional predisposition to phthisis, and a short and thick neck as showing a tendency to apoplectic affections. The large number of exceptions to these statements deprives them of much semeiological value. Enlargement or swelling of the neck is frequently observable in the first months of pregnancy, and in young females upon the approach of puberty. The lower part of the neck is increased in size by hypertrophy of the thyroid gland, or goitre, and its middle and upper portions by enlargement of the parotid, the submaxillary, or the lymphatic glands. The parotids are enlarged in mumps, and sometimes in typhoid fever, in which latter case they are very apt to suppurate. The submaxillary glands become tumefied in mercurial stomatitis. The lymphatic glands of the neck may be swollen during any acute inflammations of the parts whence their vessels are derived, as in erysipelas of the face and scalp, in tonsillitis, and sore throat, particularly that form of it which occurs in scarlet fever ; in all of which cases there is more or less tenderness of the glands, and a tendency to suppuration. In chronic ulceration of the posterior fauces, these bodies increase in size and remain swollen for a long period. Scrofulous enlargement of these glands, however, is a more obstinate affection. It is most usual in childhood, and is owing to a deposit in them of tuberculous matter. According to the best authorities, when they have become hardened by this deposit they either remain permanently enlarged, or their contents soften and are discharged, leaving fistulous ulcers, and ultimately indelible scars. In after life these marks may lead to the detection of scrofulous complications which would have been, but for them, unsuspected.

The neck is one of the first parts to show the progress of emaciation. When the tricuspid orifice of the heart is patulous, it permits a regurgitation of the blood, which causes a pulsatory motion of the veins of the neck, particularly of the external jugular. This is called the venous pulse. The carotid arteries throb violently in hypertrophy with dilatation of the left ventricle of the heart, and also when there is inflammatory disease or active congestion within the cranium.

SECTION III.

SIGNS FROM THE EXTERIOR OF THE TRUNK.

The form of the *thorax* varies according to age, sex, and temperament; being more prominent and capacious in males and in persons, generally, of a sanguine temperament, and of smaller dimensions in females and nervous individuals of both sexes. M. Woillèz, who investigated with great labour and accuracy the relations of the form, capacity, &c., of the chest to various diseases, arrived at a result confirmatory of the general belief, that narrowness of the upper part of the chest, as well in its transverse, as in its antero-posterior diameter, indicates a predisposition to tubercular disease. This gentleman found, however, that of the consumptive patients examined by him about one-third were not remarkable for contraction of the upper part of the chest. It is to be remembered that after phthisis has gone to the extent of producing emaciation, the wasting of the pectoral muscles will diminish the apparent size of the thorax. Depression of the spaces above and below the clavicles is usual in this disease at a very early stage, in consequence probably of local pleurisy and retraction of the integuments above the summit of the lungs, resulting from a deposit of tubercles in this portion of the pulmonary tissue. For obvious reasons, this sign is very strongly indicative of tubercles when it exists on one side only. A more extensive contraction of the thorax, one, for example, extending to the whole of one side of the chest, is produced by a similar mechanism. The lung, being compressed by a serous or purulent effusion, and bound down by false membranes, does not always expand in proportion as the effusion is removed; the pressure of the atmosphere, therefore, forces the ribs inwards, making the shoulder of the affected side droop, and giving the person a very awkward carriage in walking.

Dilatation of the thorax is rarely general; but it often affects the whole of one side when the pleural cavity is distended with fluid or gas. In these cases the intercostal spaces are more prominent than the ribs. Dilatation from pulmonary emphysema is rarely so extensive; in general it is most considerable at the upper and anterior portion of the chest, between the clavicle and the nipple. Other local enlargements of the chest may be due to hypertrophy of the heart, effusion into the pericardium, aneurism of the ascend-aorta which shows itself at the junction of the third rib of the right side with the sternum, and aneurism of the descending aorta which forms a tumour between the base of the scapula and the spine. In all of these dilatations, whether general or partial, the sound on percussion is duller than natural, except in emphysema and pneumo-thorax, which give a loud resonance. In all, moreover, the natural sounds detected by auscultation are either feebler than in health, or are replaced by morbid murmurs.

By inspecting the exterior of the thorax, the mode in which the patient breathes is ascertained. The number of inspirations in a minute is, for a healthy adult, about sixteen, and for an infant, twenty-five, but they are rendered much more frequent whenever an obstacle exists to the proper aeration of the blood, as in phthisis, emphysema, pleurisy, disease of the heart and pericardium, &c., and when, as in febrile affections, the heart pulsates more rapidly than natural. In the former complaints, whatever even temporarily augments the number of cardiac pulsations renders the inspirations more frequent and quick. As in normal breathing the lungs are dilated as well by the descent of the diaphragm as by the elevation of the ribs, so when either of these agents is impaired, the other acts with additional energy. When the abdominal viscera, and the peritoneum especially, are inflamed, the movements of the chest are rendered more active, because the pain produced by the rise and fall of the diaphragm forces this muscle to remain at rest. Under these circumstances, the respiration is said to be *high*. On the other hand, when pain in the muscles or nerves of the thorax, or large effusions into its cavities interfere with its freedom of action, the diaphragm moves through a larger space, and causes alternate rising and falling of the abdomen. The respiration is then called *abdominal*. For similar reasons one side of the chest may remain almost entirely stationary while the movements of the other are greatly augmented.

In its natural state, the *abdomen* is soft and yielding, and, except from obesity, does not attract attention by its size; disease, however, produces on its external covering, and in the condition of its viscera, numerous interesting and important changes. The integuments of this region are generally smooth and white, but in some women who have borne children, and in persons of either sex who have suffered from ascites, may be found irregular whitish streaks or wrinkles in the hypogastrium, resembling cicatrices, and which, indeed, indicate a superficial tearing of the skin at these points. A brownish line extending from the pubis to the umbilicus, or higher, is frequently seen in pregnancy, of which it may therefore be considered a sign. The skin of the abdomen is the ordinary seat of the lenticular rose-coloured spots which are so characteristic of typhoid fever.

Abdominal pains, for the most part, belong to one of two classes; those which arise from inflammation and are aggravated by pressure, and those which pressure relieves, and which are either owing to over-distention of the intestinal tube, or other visceral canals, or to neuralgia. The pains of flatulent and painter's colic, and of those severe attacks produced by the passage of a calculus through the biliary ducts, or ureter, are examples of the second class. In general, the seat of pain will indicate pretty nearly the organ in which it originates; but not always. The colon, in its extensive circuit, lies in contact with the kidneys, liver, stomach, &c., and its own pains may be mistaken for those of the several organs mentioned. Other functional disorders must therefore be appealed to in forming a diagnosis. In that disease, so rare as an independent affection, acute gastritis, the epigastrium is the seat of soreness, which becomes decided pain upon pressure; pain in cancer of the stomach, when it exists at all, is sharp and lancinating, and soreness is felt under pressure; in gastralgia the pain is extremely acute, lancinating, or cramp-like, and paroxysmal; many cases of indigestion are attended with dull or burning epigastric pain and soreness, and some of them are complicated with gastralgia. When the small intestines are inflamed, there is little or no spontaneous pain, excepting what is colicky, and which, arising around the umbilicus, radiates to all parts of the abdomen. But there is much tenderness upon pressure. In dysentery the character of the morbid sensation is very similar, but, in addition, there is a sharp, burning pain in the rectum, accompanied with *tenesmus*, or an irrepressible desire to go to stool. Hemorrhoids, simple inflammation of the rectum, and pressure upon this bowel by contiguous bodies, (stone in the bladder, prolapsed womb, pelvic tumours, &c.,) produce a like result.

Tormina, or acute colicky pains, are met with in various intestinal disorders. It is inferred, from the circumstances under which they occur, that they depend upon spasm of the muscular coat of the intestine; since, on the one hand, they are connected either with over-distention of this tube by gas or fæces, ceasing on the evacuation of these matters, or else with firm contraction of the bowel, as in painter's colic. They may accompany inflammation of the intestinal mucous membrane; or be due to the presence of undigested, and therefore irritating, substances; or accompany simple diarrhœa produced by cold; or exist at the outset of an attack of intus-susception, or other obstruction of the bowels; or accompany spinal neuralgia; or, finally, depend immediately upon the poisonous action of the salts of lead. Whenever gentle pressure upon the abdomen does not assuage them, or adds to the patient's suffering, it must be inferred that they are complicated with inflammation, either of the intestinal mucous membrane or of the peritoneum. This latter state gives rise to a severe pungent pain, which may be very inconsiderable so long as the patient remains perfectly motionless, but is augmented by the slightest movement, and even by the tension of the abdominal parietes when the lower limbs are extended. Its distinguishing characters are its being constant, and so superficial, that the gentlest touch of the abdomen excites it; contrasting thus with tormina, which are remittent, and with the pain of mucous inflammation, which is deep-seated.

Pain in the parenchymatous organs of the abdomen is dull and heavy; it is increased, but not rendered sharp, by pressure, so long as the peritoneum is intact. The acute pains referred to these organs when inflamed, or otherwise diseased, generally depends upon circumscribed inflammation of their peritoneal coat. Pain in cancer of the liver, for instance, has been shown to depend upon this cause; and the sympathetic pain, so called, which is then sometimes felt in the right shoulder, has also been shown to coincide with the existence of cancerous masses upon the upper surface of the organ, which, it is supposed, irritate, by their contact, the branches of the nerves supplying the diaphragm, and by a reflected action excite pain in the shoulder. A peculiarity of the pain excited by renal calculi, is, that it darts along the ureters, and is felt in the groin, while the testicle of the affected side is usually retracted. In like manner, pain in the bladder extends along the urethra to the glans penis; and pain in the uterus to the groins, the thighs, and the loins: phenomena explicable by the nervous connexions of the parts.

The abdomen diminishes in all diseases attended with general emaciation, unless a tumour or ascites be present; it is singularly hollow in chronic dysentery, its anterior parietes almost touching the spinal column, and displaying the pulsations of the abdominal aorta. In lead-colic, also, the walls of the abdomen are greatly retracted, and feel quite hard and stiff when pressed upon. The belly may be alternately distended and contracted when the rectum or lower bowels are strictured, according as the parts above are filled with, or freed from, the fæces which sometimes accumulate in them to an enormous extent. The dimensions of the abdomen may be increased in disease by air, serum, fæcal masses, or tumours. Distention by gas is called *meteorism*, or *tympanites*. It occurs, as before stated, in hysteria, in peritonitis, also in typhoid fever, and in obstruction of the bowels. Unless excessive, it is *of itself* unattended with danger.

Abdominal tumours consist either of hypertrophied or distended viscera, or of abnormal growths. Enlargement of the liver, spleen, and kidneys; distention of the bladder by urine, and of the womb by a fœtus, are examples of the first sort; the formation in the ovary and other organs of cysts, or of scirrhus, encephaloid, and tuberculous deposits, belongs to the second class. In following out the history of an abdominal tumour, it is very necessary to determine exactly the point where it first appeared, because in this manner may be ascertained the organ to which it is attached. If a tumour is not examined until after it has attained its full development, and when it has contracted adhesions to the abdominal walls, and by its pressure interfered with the functions of different organs, it is often quite impossible to decide either upon its origin or its character, whereas if its starting-point has been accurately determined, and its progress attentively observed, both of these particulars may be ascertained with comparatively little difficulty. A large tumour of the lower part of the belly, for instance, may be plausibly assigned either to the uterus or ovary; but if seen when small, its position under the linea alba, or to the right or left of this line, will be almost sufficient to determine its seat.

The *form* of a tumour, when taken in connexion with its situation, often renders important aid in diagnosis. Thus, when it retains the shape of the organ belonging to the region where it is developed, the presumption is in favour of its being a simple enlargement or distention of that organ. A smooth, globular, swelling in the hypogastrium, if of slow growth, may fairly be regarded as the distended uterus; a similar one in either iliac fossa, as ovarian dropsy; a projection in the right or left hypochondrium without irregularity of surface, and occupying the space usually filled by the organs lodged in those regions, as an enlargement of the liver or spleen. But, if in any of these situations there is a tumour of irregular shape, and studded with projections, it may be inferred that it is composed of some heterologous deposit, or a congeries of cysts. The liver, spleen, kidneys, ovaries, uterus, and mesentery, are all subject to carcinomatous enlargements, sometimes of extraordinary dimensions, and all of them marked by these characteristic protuberances. The mesenteric glands, indeed, may be enormously enlarged by a deposit of tuberculous matter in them, but this rarely occurs subsequently to childhood, and cannot, therefore, be easily confounded with cancer of the same part, which is a disease of the decline of life. When cancer affects the hollow organs, the rough surface of the deposit is towards their cavity, so that the hand can only reach the smooth or peritoneal surface of the tumour. In such cases the general symptoms must clear up the diagnosis. It is certain however that *any* permanent intestinal tumour ought justly to excite suspicion of its being cancerous, or as susceptible of cancerous degeneration, for there are none others of the digestive canal, except such as arise from retained fæces or flatus. Even these are sometimes due to intestinal cancer, particularly that of the rectum; the fæces accumulate in the sigmoid flexure and the descending division of the colon, and produce a large tumour. They may arise in other parts, in consequence of hernia, stricture, intus-susception, compression, or any other mode by which the canal may be obstructed. Stercoraceous tumours can frequently be recognised by their feel alone; they offer a certain degree of resistance without elasticity, and pit upon pressure. Encysted liquid tumours are elastic, and often manifest an obscure degree of fluctuation. Cancerous tumours are, for the most part, hard and inelastic, and never fluctuate. It is true that certain different conditions are sometimes united in the same tumour; encysted dropsy of the ovary, for example, may be connected with cancerous degeneration. In cases of this sort, the constitutional symptoms must be appealed to for the solution of whatever difficulties remain after a physical examination. Indeed, wherever both modes of investigation are applicable, both should be employed.

To complete this succinct account of the signs of disease furnished by the exterior of the body, it only remains to notice those belonging to the limbs, and to the external organs of generation. But the former have in a great measure been included in the notice taken of the general surface, and the latter will hereafter be treated of in a more appropriate place. We proceed therefore to consider the semeiology of the interior of the body.

CHAPTER II.

SIGNS FROM THE DIGESTIVE APPARATUS.

The *mouth* undergoes a great many changes in disease. In many cases of epilepsy and hysteria it is more or less constantly closed, and in tetanus, as before remarked, cannot be opened even by force. All swelling and inflammation of the glands or cellular tissue adjacent to the angle and ramus of the jaw, or of those in the posterior fauces, prevent its being more than partially opened, and that at the expense of great suffering. In low forms of fever, on the other hand, whenever there is extreme prostration, in idiocy and dementia, in apoplexy and in luxation of the lower jaw, the mouth is generally open; this is an almost unfailing symptom in the moribund. Caries of the *teeth*, according to some writers, indicates habitual irregularities of indigestion; but this is far from being established, although the extreme prevalence of dental caries and of dyspepsia in this country as compared with Europe, lends some probability to the statement. Carious teeth may excite several diseases, or prevent their cure; such as caries of the maxillæ, abscesses and ulcers of the teeth and gums, enlargement of the lymphatic ganglia of the neck, and occasionally, although not as often as is generally imagined, neuralgia of the fifth pair. The *gums* become soft and swollen in scurvy and from the influence of mercury; in the former they are of a dark or brownish-red, and in the latter of a bright red colour. Rostan states that scorbutic swelling is never seen in gums which have long before lost their teeth. Amongst workers in lead, a gray line may be seen extending along the gums parallel to, and at a short distance from, their attachment to the teeth, which in these persons rapidly decay.

The *lining membrane* of the mouth is pale in anemia, of a dusky-red in low fevers and scurvy, and purplish or of a leaden-hue in cyanosis. In sthenic inflammations of other parts, and when itself inflamed, it acquires a much brighter tinge than natural. It is the seat of diphtheritic formations originating with itself, or occurring as complications of febrile disorders attended with great exhaustion. It is very subject to aphthæ, which are inflamed follicles situated on the tongue, the cheeks, or more frequently upon the inner surface of the lower lip. They are commonly a sign of intestinal disorder. The ulcers which may be met with in the mouth are chiefly of three kinds, the scorbutic, the syphilitic, and the mercurial, and may generally be distinguished from one another by their physical characters. Scorbutic ulcers are bloody, fungous, and seated upon the gums; syphilitic ulcers are round, excavated, and their bottom is covered with a grayish matter; they usually attack the soft palate, the tonsils, and the pharynx; finally, mercurial sores are large, whitish, and superficial, and are accompanied with considerable swelling and heat. They occupy the internal surface of the cheeks and lips, and corrode the gums around the teeth, especially the last molars.

The *breath* acquires an unnatural smell in various diseases. In nearly all attended with fever it is heavy and disagreeable, but in those of great prostration it is generally sickening and repulsive. On the approach, and during the progress, of salivation, it has a metallic odour; in saturnine diseases its smell is like that of garlic; and in the diptheritic affections of the mouth and fauces, it is insupportably fœtid. This fœtor however is not necessarily a sign of gangrene. In gangrene of the lung the breath and sputa have a smell which is sickening and fœtid to the last degree, and has been aptly compared to the odour exhaled by wall-plaster when fresh.

In all ages the *tongue* has been thought to furnish important information in disease, as well by those who have really studied its various conditions, as by the practitioners who have made its inspection a mere occasion for mysterious looks, and oracular remarks. Its size and shape, and the characters of its coating have, at different times been looked upon as positive diagnostic signs of disease; but these exclusive views have rarely outlived the persons who respectively gave them currency. Yet the conditions of this organ and of its functions, have in reality such a value as to entitle them to a full consideration.

The tongue is the principal organ of the sense of taste, which is almost uniformly modified by disease. There is no more frequent sign of impending sickness than the loss of a natural relish for food, and no surer indication of returning health than the recovery of this relish. The sick rarely receive from sapid bodies the same impressions as in health ; all the food prepared for them is equally insipid, nauseous, or bitter, or they have constantly a perception of some one of these or other tastes. The insipid taste accompanies, especially, inflammation of the respiratory passages, including the nostrils, posterior fauces, and air-tubes. A bitter taste is most frequently experienced in dyspepsia, particularly in that form of it attended with eructation or vomiting of bilious matter, and, occasionally, in those more distinct derangements of the liver depending upon inflammatory or structural disease of this organ, and which are accompanied with jaundice. An acid taste prevails in those other forms of dyspepsia in which sour regurgitations take place, and also in cancer of the stomach. A salt taste in the mouth is a common precursor of hæmoptysis. A foul or putrid taste is generally due to diphtheritic inflammation, to suppuration, or to gangrene of some of the parts connected with the mouth, as the nose, throat, œsophagus, or lungs. It is also present in cases of obstinate and prolonged constipation. A metallic taste is usually the first sign of the constitutional influence of mercury; it is said also to occur in intermittent fever. In hysteria, hypochondria, and chlorosis, the taste is frequently perverted, and persons suffering under these complaints have often perceived the most exquisite flavour in chalk, charcoal, slate, and even in animal substances far gone in putrefaction. It is impossible to refer all of these morbid conditions of the sense of taste to an uniform cause. Some of them appear to be owing to the coating upon the tongue, while others may with more probability be referred to an altered condition of the nervous centres.

The *movements* of the tongue are sometimes deranged. A tremulous tongue is, in all acute diseases, of evil portent, but has no particular importance in chronic nervous disorders, such as hysteria, hypochondriasis, and chorea. If the patient protrude his tongue very slowly, or leave it exposed after having shown it, it is a sign of great exhaustion, or of congestion or other pressure upon the brain. It occurs in all diseases of a typhoid type when the intelligence becomes blunted. When the tongue is thrust constantly to one side, it indicates hemiplegia of the organ, and is owing, generally, to disease of the opposite side of the brain. But the tongue often *appears* to deviate laterally when one corner of the mouth is retracted, owing sometimes to cerebral disease, and sometimes, as in old persons, to the loss of the teeth on one side. Imperfect or complete paralysis of the tongue impedes or prevents the articulation of sounds; but the speech may be lost in some nervous affections, or from sudden fright, without any loss of power in the lingual muscles. The writer has seen a pregnant female rendered quite speechless for several hours, by a loud clap of thunder. As she was recovering her power of articulation, she pronounced words with a slow, drawling, and hesitating utterance.

Increased *temperature* of the tongue exists, and is very sensible to the patient in inflammation of the mouth and fauces, and in all fevers attended with a very hot skin. It is cool, or even cold, on the other hand, in Asiatic Cholera, sometimes in the cold stage of intermittents, and on the approach of death when the struggle is prolonged.

The tongue may be *enlarged* in glossitis, and from cancer, and in the former to such an extent that it projects beyond the lips. This condition used frequently to result form excessive salivation. The tongue is also swollen in sore throat, and is large and flabby in many bad cases of dyspepsia, showing upon its edges indentations made by the pressure of the teeth. Its entire volume may be *diminished*, when there is great general emaciation; if its size diminish very much, and it is at the same time retracted and pointed, even in acute diseases, the prognosis is bad. Prolonged hemiplegia frequently induces atrophy of one side of this organ.

In acute febrile disorders, *moisture* of the tongue is a favourable sign; but dryness, especially when extreme, and accompanied with a fuliginous coating upon the teeth, augurs badly. This latter state is observed in all protracted fevers, whether symptomatic or idiopathic, and seems to be in direct proportion to the duration of the disease. Its higher degrees are combined with roughness, a fissured appearance, and a brown or even black colour of the investing crust, and occurs ordinarily in affections of the typhoid form. It must not be confounded with a somewhat analogous condition in persons who sleep with the mouth open. The rough, enlarged, and deeply-fissured, but moist tongue, is of most common occurrence in gastro-hepatic derangements.

The tongue is *pale* whenever the blood has lost its normal proportion of red globules, as in hemorrhage and chlorosis, in chronic inflammation also of the intestinal canal, unattended with much fever. A bright *red* colour of the tongue is found in all violent inflammations, but especially in those of the upper portion of the digestive tube. Sometimes, as in scarlatina, the redness is not uniform, but shows itself in disseminated points, which are the turgid papillæ, projecting through a white coating of mucus; or this colour may be confined to the sides and tip of the organ, while its centre is whitish. A moderate coating, whether white or yellowish, has generally been supposed to indicate the accumulation of mucous or bilious matters in the stomach, and a red, dry, and glazed tongue, chronic inflammation of the intestinal canal. But these signs, as well as most of those derived from the presence, or the peculiar characters of the coating, are very fallacious. M. Louis found that redness of the tongue existed with equal frequency in phthisical patients who had no lesion of the stomach, and in those of them in whom this organ was extensively diseased. A similar result was arrived at by this author in regard to the state of the tongue in typhoid fever.

The gradual disappearance of the coating from the circumference towards the centre of the tongue, is a favourable sign, and, in acute diseases, marks the commencement of convalescence. This process is sometimes arrested, and the tongue becomes dry and red upon the occurrence of some inflammatory complication, but the change may also depend upon too great strictness of the patient's diet, for the more favourable condition has often been found to return upon the cautious administration of more nutritious food. The tongue, like other parts within the mouth, may become the seat of membranous formations; whenever this occurs as a complication, either in acute or chronic disorders, and along with great exhaustion, it is a most unfavourable sign. Ulcers of the various sorts above described, aphthæ, and the pustules of small-pox, are also met with upon the tongue.

The *saliva* is diminished in most febrile affections, but is generally increased when any of the parts within the mouth or fauces are inflamed or irritated, as in dentition, glossitis, tonsillitis, &c. Its profuse discharge is called *ptyalism*, and is more marked when produced by mercury than by any other cause. Arsenic and iodine may also occasion it. It occurs after the use of emetics, in many cases of dyspepsia, and is a most annoying symptom of the disorder which sometimes attends pregnancy. It sometimes exists as an independent disorder, *sialorrhea*. Salivation is commonly observed in confluent small-pox; it is regarded as a favourable sign, and its suppression as indicating peculiar danger. But if it depends, as it probably does, upon variolous pustules in the mouth, their condition must furnish more important indications than the mere quantity and duration of the discharge which they produce.

The quality of the saliva doubtless excites many of the morbid gustatory sensations which have been noticed, particularly the acid taste. The saliva has been found to be acid in acute rheumatism, in dyspepsia, accompanied with pyrosis, in gastric inflammation, and in most instances of mercurial ptyalism. In some cases, however, of the latter affection it is distinctly alkaline, and in others retains its normal neutrality.

Signs from Swallowing.—The morbid states of deglutition may be referred to one of two sets of causes, the one purely mechanical, the other depending upon diseased innervation of the œsophagus. In the first class may be arranged inflammation of the tongue, fauces, and œsophagus; polypi, or other tumours in the pharynx, induration and softening of the gullet, foreign bodies or strictures within, and tumours, such as abscesses and aneurisms external to this tube, and scirrhus of the cardiac orifice of the stomach. To the second class belong compression, inflammation, and softening of the brain and upper portion of the spinal cord; hysteria, hydrophobia, tetanus, and low fevers.

It might be supposed that liquids would in all cases be more easily swallowed than solids. But this is not the case. When the throat is swollen and tender, liquids, which require a more complete contraction of the muscles of deglutition than solids, to propel them towards the stomach, necessarily excite more pain than soft solids; so that the former are often rejected violently, when the latter move with less difficulty to their destination. In feebleness and partial paralysis of the œsophagus, also, the muscular fibres are more readily stimulated to contraction by a body offering a certain degree of resistance than by a liquid. In complete paralysis, however, liquids descend the throat by the force of gravity, and therefore more readily than solids; as they enter the stomach, they are apt to produce a rumbling noise, which, under the circumstances, is an almost fatal sign.

If merely imitating the act of swallowing give pain, there is inflammation of the fauces. This act performed involuntarily, and without pain, is commonly owing to elongation of the uvula, which irritates the pharynx, and causes contraction of its muscles. If there is a sensation as of a ball in the throat, with general spasms, the difficulty is hysterical; if, a short time after being swallowed, the food is regurgitated, cancer of the stomach must be suspected, or some cause mechanically compressing the œsophagus; if cough attend every effort at swallowing, we may conclude that the epiglottis or the edge of the laryngeal orifice is ulcerated; if the mere contact of a liquid with the mouth, or the sight of it, cause such spasms of the throat as to render swallowing impossible, and the patient have previously been bitten by an animal, the case is one of hydrophobia. When there is a loss of substance in the *velum palati*, the food is sometimes thrown into the nostrils. Food and drink are said, in popular phrase, "to go the wrong way," when they get into the larynx or trachea. This is apt to occur when the epiglottis is wholly or partially destroyed; when there exists a fistulous communication between the œsophagus and trachea; it often takes place on attempting to swallow while laughing or talking; and is observed in the last stages of many diseases, when it depends upon insensibility or paralysis of the muscles of the pharynx and larynx. Difficulty of deglutition is the more unfavourable the longer it lasts, and, in general, less dangerous when it occurs suddenly, than when it comes on gradually; for in the latter case it must be owing to organic disease involving the œsophagus or the brain, but in the former it is much more likely to depend upon inflammation, upon obstruction by a foreign body, or upon nervous disturbance.

Signs from the appetite.—Thirst, or a desire for drink, is one of the most ordinary symptoms of febrile disorders, and its sudden increase in the course of chronic diseases may serve to reveal the occurrence of inflammatory complications. It is most intense during inflammation of the stomach or bowels, and when profuse discharges have taken place, as in diabetes, Asiatic cholera, and colliquative sweating. Apparent absence of thirst is frequently observed in ataxic fever, when, although the patient's tongue and mouth are as dry as a potsherd, his comatose state renders him insensible to their condition.

The appetite for *food* is variously altered in disease. It is diminished, in many cases, by the remedies administered. Opiates, and the prolonged use of a diluent or farinaceous diet, have this effect. Indifference to taking food, or *anorexia*, as was previously stated, is one of the first premonitory symptoms of acute disorders, and is a favourable sign, inasmuch as it appears to be a provision of nature for preventing undue excitement of the system. On the approach of convalescence, however, when the strength needs recruiting, it indicates an imperfect or a tardy recovery. At this period the return of the natural appetite augurs well, provided it is accompanied with a corresponding activity of nutrition; but if this do not occur, there is reason to apprehend the development of organic disease, especially phthisis, and the more so if the acute affection was pneumonia, or typhoid fever.

Aversion to food occurs in nearly the same circumstances as anorexia, and is only an active phase of the same feeling. It is sometimes so strongly marked that the odour of the kitchen, or even the bare idea of eating, excites heaving of the stomach and disgust. In chronic disorders, it is a very unfavourable symptom. It is common in pregnancy, and after the use of emetics.

Voracious appetite, or *bulimia*, (βου, aug. and λιμος, hunger) is most frequently met with in nervous disorders, such as mania, hypochondria, and hysteria. The most extraordinary instances of it have been presented by persons whose intestinal canal was, like that of carnivorous animals, short and straight. A young Esquimaux is mentioned by Captain Parry, who devoured, in twenty-four hours no less than "35 lbs. of various kinds of aliment, including tallow candles." Insatiable hunger is very apt to exist during convalescence from acute diseases in which the stomach or bowels have been inflamed, and it cannot be gratified without great danger. In the progress of recovery from typhoid fever it is often observed, and in many cases of this malady which terminate fatally, from perforation of the intestine, the result is owing to a too early or undue indulgence in animal food. The writer witnessed a case of sudden death, during convalescence from typhoid fever, in a patient who perished while greedily devouring a bowl of soup. A piece of gristly meat, larger than a pigeon's egg, was found tightly wedged in his larynx.

Nausea, ("from ναυς, a ship, because those unaccustomed to sailing are affected with the sensation,") is a desire to vomit. It may arise from merely nervous disorder, from sympathy of the stomach with some other organ, or from disease of the stomach itself. It has no particular significance in disease except as a precursor of vomiting. It is one of the earliest and most constant signs of pregnancy.

Eructation, or the discharge of flatus from the stomach, and *regurgitation* or the rising of the solid or fluid contents of this organ into the throat, although in their result somewhat akin to vomiting, differ from it in being unattended with nausea, and in being effected by the action of the stomach and œsophagus alone. They are usually accompanied with heart-burn (pyrosis) in dyspepsia, and the fluid which rises is pungent, hot, and very sour. At other times it is insipid, or slightly saltish, and is then called water-brash; to this form of eructation habitual drunkards are very subject. Regurgitation of food along with the gastric fluids is less frequent, and generally indicates more serious disorder, than the form just noticed. It occurs in some of the worst cases of dyspepsia, and in cancer of the stomach. The odour of the several substances rejected is various. They may be inodorous, or have the smell of sulphuretted hydrogen, or a rancid smell, or that of the food lately taken, as of cabbage, garlic, &c. Eructation of wind usually affords relief to a sense of oppression at the pit of the stomach; in some attacks of indigestion, gas is extricated in enormous quantities. Regurgitation of solids and liquids is an annoyance without corresponding advantage.

Vomiting may be symptomatic of a local affection of the stomach, or of disorder in some other part of the system. Its simplest form is that excited by the presence of undigested food in the stomach. It is then preceded by loathing, nausea, chilliness, watering of the mouth, paleness, coldness of the extremities, and a slow or small pulse. Heaving of the abdomen then takes place, and by the concurrence of the muscles of its parietes, those of the stomach, and the diaphragm, the contents of the stomach are rejected. A marked sense of relief follows this operation, the pulse becomes fuller and softer, and the skin warm and moist. But, when vomiting is excited by any other cause than that just mentioned, the evacuation of the stomach is not followed by so great relief; as when the mucous lining of this organ has been directly irritated, or is inflamed, or when the sympathetic cause is permanent, as in pregnancy. It is then painful and exhausting, often exciting cramps in the stomach, or, as in peritonitis, producing the most intolerable suffering. By the violent retching and straining which sometimes accompany this act, it becomes a cause of abortion in pregnant females, of hernia, of apoplexy, of the rupture of an aneurismal tumour or of some abdominal organ, or may cause the involuntary expulsion of the fæces and urine. In most acute diseases it occurs but once or twice, and that at the period of invasion, in others such as cholera morbus, peritonitis, hernia, &c., it may continue throughout the attack. It is sometimes brought on, particularly after eating, by violent coughing, as in phthisis and hooping-cough. Children vomit more easily than adults, old persons rarely do so spontaneously, and always with much suffering, and great risk of rupturing the heart and arteries.

Vomiting is always more favourable at the commencement of diseases seated either in the brain or stomach, than when it takes place for the first time at a more advanced stage. The relief afforded by it is a fair criterion of its probable influence upon the course of the attack. If the epigastric uneasiness subside, the skin become moist, and the nausea disappear, the influence of the vomiting is likely to be salutary; but if nausea, epigastric soreness, and general distress persist, there is reason to fear some durable alteration of the stomach. Vomiting may, however, become literally chronic; in that case its repetition is not quite so unfavourable as in the case just recited, provided there be no evidence of organic disease of the stomach or its subsidiary viscera; for it then probably depends upon nervous disturbance of the stomach, or upon thickening or attenuation of the mucous membrane of this organ.

Some notion of the nature of a gastric disorder may be deduced from the tolerance or rejection of certain kinds of food and medicine. Those of a stimulant and tonic kind never fail to aggravate vomiting produced by inflammation of the stomach, while they more commonly allay this symptom if it depends upon nervous derangement.

The sooner vomiting takes place after eating the higher up in the digestive canal is the disease producing it. If directly after a meal, it may either indicate chronic gastritis, or cancer of the vicinity of the cardia, or general thickening of the walls of the stomach with contraction of the cavity; if it do not come on until ten or twelve hours after eating, and the matters thrown up consist of the food taken so long before, cancer of the pylorus, or dilatation of the stomach is indicated.

It is important to ascertain the quality of the matters vomited, for they vary with the morbid condition present. They consist 1st, of more or less perfectly digested *food*, as in the stage of invasion of most acute diseases; or 2d, of *mucus*, as in pregnancy and gastralgia; 3d, of a *serous* fluid containing white flocculi, as in Asiatic cholera; 4th, of *blood*, in gastric and œsophageal hæmorrhage, or when this fluid has been exhaled from the air-passages or the mucous cavities of the head; 5th, of *bile*, in the various forms of remittent and bilious fever and hepatitis, in protracted dyspepsia, and in most cases where the act of vomiting is accompanied with severe straining; 6th, of *stercoraceous* matter, in strangulated hernia, intussusception, and other obstructions of the intestine; 7th of *pus*, when an abscess, (usually of the liver,) opens into the stomach; 8th, of a matter resembling *coffee-grounds*, and which is most probably blood which has been acted upon, at the moment of its exhalation, by the acids of the stomach. This substance is very generally vomited in fatal cases of yellow fever; it is also observed among the matters rejected in cancer of the stomach, when the cancerous deposit is formed near the pylorus, and its inner surface has become ulcerated; 9th, of *lumbrici*, *hydatids*, or *gall-stones;* but of these, the two latter are very unusual; 10th, of substances which have been swallowed, and act as irritants, or otherwise excite vomiting; such are all the acrid and narcotic poisons. The matters vomited, in any case where the cause of the attack is obscure, should always be preserved for examination; for they may lead to the discovery of a suicidal intention on the part of the patient, or of a felonious intent on that of some concealed enemy. Finally, vomiting may be excited by the presence of false membranes in the throat, or be induced, artificially, in croup, in both of which cases fragments of fibrin may be found amongst the contents of the basin.

The small and large *intestines* offer but few symptoms which have not already been noticed under other heads. Allusion has been made to the development of gas which frequently takes place in them, producing oppression, and colics. Its movement, from place to place, when mingled with liquids, gives rise to certain gurgling or rumbling sounds, called *borborygmi*. They are of little value as signs, except in typhoid fever, when pressure appropriately made over the region of the ileo-cœcal valve causes a distinct gurgling, which thus limited is almost peculiar to the disease in question. In doubtful cases of this affection it becomes, therefore, a diagnostic sign of some consequence.

Signs from defæcation.—Unnatural frequency of the stools, or *diarrhœa*, and their great infrequency, or *constipation*, are two of the most uniform accompaniments of disease. These terms are sometimes applied to denote the consistence of the alvine evacuations, without regard to their frequency, the former to those of less, and the latter to those of more, than usual consistence. But, as a general rule, frequent discharges are more or less liquid, and the infrequent rather hard. Even in healthy subjects, the number of daily evacuations is subject to much variety. Infants have three, four, or five passages in the twenty-four hours, adults usually but one, and the aged even less. Those who lead a sedentary life, especially if they eat freely of stimulating food, go to stool very rarely, often not more than once in from three to six days. This confined habit of body prevails amongst females, particularly milliners, dress-makers, and others who sit constantly, and eat irregular meals. In them constipation leads to other diseases, and is frequently associated with a chlorotic condition, and with neuralgia, leucorrhœa, sick headache, and other evidences of ill health.

The use of opium, lead, and astringent medicines, generally, gives rise to constipation; and it follows the action of many purgatives. It is nearly a constant symptom of insanity, and other nervous disorders, as well as of acute inflammation of the brain and its membranes, and of structural diseases of the upper part of the spinal cord. Whatever presents a mechanical impediment to the passage of fæces through the intestine, induces obstinate constipation; as, for example, tumours, strictures, collections of scybala, and worms, as well as whatever prevents the intestinal muscles from maintaining the peristaltic action; flatulent distention, for instance, paralysis and peritonitis.

Fever, from whatever cause arising, (inflammation of the intestine excepted,) diminishes the secretions of the mucous membrane of this canal; a fact which explains the occurrence of constipation in all such affections, and the origin of the universal employment of purgatives in their treatment. The existence of constipation merely, except in so far as it leads to an excessive accumulation of fæces in the bowels, has but little influence upon prognosis; but this state acquires great importance when taken along with the symptoms which in certain cases accompany it. Thus, when it is attended with pain in the abdomen, and vomiting, obstruction of the bowels is indicated; and its cessation, under these circumstances, proves the obstruction to have been only temporary. It is of unfavourable import, when obstinate, in acute affections of the brain.

In *diarrhœa*, the stools are more frequent than natural, varying in number, from two or three to forty or fifty, in the twenty-four hours. It occurs incidentally in a great number of diseases, and habitually in inflammation of the intestinal mucous membrane, and when the latter is irritated by indigestible food, acrid substances, hardened fæces, &c. When it attends the commencement of an acute attack of a disease seated elsewhere than in the abdomen, it is of unfavourable significance; but if it arise later in the course of the complaint, and is followed by an alleviation of the symptoms, it is sometimes critical. Thus, dropsies have been cured by spontaneous diarrhœa. On the other hand, in persons of the phlegmatic temperament, and in those who already present signs of scrofula or tubercles, the supervention and persistence of this symptom indicate the existence of tuberculous ulcerations of the intestine. It is also a bad omen, when, occurring in chronic diseases of any kind, it is followed by great debility.

Sometimes there is an incessant and urgent desire to go to stool; the patient complains of a sense of weight or bearing down about the anus, as if a large discharge were about to overcome his efforts to restrain it; and yet when he yields to the call, he either passes nothing, or, with scalding pain, a quantity in every way disproportioned to the violence of his distress. This symptom, *tenesmus*, is characteristic of dysentery. It occurs, also, when the sensibility of the rectum is augmented by inflammation, piles, or ascarides; and when irritated by the pressure of abscesses, vesical calculi, an enlarged prostate gland, a retroverted or gravid uterus, &c. In fissures of the anus, the scalding and tearing sensation is often so agonizing that patients dread even the thought of going to stool, although they know that the fæces must grow harder, and their suffering be increased by the delay.

When the sphincter ani has lost its power of contracting, through disease of the brain or spinal marrow, or through great debility, the fæces are discharged involuntarily; in the one case without the patient's consciousness, and in the other without his being able to prevent it. In acute diseases, this symptom indicates almost certainly a fatal result; but in chronic affections, idiocy and dementia, it involves no peculiar danger. Sometimes the involuntary discharge of fæces is consequent upon an unnatural opening being formed for their escape, as in artificial anus, caused by a wound of the abdomen, or hernia. M. Chomel relates an extraordinary case of a woman whose small intestine communicated directly with the cavity of the uterus, adhesions having been formed through the irritation of cancer in the latter organ; in consequence of which abnormal arrangement, the fæces escaped continually from the vagina. They pass through the same canal in that most disgusting affection, recto-vaginal fistula.

The inspection of the *alvine evacuations* is of great utility in practical medicine. It is too much the habit, at present, to omit their examination altogether, on account of its repulsiveness, and the difficulty of effecting it, either in private or public practice; and this habit has induced the still more blameable one, of neglecting to make proper inquiries on the subject.

The *consistence* of the fæces varies in the healthy state according to the age, the food used, the habits of exercise, &c. Children at the breast pass fæces of pap-like consistence. Subsequently, with advance of years, the fæces grow progressively harder. Vegetable furnishes softer discharges than animal food. In disease, the excrement may be as hard as dry clay, or as thin as serum, or of any degree of consistence between these two extremes. It is most liquid in mucous and serous diarrhœas, and hardest when a mechanical impediment to the passage of the contents of the intestines exists. In mania, melancholy, and lead colic, the fæces are extremely compact. When long retained, they are apt to be discharged in firm, globular masses, resembling sheep's or goat's dung. If they are then unmixed with fluid, it may be inferred that the bowels are completely evacuated; but when thus mixed, it is probable that a hardened mass is retained somewhere in the colon, which, by its irritation, causes this combination of the discharges proper to both diarrhœa and constipation. Persons of sedentary habits frequently assert their bowels to be perfectly regular, and even loose, when they have in reality a large collection of scybala in the colon, exciting a daily evacuation like that described. In stricture of the rectum, the fæces assume the shape and size of the aperture through which they pass, and may be flattened, indented, or long and slender.

The aggregate *quantity* of intestinal evacuations is, for the most part, small in constipation, and large in diarrhœa; but the individual stools are more commonly copious in the former. It has already been stated that they are both scanty and frequent in dysentery.

The *colour* of the fæces varies considerably. In children at the breast, they are habitually of a light yellow colour; during the first dentition, and especially in the summer complaint (gastro-enteritis) of this climate, they often resemble hashed spinach, both in colour and consistence. This colour, frequently, does not show itself until the excrement has been exposed to the air for several hours—a fact which accords with the opinion of several eminent chemists, that the colour is not derived from the presence of bile, but of a salt of iron. In malignant cholera the stools contain little flakes of fibrin, which gives them a turbid white appearance, resembling rice-water. Under all circumstances in which the secretion of bile is deficient, they are of a grayish-white colour, like that of putty or potter's clay; when bile is in excess, they acquire a brownish yellow, or even a dark bronze colour. Pale-coloured stools do not necessarily depend upon a scanty secretion of bile. They are often produced by the continued use of chalk mixture. Pure bile is sometimes found in the fæces of persons lately returned from a hot climate; after a violent fit of anger, and after purgative doses of calomel. *Redness* of the evacuations is generally due to the presence of blood, and is always a sign either of hyperemia, passive congestion, or the loss of the fibrinous element of the blood—those cases only excepted in which this fluid has been swallowed, or proceeds from the rupture of an aneurismal sac, or from a wound. Thus, it is discharged from the bowels in dysentery, in congestion of the liver and spleen, in hæmorrhoids, in petechial typhus, in scurvy, and purpura. Bloody stools occur, also, in cancer of the intestine; the abdominal pain, constipation, general emaciation, and a tumour of the abdomen, serve to distinguish this from other occasions of intestinal hemorrhage. Hæmorrhoidal flux may be recognised by the purity of the blood lost, the absence of colicky pain, the presence of a feeling of weight in the sacral region, and the sense of relief which follows the discharge. In general, blood from the upper portion of the digestive tube is darker than what is exhaled nearer to the anus. When intimately mixed with the fæces, it gives them a reddish-brown, or blackish hue. It should be remembered, however, that preparations of iron have the same effect. Rhubarb stains the fæces yellow, and indigo blue. A black substance may be evacuated by stool, different from any of the above. Dr. Graves mentions the case of a dyspeptic patient who discharged, by vomiting and purging, enormous quantities of a black fluid which exhaled an insupportable odour of sulphuretted hydrogen. When the gas just named is present in the bowels of a person under the use of acetate of lead, the dejections are turned black.

Sometimes half-digested food is discharged from the bowels. This state is called *lientery*. It is a sign of weak digestion, or of chronic inflammation of the intestinal tube. It is not uncommon in tuberculosis of the mesenteric glands. Infants at the breast frequently void curded milk ; this may arise from a state of over-activity of the digestive canal, causing the food to be hurried on too rapidly ; but it is also quite consistent with good health, and then arises from the child having swallowed more milk than it was able to digest.

Serous stools have been alluded to as they occur in cholera ; they may also follow the suppression of copious discharges from other organs, and the use of saline and drastic purgatives. Spontaneous serous fluxes depend immediately upon passive congestion of the abdominal organs. Evacuations of *mucus* accompany enteritis, and the first stage of dysentery ; they are often met with when worms, or hardened fæces accumulate in the bowels. *Pus*, when found in the dejections in considerable quantities, and but partially mixed with fæces, may be inferred to proceed from the opening of an abscess into the intestine ; when it only streaks the surface of moulded fæces, its source is a fissure or fistula about the verge of the anus. In dysentery it is sometimes mingled with blood, and shreds of false membrane. The last-mentioned substance is occasionally passed in the form of a complete tube, during the enteric inflammations of children. Fragments of concrete lymph in the dejections, have been mistaken for joints of the tape worm, and give both patient and physician unnecessary alarm. A close inspection with the aid of a magnifying glass, will readily detect the absence of regular structure in the former. Portions of the intestine separated by sloughing after intussusception may be thrown off by stool, and still the patient recover. Biliary and intestinal calculi, and, when a fistulous communication between the bladder and rectum exists, urine also, may be found in the stools. The discharge of worms is important as being the only infallible sign of the existenee of these parasites within the intestinal canal; all the other so-called symptoms of worms, when taken together, furnish only a probability of their presence.

The natural *odour* of the fæces is sufficiently offensive, but in some cases of disease it becomes intolerably fœtid. This is of course the case when the bowels are attacked with gangrene, whether from cancer, stricture, or follicular or mucous ulceration; in simple ulceration, in almost all affections of a typhoid form, whenever the contents of the bowels are long retained, as in melancholy, in old age, from neglect of defæcation, &c., they are somewhat less, but still highly offensive. In all diseases attended with rapid wasting of the body their smell is intensely sickening. The stools of consumptive patients are of this description. Chemical analysis has shown that they contain a very large proportion of fat. It may be conjectured that the fatty liver of phthisis results from the absorption of adipose matter from the intestine through the radicles of the portal veins.

CHAPTER III.

SIGNS FROM THE GENITO-URINARY APPARATUS.

The *male* organs of generation furnish several useful signs. The penis is usually enlarged in children who are addicted to onanism, and in adults who indulge in venereal pleasures. If they carry them to great excess, on the other hand, the organ becomes shrunken and flaccid. *Priapism* in children may be owing to the vice just named, to vesical calculus, to ascarides in the rectum, or to the irritation of hardened fæces there. In youths and grown persons it is a favourable sign on the approach of convalescence, as showing the renewed activity of the nutritive function. When, on the contrary, it occurs during coma, or after injuries to the brain or spinal marrow, it is a sign of evil augury. When it attends affections of the bladder or urethra, it shows them to be unusually active. Priapism is one of the symptoms of erotic mania, or satyriasis; its importance then is secondary to that of the primary affection. It may also proceed from prolonged continence, in persons of a nervo-sanguineous temperament, and from an over-dose of cantharides. An habitually flaccid state of the penis is observed in impotence depending upon a want of venereal desire; this is produced by several diseases, but in a marked degree by diabetes, Greek elephantiasis, and chronic diseases of the brain. Involuntary seminal emissions, upon slight provocation, proceed from debility and generally from that induced by venereal excesses or onanism.

The *scrotum* and *testicles* may be the seat of swelling of various kinds. Anasarca is known by its occupying the whole scrotum, and its coinciding with subcutaneous effusion in other parts. Swelling of one side may be owing to distension of the cavity of the tunica vaginalis. This may be due to hydrocele, or hernia, affections which are chiefly distinguished by the transparency of the former, and the opacity of the latter tumour. A tumour composed of tortuous and soft veins, and diminishing in the horizontal position, is formed of the enlarged veins of the cord, and called varicocele. Simple enlargement of the testis occurs in the metastasis of mumps. The diagnosis of other tumours of the testicle is very difficult, but very important, and belongs to the province of special surgical pathology. Retraction of the testicle is observed during a fit of the gravel. Excruciating pain in this organ, without change of form, size, or temperature, is characteristic of the complaint described by Sir Astley Cooper as *irritable testis*, and which subsequent investigations have shown to be, essentially, neuralgia of the ileo-scrotal nerve.

The *female* parts of generation are of far greater consequence than the male, in semeiology. Their close sympathetic relations with almost every other part of the organism, cause them to share in nearly every disease which can affect the economy, and their own disorders become a prolific source of mischief to the general health.

Morbid discharges from the vagina are of several kinds;—that of gonorrhœa, which is yellowish or greenish, and accompanied with heat, tenderness, and swelling of the parts; that of leucorrhœa, which is generally of a lighter colour and muco-purulent, but sometimes is not distinguishable from the last mentioned; that of cancerous degeneration, which is sanious, bloody, and extremely fœtid; and that of the lochia, which follows parturition, is at first bloody, and gradually becomes like healthy mucus, and exhales a stale and disagreeable smell. Leucorrhœa is a term usually applied to all chronic discharges from the vagina, and may depend upon various causes. Amongst these are inflammation of the vagina and lining membrane of the uterus, indurations, polypi, steatomatous tumours, scirrhus of the vagina or womb, displacement of the uterus, and the irritation of oxyures in the rectum, hardened fæces in this canal, and stone in the bladder. It is also frequently associated with the plethora produced by over-feeding and sedentary habits, and, on the other hand, with more direct debility, as in chlorosis, prolonged lactation, &c. The difficulty of ascertaining the real cause of fluor albus in a given case, renders necessary the employment of the touch and the speculum, in order to obtain a satisfactory notion of its origin.

The suppression of the *lochia* is usually regarded as the cause of the inflammatory affections of the womb and peritoneum which so frequently and with such fatality succeed it; but it is now sufficiently proven that such suppression is the consequence, and not the cause, of these dangerous incidents; they begin to show themselves before it commences.

Sterility is sometimes, though rarely, owing to mechanical impediments to the passage of the semen through the vagina, uterus, or fallopian tubes; it is very commonly associated with amenorrhœa, but is frequently observed in cases where neither of these causes, nor any others, can fairly be alleged.

The *menses* are disordered in many different diseases. They may be scanty or suppressed; they may be accompanied with various degrees of pain; or they may be too profuse. It is not easy to generalize the circumstances under which these several conditions exist. In regard, however, to scanty catamenia it may be admitted, that, apart from their frequent dependence upon structural lesions of the ovaries and womb, they indicate a deteriorated condition of the nutritive function, as may be inferred from the partial or complete suspension of the menstrual flow in chronic exhausting maladies, and especially in pulmonary consumption. In the case of a female predisposed to this disease, the state in question should excite alarm. The fact is familiar to every one, that suspended menstruation is one of the most ordinary of the signs of pregnancy.

Signs from the Urine.—With a return to the study of nature on the part of modern physicians, the habit of examining the urine, so prevalent amongst the ancients, has been revived. Formerly, the signs derived from this source were interpreted in the loosest possible manner, and used to illustrate the most opposite hypotheses. Now, the medical profession appears too much disposed to adopt the results of chemical investigation as final, and to apply them on all occasions to explain the phenomena of disease. The latter error has thus far proved to be the less dangerous one;

yet it must be guarded against, for unless the theories which are now beginning to display their brilliant coruscations around the scanty and unaffiliated facts of pathological chemistry differ greatly from all that have dazzled scientific men during the last two thousand years, they will soon disappear and be forgotten. While, therefore, it is necessary to present a succinct account of the pathological indications furnished by the urine, so far as there seems to be sufficient evidence of their reality, we shall not burden the description with those numerous details, which are either unimportant in the present connexion, or still continue to be subjects of dispute.

Healthy urine, when recently discharged, possesses the ordinary temperature of the body, is transparent, of a lemon or amber colour, exhales a peculiar aromatic odour, which it loses on cooling, but regains on being warmed, and has a bitter, saline, and somewhat pungent taste. Its average specific gravity is about 1·018. It has a slightly acid reaction. About ninety-three parts in one hundred of such urine are pure water; the remainder are made up chiefly of urea, and saline and organic matters, which constitute from six to seven hundredths of the whole amount of urine discharged. It is estimated that about two and a half ounces, avoirdupois, of solid matter are eliminated by the kidneys of a healthy adult in twenty-four hours, of which nearly one-half is composed of *urea*, a substance formed from the effete nitrogenized products of nutrition.

The *quantity* of urine voided varies greatly even in health, and in different individuals; but, other things being equal, depends upon the amount of fluid ingested. It is more copious in winter than in summer. In the latter season, much more water is consumed, but its tendency is to the skin, where it serves the purpose of keeping down the temperature of the body by its evaporation. In winter, on the other hand, there is little or no sensible perspiration, and the fluids of the economy are excreted chiefly through the kidneys. The watery element of the urine is alone influenced in its amount by the activity of the other secretions; so long as health continues the daily average of the solid constituents remains very nearly the same. Hence it is evident that the sp. gr. of the urine must be low when this fluid contains much water, and high when its proportion of water is small.

But the specific gravity, or the proportion of solid contents in the urine, is not the same at all hours. After copious draughts of water, its sp. gr. is lowest, (1·003 to 1·009); what is voided on rising in the morning, if no supper have been eaten the night before, is formed almost exclusively from the waste of the body, and its sp. gr. ranges from 1·015 to 1·025; the urine secreted during the digestion of a hearty meal is loaded with solid matters, and its sp. gr. is from 1·020 to 1·030. Hence the average specific gravity of the urine can only be ascertained in a particular case, by adding together and examining all that is passed during the twenty-four hours. If this is impracticable, a near approach to the truth may be made by determining the sp. gr. of that voided before breakfast.

Besides these periodical changes, there are others due to the quality of the food. Animal food, containing a large proportion of nitrogen, renders the urine heavier; vegetable food, by means of its watery constituents, lowers the density of the urine. From these considerations it is evidently easy to calculate how much solid matter is daily voided in a given case, merely by knowing the sp. gr. of the urine containing it. For if 1000 grains of urine of a certain sp. gr. contain so many grains of solid matter, a given weight of urine of any other sp. gr. must contain a proportionate weight of solids. Tables have been constructed upon this principle which show at a glance the quantity of solids in 1000 grains of urine of different densities; so that we have only to learn the absolute weight and the sp. gr. of the urine passed by an individual in twenty-four hours, in order to determine the weight of solid matter excreted by his kidneys during this period.

The most important solid constituents of normal urine, and which undergo extensive changes in disease, are the following. *Urea*, of which rather more than half an ounce is said to be secreted in twenty-four hours: *Uric acid*, of which about eight grains are passed daily, in combination with ammonia, forming a soluble urate. But when the ammonia is withdrawn, or is insufficient to saturate the uric acid, this latter is precipitated in a solid form, constituting red gravel, and the most ordinary variety of calculus. There are several *fixed salts* including the sulphate of potash, the phosphates of soda and lime, and the ammonio-phosphates of soda and magnesia, of which, taken together, about 138 grains are contained in the urine evacuated during twenty-four hours.

So long as the above-mentioned constituents maintain their normal relations to one another, and to the quantity of urine discharged, the fluid remains clear and transparent for some time after it has become cool, or is perhaps rendered a little hazy by floating mucus. After a time, however, an unpleasant odour is exhaled, the urine has become alkaline, a precipitate of the triple phosphate, and of the phosphate of lime is thrown down, and a greasy iridescent scum composed of these salts, and of mucus, forms upon the surface of the liquid. The addition of hydrochloric acid causes such urine to effervesce by decomposing its carbonate of ammonia. These, and similar conditions, found in urine after a sufficient time has elapsed for the decompositions noticed to take place spontaneously, are not, therefore, to be regarded as indicative of disease.

In like manner certain modifications of its physical properties are quite consistent with health, and may be produced at will. Madder imparts a deep orange-colour to the urine, infusion of logwood, raspberries, mulberries, and blackberries, increase its redness; indigo makes it blue, rhubarb and angustura bark yellow, and ferruginous preparations blackish. Turpentine communicates to it an odour compared to that of violets; copaiva its peculiar smell, and asparagus a disgusting stench. Tannin taken internally is excreted by the kidneys, and causes a black precipitate to be formed when a solution of a salt of iron is added to the urine. Mineral acids received into the stomach do not affect the composition of the urine, but vegetable acids and alkalies, respectively communicate to it their properties.

The physical qualities of morbid urine.—The *quantity* of the urine is much influenced by disease. When this fluid ceases to be secreted by the kidneys, there is said to be *suppression*, and when it cannot escape from the ureters or bladder, *retention* of urine. The former may depend upon inflammation of the kidneys themselves; it is rarely, however, complete. Extreme scantiness of the urine is met with chiefly in low fevers; but, under whatever circumstances it occurs, it is an almost fatal sign. A more moderate diminution of the urinary discharge accompanies nearly all febrile affections even from their commencement; during the decline of scarlatina, and other exanthemata, the continuance of this condition is unfavourable, for it portends dropsical effusions. Retention of urine (which is distinguished from suppression by the existence of a rounded tumour formed by the distended bladder in the hypogastrium) may result from a mechanical impediment to the escape of the urine, such as a calculus in the urethra or bladder, stricture, enlarged prostate, the pressure of the gravid uterus, of the displaced unimpregnated womb, or other tumour within or without the bladder; or from a loss of the contractile power of the muscular coat of this organ, in consequence of congestion or other disorder of the brain or spinal marrow, or, finally, from spasm of the sphincter vesicæ. Retention is a common symptom in all affections attended with coma, and also in hysteria, and should in such diseases be carefully inquired after. The quantity of the urine is increased whenever the other secretions are diminished without fever, as in the cold stage of intermittents, and under the influence of fear, anxiety, and other depressing passions. It also exists as an independent disease, in which for many years the patient may pass gallons of normal but diluted urine during the day, and suffer no inconvenience beyond the thirst which prompts him to repair so great a waste. In diabetes there is a similar excessive flow of urine, but not of normal composition. Profuse discharges from the bladder occasionally occur as critical evacuations in dropsy.

Urine may be quite *colourless*, and limpid as water, when its quantity is increased by any cause not affecting its composition; as after copious draughts of aqueous fluids, in hysteria, &c. It may be rendered whitish or lactescent by the admixture of mucus, or pus, or the phosphatic salts; of a dark-red colour by the presence of dissolved blood, as in hemorrhage from the mucous lining of the urinary passages; of a bright or yellowish-red in inflammatory fever; and of a yellow or greenish hue in affections of the liver attended with jaundice.

The *odour* of urine is frequently ammoniacal in low forms of fever, after injuries to the spinal cord, and even when from other causes the secretion has been long retained in the bladder. It is often fœtid when it contains pus derived from ulceration of the urinary mucous membrane, particularly when of a malignant form, and also in those diseases marked by dissolution of the blood. It has a sweetish smell and taste in diabetes.

The *consistence* of the urine varies in disease. During the first stage of acute diseases, it is usually thin, but becomes turbid during their decline ; when this change does not depend upon disease of the urinary apparatus itself, it is a favourable indication. Urine which is at all turbid when voided, deposits, on standing, a sediment, whose composition it is very important to understand. Sometimes it is formed of mucus, sometimes of pus, blood, or semen, or of some one or more of the saline, acid, or earthy constituents of the urine. Blood may usually be recognised by its colour; but, thus far, no method of clearly distinguishing in all cases between pus and mucus, without a microscopical examination, has been discovered. Often, however, the respective qualities of these two products are distinctly marked, to wit : the whitish, translucent, stringy, and tenacious characters of mucus, and the greenish colour, opacity, and slight adhesiveness of pus ; but in many instances the two products are commingled. The urinary sediment may also contain calculi, worms, hydatids, and, in recto-vesical fistula, even fæces. A whitish, opalescent, and somewhat fatty pellicle called *kystein*, is formed upon the surface of the urine of a large proportion of pregnant females, and may therefore be ranked amongst the signs of pregnancy.

The chemical properties of morbid urine.—The constituents of the urine, whether normal or accidental, detected principally by chemical reagents, may now be summarily noticed. The pathological conditions affecting the proportion of *urea* do not appear to have been well ascertained, nor to possess a high degree of importance. In diabetes it is replaced by sugar. *Uric acid* is sometimes present in large excess, and is then precipitated in the form of a crystalline deposit. It may, however, be thus precipitated without being redundant, for a stronger acid than itself, as the muriatic or phosphoric may accidentally exist in the urine, and uniting with the base of the urate of ammonia, cause the acid to be thrown down. The *earthy phosphates* are less commonly in excess. But when they are so, their physical characters betray their presence. They are, in some instances, sufficiently abundant to render the urine milky when first passed. Not unfrequently they form dense masses in the urine, hanging in ropes like the thickest puriform mucus, from which, indeed, they cannot be distinguished by the naked eye. Sometimes, as the urine cools, they are deposited in the form of a white crystalline gravel; or, as more commonly happens, after a few hours repose of the liquid, crystals of these salts collect upon its surface in the form of an iridescent pellicle, like the film which is seen upon lime-water. One of the constituents of the blood, serum, or rather *albumen* in solution, is passed with the urine in a great number of diseases, and in one, the large amount of it habitually discharged characterizes the malady, and has even conferred upon it a name, albuminous nephritis, or Bright's disease. In another affection the urine is remarkable for the quantity of *sugar* contained in it, by which it acquires a sweet taste and has its density considerably increased. Sugar and urea, indeed, elevate the specific gravity of the urine more than do any others of its soluble constituents. The colouring matter of the *bile* communicates to the urine a light or dark yellow colour, according to the quantity of it held in solution. *Oxalate of lime* is by no means an infrequent ingredient of the renal secretion, but it readily escapes notice, and requires a particular manipulation of the urine for its detection. It is a prolific source of calculous concretions.

Various other substances are met with in urine altered by disease, but they are of inferior consequence to those already enumerated. According to the chemists, the great number of them are not original products, but result from the decomposition of urea and uric acid, and of the recomposition of their elements in new forms. The slightest disturbing influences seem capable of producing these changes. There is a wide difference between the physical characters of sugar and oxalic acid, and between those of albumen and uric acid, and yet they have respectively so close a resemblance in their chemical composition, that the addition, subtraction, or transposition of a single element of one of them shall be sufficient to create another one of the number. The extreme facility of these transformations, and our almost total ignorance of the laws which regulate them, must, it would seem probable, render nugatory every attempt to account for the morbid states of the urine upon merely chemical principles. Such attempts appear still more likely to be unsuccessful when it is considered that the morbid states of the urine are, for the most part, effects rather than causes of disease; effects either of inflammation, or of some structural lesion of the kidneys themselves, or of some constitutional vice, or else, what is still oftener the case, of some derangement of the digestive function. The primary assimilation of the food may be imperfect, and hence the whole function of nutrition become disordered.

A brief account of the modes of detecting in ordinary practice, the most important alterations of the urine, may not, perhaps, be misplaced here. The apparatus necessary for examining the urine at the bedside is very simple, and consists merely of a gravimeter for measuring the specific gravity of fluids, a little blue and red litmus paper, a test-tube, a spirit lamp, and a vial of nitric acid.

The reaction of the urine is first to be tested; if acid, it will redden blue litmus paper; if alkaline, it will turn the red paper blue: if neutral, it will produce no change in either colour. If there is *no* cloud in the urine, a small quantity of it may be placed in the test-tube over a spirit lamp. Should a white deposit be formed, it must be either albumen or the earthy phosphates; but by adding a drop of nitric acid, that question is settled; for the acid will coagulate the albumen more firmly, but dissolve the salts.

If the urine is very high-coloured, it may be supposed to contain either the colouring matter of bile, or blood, or an excess of uric acid. If blood be present, heat will cause the liquid to lose its transparency, as will also nitric acid; whereas heat will not affect the bile pigment, and nitric acid will at once turn it green. If uric acid be the cause of the dark colour of the liquid examined, the addition of nitric acid will precipitate it in the form of a brownish sediment.

Pale urine usually contains an excess either of water, urea, or sugar. If the first, its sp. gr. will be low; if either of the latter, its sp. gr. will be high. By adding a little nitric acid to a portion of urine contained in a test-tube, surrounded by cold water, feather-like crystals of nitrate of urea will be deposited, if this substance be in excess. If no urea is found, the test for sugar may be applied. This requires some time and caution, when the proportion of sugar is trifling. But, in most instances, it is sufficient to place a drachm or two of the suspected urine in a test-tube, with about half its weight of liquor potassæ, and boil the mixture over a spirit lamp. The previously pale liquid immediately assumes a peculiar orange-brown colour. This test has been further perfected by Dr. Heller, of Vienna. After boiling the liquid for some time, if nitric acid be added, a very evident odour of molasses is perceived.

Should the urine be *alkaline*, it remains to be inquired whether this state depends upon its containing albumen or ammonia. The addition of a little nitric acid will determine this point; for, if albumen be present, a coagulum will be formed; but if ammonia, a brisk effervescence takes place, in consequence of carbonic acid being liberated.

If, instead of being clear, the urine deposits a *sediment* on standing, its character may be determined by similar means. Thus, when the deposit is flocculent, and readily diffusible by agitation, it is made up chiefly of mucus, which is insoluble by nitric acid. When ropy or viscid, it may consist of the phosphates, or of mucus, or pus. The first are dissolved by nitric acid; the second, if pure, remains unchanged; and the last, if pure also, will be coagulated by the acid.

The *colour* of the sediment aids in determining its nature. If *white*, it may consist of urate of ammonia, or the phosphates; but the former disappears under the action of heat, and the latter when nitric acid is added. If the deposit be coloured, it consists either of uric acid, or of urate of ammonia dyed with purpurine, or of blood. But the first can be recognised by its crystalline structure, the second by its disappearance when heated, and the last by its coagulating under the same influence.

Dr. Golding Bird, from whose admirable essay these details are in great part derived, gives the following brief summary of the diagnosis of urinary deposits, which, if committed to memory, will be found a sufficient guide in nearly every case: "If the deposit be white, and the urine acid, it, in the great majority of cases, consists of urate of ammonia; but if it should not disappear by heat, it is phosphatic. If a deposit be of any colour inclining to yellow, drab, pink, or red, it is almost sure to be urate of ammonia, *unless visibly crystalline*, in which case it consists of uric acid."

The manner in which urine is voided is modified by disease. In health it is discharged at certain regular intervals, freely, and without pain. But, under various circumstances, the call to urinate may be almost constant; the stream may be more sluggish than natural, or interrupted, forked, twisted, or small; or it may be passed without the patient's consciousness, or in spite of his attempts to control it. The last-named condition is called *incontinence.* There may be such extreme difficulty in voiding the urine, that it issues only in drops, and is attended with heat, pain, and tenesmus, about the neck of the bladder—this is *strangury.* If pain be absent, while the urine, as it were, distils from the urethra, there is said to be *dysury.*

To complete this portion of the present subject, it remains to point out the semeiological value of the symptoms which have been described. Profuse and chronic discharges of urine, containing sugar, are characteristic of diabetes; a like abundance, of a non-saccharine fluid, indicates the disease variously denominated diabetes insipidus, hydruria, and polydipsia. Clear and transparent urine, containing neither blood nor mucus—frothing when agitated, and coagulating on the application of nitric acid and heat—is albuminous, and, in chronic disease, indicates granular degeneration of the kidneys. During the first stage of Bright's disease, the urine contains blood corpuscles. Urine made green by the addition of nitric acid, contains the colouring matter of the bile. Crystals, a gritty sediment, and calculi, in the urine, announce the existence of some one of the forms of gravel, which is to be determined more precisely by the methods above described. Hydatids, in this fluid, generally proceed from a cyst in the kidneys.

Mucus in the urine, if in considerable quantity, is generally owing to vesical catarrh, or to enlargement of the prostate gland. Pus may be derived from inflammation of the pelvis of the kidney, (*pyelitis*,) or from that of the lining membrane of any part of the urinary passages, or from an abscess of the kidney, or prostate gland; and when sanious, fœtid, and bloody, it is almost certainly indicative of malignant disease of the bladder. Blood in the urine is commonly due either to inflammation of the kidney, to calculous concretions in its pelvis, or to erosion of a vessel in the bladder. It also frequently accompanies the course of a variety of acute and dangerous diseases. The urine in small-pox, for instance, is often bloody. So is it in purpura, in typhoid fever of bad type, in scorbutus, in acute anasarca from exposure to cold, &c. It may even occur as a distinct affection, without any general or associated symptoms. The manner in which pus and blood are voided, is of consequence in diagnosis. If they are discharged with the commencement of the stream, it may be presumed that they are formed in the urethra. If they accompany the conclusion only of the discharge, they are usually regarded as proceeding from vesical disease, and, if intimately mixed with the urine, from the kidney. But it is evident that the value of this distinction is doubtful; for, whether the bloody or purulent discharge proceed from the bladder or the kidney, it will, if the patient remain at rest, be voided only at the conclusion of urination; and if he be in motion, it will mix with, and accompany in its emission, all the urine contained in the bladder. Bodies, looking like earth-worms, are sometimes passed from the bladder. They are coagula of blood, moulded in the ureters. They generally give rise, while in these canals, to the symptoms of nephritic colic, or of a fit of the gravel.

Frequent calls to urinate may be owing to a large increase of the renal secretion, and, when attended with pain, to a concentrated state of the urine,—to inflammation of the bladder—the ingestion or absorption of the active principle of cantharides, or of turpentine; to the presence of a calculus in the bladder, to enlargement of the prostate gland, to pressure of some adjacent organ or tumour, and to an excited state of the nervous system. Infrequency of voiding the urine depends, in disease at least, either upon its scanty secretion, (ischuria, suppression) or its retention in the bladder. Two forms of the latter are to be distinguished: the one in which a physical obstacle prevents the escape of the urine, and the other in which the patient's sensibility is so blunted that he is unconscious of the distention of his bladder. In the latter case, when a certain amount of urine is collected, all beyond that quantity forces a passage, and there seems to be incontinence, when there is in reality retention. In paraplegia, the amount thus retained becomes gradually less and less, and at last the urine escapes from the urethra almost as fast as it is poured into the bladder. Such incontinence is also not unusual after operations for the removal of stone in the bladder, especially when the patients are very young. A twisted, forked, or thin stream of urine, is commonly indicative of stricture of the urethra; it may, however, be caused by a fragment of stone, or other foreign body, in this canal.

The symptoms furnished by the urine are not without their value in prognosis. If, for example, they lead to the detection of diabetes, or the suspicion of Bright's disease, the most unfavourable judgment must be formed of the ultimate issue of the case. Here the certainty of the prognosis is entirely measured by that of the diagnosis. In other circumstances, particular symptoms foreshadow the subsequent course of the attack. Thus bloody urine at the commencement of a febrile disorder is an exceedingly unfavourable occurrence; in acute disorders generally, so long as the urine remains clear, or, if at all clouded, deposits no sediment, a speedy termination of the attack ought not to be looked for; while, on the other hand, when in the place of such urine, there is a discharge which presents, on standing, a copious lateritious sediment, a remission, if not the definitive resolution of the malady, is at hand. But even before the appearance of such deposits, the approaching decline of the attack can sometimes be predicted from an examination of the urine. It has been found, according to Martin-Solon, that the urine is albuminous in most acute diseases, just before the commencement of their decline. The sign is not however of much importance, inasmuch as it is often met with in cases which for a long time afterwards give no evidence of improvement, or which even terminate fatally.

It need scarcely be remarked that the prognosis founded upon urinary symptoms, even when these are of the worst possible nature, depends in a great measure, also, upon their degree; for even diabetes and Bright's disease, although incurable, are in many instances so far amenable to treatment as to be prolonged far beyond the average duration which general observation would assign to them. A cautious prognosis should especially be given in calculous affections, particularly at a period of life when a change of constitution may still be hoped for from a change of habits.

CHAPTER IV.

SIGNS FROM THE NERVOUS SYSTEM.

THE physiology of the nervous system is involved in so great uncertainty, that very few propositions relating to it are established by the general consent of scientific investigators. A corresponding, or rather an augmented, obscurity envelopes its pathology; and in this darkness the physician must grope his way towards truth, conjecturing much and feeling sure of very little. This fact is the more to be regretted, because no other system furnishes so many remarkable symptoms as the nervous. Whether the patient sleeps or wakes, acts or suffers, all that he does or feels is through its agency. It is the power which presides over all the rest, the moving influence of the whole animal machine. It not only governs individual parts, but harmonizes the action of all, (and that quite independently of the will,) binding together the several portions of a most complicated structure by the strongest ties of sympathy, so that the well-being of one promotes the general good, and no one can suffer without affecting all. But those sufferings and disorders which claim particular attention in this place, are so varied in their sources, so uncertain in their nature, degree, and combination, are attended, for the most part, with such different lesions, if attended by any, that they are not only difficult to describe when first observed, but even more so to recognise when they recur. While the respiratory, circulatory, digestive, and every other apparatus, composed of anatomical elements differing widely amongst themselves, has each a special and single function to perform, the nervous system, with an apparently simple anatomical arrangement, presides over three distinct functions, of whose physiology the rudest and grossest notions only have hitherto been obtained. It would seem impossible, therefore, to analyze processes in which all three of these functions, sensation, motion, and intellection, appear to be combined. Much has indeed been done by modern investigators in explaining certain nervous phenomena, by first observing the phenomena of disease which appear to be connected with definite lesions of structure, and then by imitating, as far as possible, the same lesions in experiments upon the lower animals. The results of direct observation, rather than the explanations inferred from these sources, will be set forth in the ensuing sections.

SECTION I.

SIGNS FROM THE FUNCTION OF SENSIBILITY.

The *general sensibility*, or common sensation, may be exalted, perverted, impaired, or altogether lost. In hysteria, in that state falsely called magnetic, in inflammation of the brain, and fevers, and during the decline of certain affections such as typhoid fever, it is often very acute. In acute meningitis, in rheumatic and scrofulous ophthalmia, and in neuralgia of the eye, intolerance of light is often so extreme, that the patient finds no repose except in utter darkness; in cerebral inflammations, and in some cases of hysterical disorder, the sensibility is so acute that the gentlest whisper may pain the ear, and the mildest odour offend the smell; when the spinal meninges are inflamed, the cutaneous sensibility is so much exalted that the mere contact of the bed-clothes with the skin, or the least touch of an attendant's hand, may excite the most intolerable suffering. The last-mentioned symptom is not uncommon after acute diseases of an ataxic form, and has then no peculiar danger, but when it, or other forms of exalted sensibility, appear at an early stage of an acute attack, without any structural disease of the organs whose functions are altered, they are unfavourable indications. They are much more serious when accompanied with fever, than when they occur in persons of a nervous temperament, the morbid sympathies of whose organs are readily excited; for the presence of fever, under the circumstances, points to a probable inflammation of the brain.

There is a form of exalted sensibility, not so much to external impressions as to those which depend upon morbid changes going on in the economy, and which in its several degrees may be spoken of as discomfort, restlessness, anxiety, and distress. The first of these is the ordinary precursor of acute attacks; the second is more commonly a sign of some complication about to arise in the course of another disease; the third and fourth are measures of the severity of such complication, and often precede the unfavourable change in a disorder which leads to its fatal issue.

Pain is a sensation which many have attempted to define, but unsuccessfully. Nothing is known of its nature, and but little of what is essential to its production. In general, it results from some impression made upon the nervous extremities, and transmitted to the brain, where it is perceived. But in other cases, the impression is made at the origin of a spinal nerve, or in the spinal marrow, or in the brain itself, while the sensation is referred to a distant part of the body. This fact should be borne in mind, for when no sign of disease in a part can be detected besides pain, an examination of the trunk of the nerve distributed therein, as well as of the nervous centres, may lead to the discovery of its cause.

The *causes* of pain have been arranged under the following heads: 1st, lesions of the organs where it is felt, such as wounds, bruises, lacerations, burns, the deposit of morbid products in their tissue, as in inflammation, cancer, &c.; 2d, a healthful sensation unduly prolonged, or too intense, such as that produced by hunger, thirst, heat, and cold; 3d, a sympathetic influence, as when pain in the shoulder is caused by disease of the liver, or pain in the glans penis by stone in the bladder; 4th, a functional, or at least not structural, disorder of the nervous apparatus, as in neuralgia.

That all persons do not experience the same amount of pain under the same external circumstances, is a well-known fact; the delicate and luxurious lady would sink under a hurt which a healthy labourer would scarcely allow to interrupt his occupation. Yet it is next to impossible to determine the degree of pain actually endured, since the only evidence of its existence is derived from the exclamations and other manifestations of the patient, over which he has a certain degree of control. Moreover, in various depressed or excited states of the nervous functions, he may be actually insensible to injuries which at another time would have occasioned him severe distress. Children, females, hypochondriac, hysterical, and nervous persons, appear to suffer pain most keenly, and of these, females most of all. Yet they, in whom the nervous temperament is most fully developed, endure with heroic fortitude, not only the grievous pains peculiar to their sex, but the still more excruciating anguish inflicted by the surgeon's knife, particularly when the occasion requires them to moderate or to repress their cries. The concentration of the mind upon a subject, or a state of high mental excitement, will often produce complete insensibility to pain. Soldiers wounded in battle are frequently unconscious of their hurt until the end of the combat allows them to think of themselves, or the loss of blood overpowers them. It is not uncommon for maniacs to be quite insensible to the severest cold, and to show no sign of suffering when they have mutilated their throats, genitals, or other parts, in attempting to commit suicide. The writer has seen a man seventy years of age, and who had been for a long time enfeebled in mind, with three carbuncles upon his back, two of them as large as a goose-egg, and that without his manifesting the slightest uneasiness, or any consciousness of an affection, which, under other circumstances, would have been intolerably painful. Whatever, in general, blunts the perceptive faculties, of course induces a greater or less degree of insensibility to pain, as may be daily seen in coma, from whatever cause arising, in the paroxysms of epilepsy and hysteria; in the state of somnambulism; during the influence of alcohol, ether, chloroform, and narcotics. In diseases, therefore, attended with coma, extensive and dangerous complications may arise, without any consciousness on the part of the patient.

Pain, then, is modified by the condition of the patient. It varies also according to the nature of its cause, being different, for example, in cancer, and in inflammation, and in the several degrees of the latter. The same agent may assuage one variety of pain but aggravate another; thus cold, which allays the pain of inflammation, increases that of neuralgia and colic. It may be continued, with exacerbations, (and this is its ordinary type,) or it may be intermittent, as in some forms of neuralgia. It varies, also, with the tissue affected, and is not always proportioned to the sensibility of this tissue in health. Perhaps the most intolerable of all pains are those of inflammation of the bones and fibrous textures, which have naturally but little sensibility. Serous membranes, also, show but little feeling when mechanically irritated, but are extremely painful when inflamed. Mucous membranes, on the other hand, are more tender in health than when diseased.

The several *varieties* of pain have received different names, expressive of their peculiar characters, which, in many instances, are sufficient for the discrimination of diseases.

Dull or heavy pain is generally caused by the weight of some enlarged or congested organ, by the dragging of an internal tumour, or by an effusion into some serous cavity. In females, when felt in the loins, it frequently precedes the menstrual flow, and in males the formation of hemorrhoids. When seated over the eyes, it is frequently the precursor of epistaxis.

Tensive pain exists when the affected parts are put upon the stretch, as when attempts are made to reduce a dislocation; when the variolous eruption is about to appear or to maturate; in ascites and tympanites; or when purulent collections are forming in the cellular tissue. It is commonly accompanied with a throbbing sensation, in acute abscesses; with burning, in erysipelas, cutaneous inflammations generally, and carbuncles; and with a sense of tearing, in gout and rheumatism. The throbbing alluded to corresponds to the arterial pulsations.

Smarting pain is chiefly felt when the skin, denuded of its cuticle, is exposed to the air, or any irritating substance comes in contact with parts which are naturally protected.

Lancinating, or sharp and darting pain, is met with chiefly in neuralgia, rheumatism and cancer; it seems to follow the course of the nervous trunks, and is felt only for an instant in its greatest intensity; in the intervals between its exacerbations there is either no pain, or one that is dull and contusive. In the several forms of abdominal paroxysmal affections which go under the general name of "colic," the pain is at the same time lancinating and tensive.

Perforating or gnawing pain, terms which sufficiently explain themselves, is chiefly experienced in rheumatism, gout, and inflammation of the periosteum and bones. It is common in the tertiary forms of syphilis, and then is most intense at night, as indeed are most of the pains accompanying disease of the fibrous and osseous tissues.

Itching is a disagreeable sensation felt in many diseases of the skin: in scabies, for instance, which is emphatically called *the itch*, and in prurigo, a papular eruption, which is sometimes attended with such intolerable itching as to produce delirium.

The degree of pain caused by a disease is no measure of its gravity. The most dangerous maladies, such as fevers, inflammations of the lungs, liver, and kidneys, pulmonary phthisis, and hydrocephalus, are attended with but little pain, and even when the inflammation of a parenchymatous organ extends to its investing serous membrane, the increase of pain is scarcely evident, so long as the patient remains completely at rest, and even when excited by pressure or motion, it is never so intense as that of *tic douloureux*, or of lead and other colics which are seldom fatal. The evil influence of pain consists in its exhausting the strength, and is therefore conspicuous in chronic affections, which, by profuse discharges, or long confinement, have already produced general debility. It is under these circumstances that the greatest triumphs of moral courage over the progress of disease are witnessed; when the constitutional cheerfulness or the religious confidence of the patient preserves his calmness and resignation amidst tortures which would drive another into gloomy despondency, or into outbreaks of passionate despair.

Few persons can endure prolonged and unremitting pain; such, therefore, is of evil augury. Movable or wandering pain is less serious than such as is fixed, and external than deep-seated pain. The occurrence of severe pains in the loins at the commencement of an eruptive fever indicates that it will be severe. The interruption of the function of an organ by pain must be taken into account in estimating the prognostic value of this symptom. Thus, painful affections of the limbs are of much less consequence than those of the chest which interfere with respiration. Yet it must be admitted that pain, alone, never interferes with the action of organs to a degree sufficient to produce death, although it has now and then extinguished life by means of the shock communicated to the nervous system.

When pain ceases, and at the same time the strength suddenly fails, the pulse grows weaker, and the face sunken, it is often a sign that the affected parts have been attacked with gangrene, and have lost their previous sensibility. For a similar reason, the prognosis must be unfavourable when inflammatory or other complications, which are usually painful, arise without attracting the attention of the patient. A less serious, though extremely unpropitious circumstance, is the occurrence of severe pain during the decline of an attack, for it indicates either a relapse, or a new disease, which must be dangerous in proportion to the debility already existing. Such untoward complications are pneumonia, which arises in the course of many acute diseases, endocarditis and pericarditis in articular rheumatism, peritonitis after parturition, and during the decline of typhoid fever, &c.

Pain confined to a single organ, and seeming of itself to constitute the whole disease, is commonly regarded as a form of neuralgia, and receives a corresponding name. Thus we have gastralgia, hepatalgia, nephralgia, enteralgia, &c., that is to say neuralgic pain of the stomach, liver, kidneys, bowels, &c. There is one organ, however, the head, which is the seat of some degree of pain in nearly every acute disorder, in all at least attended with fever, besides having its own local and peculiar pains. *Cephalalgia*, or headache, is a term used to designate a variety of pains in the head. One of its most common forms is that called nervous headache, and is extremely common amongst persons of an excitable disposition. In them it is brought on by whatever directly or indirectly debilitates: by bleeding, purging, fatigue, or getting the feet cold; by alcoholic stimuli, animated or angry discussions, loud noises, vivid lights, using the eyes too closely, powerful odours, prolonged study or thought, &c. These causes often produce a pain in the frontal region so intense that the slightest effort of body, mind, or senses, is intolerable; but if no other symptoms are present, the affection nearly always disappears after a few hours repose. Nothing is more common than for this pain to cease at sunset, although it may have been extremely severe throughout the entire day. When along with it there is nausea or vomiting, with chilliness and depression of spirits, the attack is spoken of as sick headache, or *migraine*.

Hemicrania, usually regarded as a form of headache, belongs to the neuralgiæ. It is in most instances a neuralgic affection of the branches of the trigeminus which supply the brow and the side of the head, and of those of the occipital nerve which run forwards. At a point near the parietal protuberance, where the branches of these two nerves anastomose, is the seat of the severest pain, of that which in hysterical subjects has been compared to the suffering which a nail driven into the part might cause, and it is called from that circumstance *clavus hystericus*.

Cephalalgia accompanies nearly every disease of the brain, its membranes, and the cranium. In cerebral congestion it is described as deep-seated, with a sense of fulness and weight in the head, dizziness, hazy or indistinct vision, and dulness of the intellect; buzzing or humming noises are also heard in the ears, and the integuments of the face are swollen and red. The headache which marks the invasion of febrile diseases, the exanthemata, in particular, appears to be generally of this description, while, at the same time, the extreme sensibility to external impressions, the restlessness, and irritability, the indisposition to mental exertion, all indicate that the headache is, in part, also nervous. In the eruptive fevers it always abates, and often ceases, upon the appearance of the eruption. In typhoid fever it is more protracted, and when very intense, terminates in coma.

When the meninges are inflamed, especially in children, the headache is, for the most part, very acute, and apt to extort that shrill and peculiar cry so often heard in tubercular meningitis. This pain may accompany diverse lesions of the cerebral membranes, injection of the capillaries, false membranes upon or within the arachnoid, purulent infiltration of the pia mater, or collections of pus or serum in the ventricles, and is the same, whatever point may be the seat of inflammation. It is characteristic of pain in the head, originating from such causes that it begins with the first symptoms of the disease, and goes on increasing until resolution commences, or coma blunts the sense of suffering.

In persons otherwise in good health, a constant and obstinate headache, or one marked by slight remissions only, ought to create suspicion of some organic disease within the cranium, unless the patient be young, of the female sex, and of an excitable temperament. Insanity, and inflammation of the brain, or meninges, are often preceded for years by pain in the head and disturbed sleep. The prognosis will be the more unfavourable, if the pain is fixed and confined to a very small space; and especially if, in connexion with these symptoms, there is formication, numbness, feebleness, or pain in the limbs of the opposite side of the body, or attacks of epileptiform convulsions.

Chronic cephalalgia, marked by regular exacerbations, occurring at night, and rebellious to general and local agents of an antiphlogistic description, is nearly always of syphilitic origin, and is immediately produced by an exostosis upon the internal or external face of the cranium. The pain which accompanies inflammation and caries of the frontal, or of the mastoid or petrous portion of the temporal bones, is at first dull, then acute, darting, and excruciating beyond description. It is soon combined with symptoms of compression, or of inflammation of the brain, such as paralysis, or delirium, and is therefore a very unfavourable prognostic sign.

Perversions of the senses, &c.—In some cases of cerebral congestion, and of inflammation of the brain, all objects appear red to the patient; in others, he perceives sparks, flames, fireballs, &c. Haziness and indistinctness of vision may be owing to an affection of the eye itself, (amaurosis, cataract,) or it may, as in some cases of tubercular meningitis, be the prelude to this affection. Dark, waving lines, points, and other ill-defined objects, floating in the field of vision, are most frequently accompaniments of dyspepsia, with derangement of the circulation, whether sluggishness or local determination. Double vision usually arises from strabismus, which has already been noticed; but it may also occur during inflammatory and organic diseases of the brain, without sensible deviation from parallelism of the axes of the eyeballs. Alone considered, this symptom is not of much value in diagnosis or prognosis. Sometimes only one half of an object is visible; the cause of this phenomenon is not well understood. It is met with occasionally in narcotic poisoning. MM. Hardy and Béhier mention a case of poisoning by belladonna, in which the patient perceived at first only the one half of objects, and then they appeared to him upside down.

Unreal sounds, such as ringing, humming, whistling, or moaning, are very common symptoms in the pyrexiæ, and also in anemia and chlorosis. In the latter they are augmented by whatever quickens the circulation. They are occasionally heard by persons in a state of nervous excitement or anxiety. The writer has known a person, in a very anxious state of mind, pass whole nights awake, tormented with a sound precisely like that made by carpenters in shingling a roof, and which no effort of the will, or change of position, succeeded in quieting. Such unnatural sounds sometimes give warning of epileptic attacks. They are also heard on the approach of deafness, arising from inflammation of the ear, or partial closure of the Eustachian tube.

When patients have a perception of unreal smells, in acute diseases of a low type, there is reason to apprehend that the disease is growing worse, particularly if the supposed smell be disagreeable. Nervous individuals are subject to such aberrations of sensibility, and in them they are without serious meaning. The cases alluded to, must not be confounded with those in which there is a foul secretion from carious bones, or from a mucous surface connected with the nasal fossæ.

The morbid alterations of the sense of taste have already been described, and those of the sense of touch alluded to under various heads. It will be sufficient to say of the perversions of the latter, in this place, that when a patient attributes to a body examined by the sense of touch, other qualities than really belong to it, there is reason to suspect commencing disorganization of the brain.

There are two forms of morbid perception, which it is important to distinguish: *illusion* and *hallucination*. The former gives to external objects or occurrences a false interpretation; the latter creates, out of the materials of thought, unreal objects or occurrences. Both accompany various forms of insanity, but both may also exist in minds only temporarily disturbed, and not insane. It is an illusion to take one person for another very different one; to imagine a familiar friend transformed into an animal; to hear prophetic sentences in ordinary conversation. It is an hallucination for one to suppose he is irrevocably doomed to perdition; that he has committed a horrid crime; that he hears the voice of the Almighty, or sees angels or the spirits of the departed around him. Hallucinations may annoy the most philosophical and well-balanced minds, and many are the cases in which distinguished persons of such character have described their visions, knowing them full well to be mere fictions of the brain. Others, less collected or less informed, have taken these phantoms to be real, and either founded fanatical sects upon their error, or promulgated the surprising ghost-stories, which startle the composure even of scientific men.

Diminished sensibility may affect the whole, or a portion only, of the nervous system; it may, also, as regards degree, be either partial or complete. Total loss of sensibility in a part is called *anæsthesia.* The phrase 'paralysis of sensation' is sometimes employed to designate diminution or loss of the tactile power.

Common as well as special sensibility are very generally impaired in adynamic and ataxic fevers; the hearing grows dull, the sight dim, the smell and taste lose their acuteness, perceptions of every kind become indistinct, and often when coma supervenes, sensation appears to be entirely lost. The same thing occurs in extensive disease of the brain, in concussion and compression of this organ, in apoplexy, and in serous effusion into the ventricles. Local anæsthesia is not very frequently observed without a corresponding loss of voluntary motion, but the latter is constantly met with independently of any loss of sensibility, as in the paralysis which is caused by apoplexy. In this affection, as well as in many chronic disorders of the brain, it is not uncommon to find the palsied side more susceptible to cold and external impressions, generally, than the sound one. Some diseases of the spinal marrow, especially such as are consecutive to caries of the vertebræ, are apt to impair sensibility without affecting motility. Aside from this class of cases, simple anæsthesia occupying any considerable portion of the body is usually functional.

Diminished sensibility, it has been stated, may be either general or local. A case is recorded by M. Defermon, in which the entire body, with the exception of a small space upon the right cheek, became insensible, while the intelligence remained unimpaired. A somewhat similar state has been occasionally noticed upon the approach of death. Andral relates of Baudelocque, the founder of modern obstetrical science, that in his last hours he repeatedly affirmed that he was dead. He had lost his consciousness of every thing but his own existence. When the affection is local it may be confined to the hands, the feet, one side of the face, or other circumscribed portions of the cutaneous surface. Such a condition is sometimes met with in hysteria, and in poisoning by lead, or may be induced by a cause acting directly upon the part, such as a blister, exposure to the sun, and erysipelatous inflammation. When the sense of touch is partially impaired, the patient is aware of the contact of external bodies, but cannot determine their density or temperature, nor, without the aid of sight, distinguish their form and size. This symptom is frequently observed as the forerunner of paralysis from cerebral or spinal disorganization.

Insensibility without loss of motion generally exists in the state of somnambulism, and in hypnotism, or nervous sleep, artificially induced by acting upon the attention, the imagination, or the credulity of the patient. Its production by the inhalation of ether and chloroform, and the fact that it is possible for a person to witness all the steps of a surgical operation performed upon himself without experiencing pain, are now familiarly known to medical men. The extraordinary but undeniable phenomena here adverted to demonstrate the vanity of hoping to solve the mysteries of human organization by the mere perceptions of the anatomist or the analyses of the chemist.

In complete anæsthesia sensibility is lost, not only in the skin, but in the deep-seated parts, so that they may be burned, cut, or lacerated without producing the slightest pain. Hoffman relates of a young man who was paraplegic that he became aware that one of his limbs was roasting at the fire, only by the smell which it emitted. Inflammation of the soft parts, fracture of the bones of paralysed limbs, ulcers of the skin from pressure or the application of sinapisms, may take place without the consciousness of the patient; and hence the practical caution to examine repeatedly the parts subjected to pressure in paralytic patients, and to avoid applying to insensible portions of the skin blisters or other irritating agents.

SECTION II.

SIGNS FROM THE ORGANS OF VOLUNTARY MOTION.

As already intimated, motility, or the power of motion, is closely connected with sensibility; it is regulated by the same organ, the brain, and is even more susceptible than the allied function, of being modified by disease.

The only morbid states in which muscular power is *augmented* are those of cerebral or nervous excitement. Such increase of strength, when it depends upon inflammation of the brain or its membranes, as during the delirium of acute diseases, is a very bad sign; it is commonly followed by coma and death. If, however, it is manifested in an attack of mania which, so far as our knowledge extends, is a functional disturbance of the brain, the most prodigious display of muscular power has no peculiarly evil significance; it diminishes as the maniacal fury abates, and may be renewed with equal violence at the next paroxysm.

Muscular *debility* occurs at some time in the course of nearly every disease. In such as are general, the pyrexiæ or fevers, it commonly precedes the other symptoms, commencing as mere lassitude, and gradually increasing until the patient can no longer stand upright; or it may, at once, assume this aggravated form, especially in epidemic and endemic diseases. In these it is not uncommon for a person to fall down suddenly, or to feel as suddenly unable to proceed with the occupation that happened to engage him at the time. Muscular weakness occurs later in affections of an inflammatory type, and is then due, either to congestion of the brain, impoverishment of the blood, or wasting of the muscular tissue. The last-named cause is alone operative when, for example, a person has been confined to bed with a sprained ankle or other affection which gives rise to little or no febrile reaction.

Deterioration of the blood may be regarded as a cause of weakness, since in low forms of fever the fibrinous element of this fluid is deficient, and in anemia which is marked by great prostration, there is a diminished proportion of the red-globules of the blood. It is not improbable that these conditions become influential chiefly from their rendering the blood incapable of affording proper nourishment and stimulus to the nervous system. In low fevers, too, the loss of power due to the altered composition of the blood, is increased by the pressure of the overloaded blood-vessels upon the brain. Diminished power in consequence of cerebral congestion is a degree of paralysis; when the congestion is greater, or terminates in apoplexy, the paralysis is complete.

Paralysis, meaning literally, relaxation, (παρα, λυω) is properly applied only to loss of motion. It may be general or partial. It is usually confined to one side of the body, when it depends upon disease in either half of the brain, and is then called hemiplegia. It affects both sides of the lower half of the body when the lesion producing it is within the spinal canal, and is then termed paraplegia. When much more restricted in extent, it does not often depend upon disease of either of the nervous centres, but more usually upon some injury or merely functional alteration of a particular nerve. This state ought not to be confounded with loss of power resulting from atrophy of one or more muscles. The movements of the arm, for instance, may be impaired or lost when the deltoid muscle wastes away in consequence of a contusion or of rheumatism, and may be regained if the muscle become developed anew. Even when paralysis depends upon cerebral disease, it is not necessarily permanent; it often diminishes greatly, and occasionally is altogether cured.

In the great majority of instances, paralysis from disease of the brain is seated in the side of the body opposite to that of the cerebral lesion. The exceptions to this rule are few, and not easily explained. It has also been maintained that when an upper extremity is paralysed, the seat of the lesion is in the optic *thalamus*, and that a lesion of the *corpus striatum* produces palsy of the opposite lower limb; but these alleged correspondences are not frequent enough to obtain the authority of laws. The worst forms of paralysis are those which accompany manifest and acute cerebral disease, apoplexy, for example. The gravity of this symptom is, indeed, entirely subordinate to that of the lesion upon which it depends, and the latter can only be inferred from the aggregate of the symptoms. Thus the prognosis must be looked upon as extremely unfavourable when the attack is sudden, the paralysis extensive and complete, and the loss of consciousness protracted; and, on the other hand, when the paralysis advances gradually, there is more reason to hope for prolonged life, if not for a complete restoration of health. Paraplegia sometimes lasts for many years without greatly interfering with any function except locomotion; but when it occurs during fevers, and advances rapidly, it is of very sinister augury, especially if it involve the sphincter muscles of the anus and bladder.

Perversions of motility include the large class of convulsive disorders, as well those which are generally recognised to be of this sort, as others which are not less truly so, and which consist of involuntary and spasmodic movements. *Trembling* is one of the most familiar forms of perverted motion. It is usually accompanied with coldness of the surface, when occurring in the cold stage of intermittent fever, or during the period of invasion of inflammatory affections; but it may be a purely nervous disorder, as in ataxic fevers, and in persons of an excitable temperament. During convalescence from disease, it appears to depend upon simple muscular and nervous debility. It is also a consequence of receiving into the system particles of mercury and lead, by those who work at trades in which these metals are used, and is also a frequent result of excessive indulgence in venery, in alcoholic drinks, opium, tobacco, or coffee. The shaking palsy of old age is unconnected with any determinate lesion of the nervous centres.

Convulsions, properly so-called, affect two forms, the *tonic* (τεινω, I stretch), in which the muscles remain firmly contracted for a certain space of time, and the *clonic*, (κλονοσ, agitation,) in which there is a rapid alternation of muscular contraction and relaxation. Both forms may be either general or partial, and depend either upon some alteration of the brain or spinal marrow, or of their meninges, or upon sympathy with the disorder of some other organ, or else exist independently of any local disease of the nervous or other systems. The last named are called *idiopathic* convulsions, because the physical changes which precede their development elude the closest scrutiny. Most of the cases of sympathetic and idiopathic convulsions are now regarded as illustrative of a physiological principle first fully developed by Marshall Hall. He showed that the whole muscular system is under the immediate control of the spinal marrow, which possesses a power of causing contractions in the muscles when a stimulus is applied either to them or to it. This, which is aptly denominated the reflex function, is independent of volition, and governs all the involuntary movements, those of the respiratory, digestive, and cardiac muscles, and, in a particular manner, the sphincters. The convulsions of infancy, so often attributable to the irritation of the gums during dentition, to the presence of worms, indigestible food, &c., in the digestive canal, those which follow emotions upon the mind, and the spasms of tetanus, in consequence of a wound, all illustrate the operation of this function. Through it, also, an unusual irritant applied to a part will excite contractions of the muscular apparatus associated with it in the performance of a given function ; thus, sneezing is produced by irritation of the nostrils ; winking, by irritation of the conjunctiva ; retching or vomiting, by tickling the fauces ; retraction of the testicle, by a calculus in the ureter ; spasmodic movements of a paralysed limb, when it is smartly struck, &c.

Tonic spasms, or muscular contractions, occur in several degrees, such as cramp, stiffness of the joints, permanent flexion of a limb, and tetanus. *Cramp* is a painful contraction of a muscle, lasting from a few minutes to several hours. Its most common seats are the gastrocnemii muscles and those of the abdomen. During pregnancy, and when there is a large ovarian tumour, it frequently attacks the lower limbs, in consequence of the pressure to which the sciatic or anterior crural nerve is subjected. In old persons, not previously subject to this affection, it sometimes indicates latent softening of the brain. It is, however, a common symptom of slight derangements of the health, and is excited by over-fatigue, indigestion, or cold feet, in nervous individuals; also by drinking green tea, and by the immoderate use of tobacco.

One of the most ordinary signs of softening of the brain is rigid flexion of the fore-arm upon the arm. This contraction of the flexor muscles of the limbs comes on gradually, and in that respect differs from an analogous symptom occurring in hysteria, but which disappears with the decline of the paroxysm. When the rigidity in question is observed after an attack of apoplexy, it is in most instances a sign that inflammation is going on around the extravasated blood, and therefore of an extension of the disease. But it is highly important to know that this symptom is not always of such serious consequence, that it is not, as was formerly supposed, pathognomonic of cerebral softening, but is sometimes produced by a simple extravasation of blood in the brain, that it even occurs sometimes as a sympathetic phenomenon in diseases of the chest and bowels, and sometimes without any assignable cause. Permanent contraction of one or more muscles of the eye is also a sign of cerebral disease, especially of large effusion into the ventricles; but is much more frequently coincident with perfect health, as when it is congenital; it may also depend upon rheumatism, dentition, or upon worms, or other irritating bodies in the intestinal tube.

Tetanus is another and remarkable form of tonic spasm, and is generally owing either to inflammation of the meninges of the spinal marrow, or to a wound, usually of some tendinous, ligamentous, or nervous part. Hence it is divided into idiopathic and traumatic. The first named variety is always attributable, either to direct violence to the spine, or to the impression of cold, after exposure to heat. Sometimes the muscles which raise the lower jaw are alone affected, and the mouth is firmly closed; this is called *trismus*. When the muscles upon the posterior part of the trunk are involved, the body is bent backwards in the form of an arch; to this form the name of *opisthotonos* is given. *Emprosthotonos* and *pleurosthotonos* are terms respectively applied to designate the forward and lateral bending of the body in this disease.

Catalepsy is a convulsive disease in which both flexor and extensor muscles are in a state of tonic spasm; for it is a peculiarity of the disease that a limb, or the whole body, retains for an indefinite period any position in which it may be placed.

Clonic convulsions, or those in which muscular contraction and relaxation alternate with one another, are much more frequent than the form just described. *Subsultus*, or jerking of the tendons in low grades of fever are of this sort, and ranks amongst the unfavourable signs which are presented in the typhoid state; it accompanies great exhaustion.

A *grinding* motion of the lower jaw exists in many cases of cerebral and meningeal disease, whether inflammatory or tuberculous; this, with rolling of the head from side to side, is very characteristic of meningitis in children. *Hiccup* is another partial convulsion, which is supposed to affect the diaphragm. It is of little consequence, except in diseases attended with prostration or collapse, and is in such cases an almost fatal sign.

General convulsions are best illustrated by hysteria, epilepsy, eclampsia, and chorea.

It is somewhat remarkable that clonic convulsions are less dangerous in proportion as they involve a greater number of muscles. When the whole muscular system is affected, the disease is either curable, as in most instances of hysteria and chorea, or else of very long duration, as in epilepsy; after the death of persons suffering from either of these diseases, there is rarely found any lesion to account for the violent functional disturbance which had existed. On the other hand, when one muscle or set of muscles is spasmodically affected, there is reason to believe that the state depends upon an organic lesion of the nervous centres.

Convulsions and spasms, generally considered, are more significant of danger in males than in females or young children, because in the latter classes they are very easily excited. They are less unfavourable at the commencement of an acute attack than at a later stage of its course, especially if then accompanied with other signs of cerebral disturbance, such as delirium, coma, or paralysis. They acquire a peculiar gravity when connected with injuries of the head, profuse hemorrhages, or exhausting discharges of any description. When convulsions do not occur in the course of an acute disorder, they are generally paroxysmal, and are dangerous in proportion to the shortness of the intervals between the paroxysms and the duration of these latter.

Much is said in medical treatises concerning spasm of the *involuntary* muscles of the heart, the stomach, the intestines, the bladder, the urethra, and some mention is made of spasm of the gall-ducts, of the ureters, the bronchia, and even of the arteries. Thus, it is stated by Dr. Williams, (*Principles of Medicine*,) that "spasm of the intestines in colic is induced by reflex irritation resulting from acrid matter in them" . . . . that "spasm of the bronchi so suddenly occurring in spasmodic asthma, also sometimes arises from intestinal irritation," and that in the same way "the heart is liable to be excited by considerable irritation in any part of the body." Spasm of the stomach may possibly exist in that obstinate vomiting, without nausea, which is excited by pregnancy; but the diaphragm and abdominal muscles, which are principally, if not solely concerned in the act of vomiting, and which are voluntary muscles, are much more likely to be excited by the reflex irritation of the gravid uterus; the sensible resistance sometimes opposed to the passage of an instrument along the inflamed urethra in either direction, and tenesmus of the rectum, may indicate spasm of these parts respectively; but even in these cases its existence is inferred rather than demonstrated, and may plausibly be referred to the action of the voluntary muscles. "Intestinal spasm" caused by "acrid matter" is a double assumption, for no one has ever seen the former, and it is not very clear what the latter signifies. On the contrary, no fact is more familiar than that "spasmodic" pain in the belly accompanies over-distension of the bowels, and is at once relieved by the discharge of flatus. In this case it is evident that the fibres of the intestinal muscles are elongated, not contracted, as it must be supposed they would be in spasm. The alleged "spasm of the bronchi" appears to have no demonstrable existence. Cases of nervous asthma may indeed exist, of asthma quite independent of structural alteration of the lungs and heart; but their phenomena are quite as readily explained by supposing the existence of spasm in the external muscles of respiration, and in those of the larynx, as by assigning to them a cause which, in the very nature of things, is incapable of demonstration. Spasm of the biliary ducts and of the ureters, in so far as it is connected with pain, is in the same category as that of the intestinal canal; distension of these conduits by calculi is the ordinary cause of the pain in them called spasmodic, and may as readily be referred to overstretching of their fibres as to spasm, for there is no evidence that pain can be excited in these organs unless they are immoderately distended. Spasm of the capillary blood-vessels is confessedly an ideal state, but one which has figured as largely in medical theory as if it possessed a positive and palpable value. It was the prominent feature of Cullen's theory of fever. This distinguished man taught that some of the causes of fever produced collapse of the brain, which occasioned universal debility of the voluntary muscles and extreme vessels, which, in its turn, was followed by spasm and constriction of the capillaries! At this hour it seems almost incredible that the great genius of Cullen should have been expended in weaving so flimsy a fabric as this hypothesis of the pathology of fever.

The disorders of the mind, which may be properly treated of under the head of general semeiology, are such only as are symptomatic of some bodily disease. The various forms of insanity constitute a totally distinct class. In the latter, the affection is altogether functional; it is one of symptoms alone. In the former, the symptoms are also signs—signs of some tangible alteration of the solids or fluids of the body, already revealed by other morbid phenomena. Insanity is rarely owing to ill health alone, but delirium and coma, in their several degrees, have always an evident connexion with some strictly morbid state. Insanity is of indefinite duration, lasting usually for weeks or months, and often for years; delirium, coma, &c., usually terminate in a few hours or days. There is, indeed, a delirium which is due to direct impressions upon the nervous system, but which usually subsides as soon as its exciting cause ceases to operate. This is observed in violent fits of anger, during hysterical paroxysms and painful parturition, and after epileptic fits, and severe surgical operations.

Proper *febrile delirium* is nearly always preceded or attended by signs of cerebral disturbance: such as sleeplessness, headache, vertigo, altered tone of the voice, forgetfulness, flushed face, heat of head, and injection of the conjunctiva—symptoms indicating a determination of blood towards the brain. It may be either calm or violent. In the former case, the patient seems to retain a partial consciousness of his situation, and, if spoken to, while talking incoherently to himself, may have his attention drawn to a particular subject; or if opposed in his attempts to get out of bed, or commit any other impropriety, will offer no resistance. In some cases, delirium assumes very curious forms; the patient, for instance, whistles continually, or remains obstinately silent, or talks with a degree of fluency and correctness to which he is unused, or assumes a tone quite different from his ordinary one. This form usually presents itself combined with much debility, and some stupor or dulness of apprehension, in fevers of an adynamic type, and towards the close of some cases of inflammation, especially those of inflamed internal organs passing into a state of suppuration, as in pneumonia, and puerperal peritonitis.

Active or furious delirium is characterized by extravagant cries, shouting, laughing, imprecations, or the most ridiculous or obscene language. The patient seems in a violent passion, threatens or strikes every one within his reach, and attempts to destroy everything he can get hold of; or he breaks out into wild lamentations, wringing his hands, and tearing his hair; or in other instances, as in delirium tremens, he fancies himself pursued by legions of devils, or that some other frightful danger besets him. In this form, the patient is wholly unconscious of what he says or does. On the return of reason, he frequently supposes that he has been asleep and dreaming. In this respect, as well as in those already mentioned, delirium differs from insanity. The insane most commonly remember, with singular accuracy, every word they have spoken, and every extravagance they have committed during the attack; and if this distinctness of recollection sometimes occurs after delirium, it is only in exceptional cases. The two forms of delirium which have been noticed, may succeed or alternate with one another. When maniacal delirium supervenes upon the more tranquil form, it must usually be looked upon as a sign of meningeal or cerebral complication, and therefore as of very unfavourable augury.

Like other perversions of the nervous function, delirium may be symptomatic of an affection of the brain, or sympathetic with disorders of other organs, or, finally, idiopathic. It appears to accompany inflammation of the meninges, and of the surface of the brain, rather than lesions of its interior substance, with which, on the other hand, disorders of motility and sensibility more frequently coëxist.

The most numerous instances of sympathetic delirium are furnished by inflammations of the abdominal organs, and by diseases in which the composition of the blood is altered. The latter condition is influential in typhus and typhoid fevers, in purulent absorption, and in scurvy; anemia, too, characterized by an alteration of the blood, differing from that of the diseases just mentioned, is occasionally marked by delirium, especially in hysterical females.

Sympathetic is much more common than symptomatic delirium; since, for every case of inflammation of the brain, or its membranes, there are many diseases of other organs which cause a temporary derangement of the intellect. This fact ought not to be lost sight of; for, if it is, the error may be committed of treating these sympathetic aberrations as if they depended upon actual disease of the brain. It is certainly difficult, in many instances, to distinguish the two forms of disorder; but the life of the patient may depend upon a correct diagnosis, and there can be no doubt that many lives have been sacrificed in consequence of an ignorance of the distinction alluded to. Many a case of commencing insanity has been treated by copious depletion, merely on account of the mental disorder, when the paleness of the face, the languor and feebleness of the circulation, the palpable derangement of digestion, or the influence of some moral cause, imperatively indicated a very different management. Anemic delirium and puerperal mania, have repeatedly been aggravated, or rendered incurable, by a similar want of discrimination.

Suspended consciousness or sleep, in disease, presents several varieties or degrees, which have been distinguished by different names. These are, *somnolence*, *coma*, *lethargy*, and *carus*. Somnolence, or drowsiness, is a state between waking and sleeping—of half-consciousness—from which the patient may easily be roused by a question addressed to him. *Coma*, or deep sleep, is generally described as of two kinds: *coma vigil*, or uneasy sleeping, when the patient talks to himself, while his eyes remain closed; or, if spoken to, will listen or answer, and then fall asleep again. In *coma somnolentum*, the patient remains motionless and silent, and, if roused, immediately relapses into his previous stupor. By *lethargy* is understood a more prolonged comatose condition; and by carus, a state of complete insensibility, from which no stimulus will arouse the patient.

A morbid disposition to sleep has *chiefly* two sources; 1st, disorder of the brain, from inflammation, concussion, or pressure caused by some disease within the cranium; and 2d, sympathetic congestion. Perhaps all of these causes, except concussion, may be included under one general title, viz., pressure; for whether it be by blood, as in hyperemia, passive congestion, and apoplexy; by serum or pus, as in dropsy and abscess; or by a solid body, as a depressed fragment of the skull, or a tumour within the cranium,—the brain must still undergo compression. The degree of coma arising from these causes, other things being equal, is directly proportioned to the degree of pressure. Thus it is sudden, and very complete when a large apoplectic effusion into the ventricles takes place. It would seem, also, that compression must be effected with a certain degree of rapidity in order to produce the symptoms just enumerated; for oftentimes, when a tumour within the cranium is of very slow growth, the operations of the mind remain undisturbed, until the offending body acquires a very large size. Sympathetic congestion of the brain producing coma is observed in many severe inflammations of other parts, of the heart, lungs, and bowels, for example, and also in the pyrexiæ, or low fevers characterized by a diminished proportion of fibrin in the blood. It is also met with in the congestive or cold stage of malignant intermittents, in all cases of asphyxia, of poisoning by carbonic acid gas, by the emanations of lead, and by over-doses of alcohol, opium, and other narcotics.

Coma is an ordinary symptom of idiopathic jaundice, and of suppression of urine; in these cases, as well as in several of those already mentioned in which the blood undergoes a sensible alteration, it may be fairly presumed that such alteration is efficient in producing the symptom in question, because the circulating fluid no longer affords a sufficient and natural stimulus to the central organ of the nervous system. That various degrees of loss of consciousness may be entirely independent of pressure upon the brain is shown by the phenomena of natural sleep, by those of concussion previously noticed, of syncope, and of the state called trance, in all of which it is apparent that the brain itself is the starting-point of the influence which brings torpor upon its faculties. Surprising instances of prolonged sleep are related by authors. Van Swieten mentions the case of a man who, after strong mental excitement, slept for four months, during the first two of which he was perfectly insensible to all impressions; and another of an individual who without appreciable cause, and at intervals of one and two years, slept from one to four months.

The dependence of coma upon such opposite conditions of the economy imposes upon the practitioner the duty of ascertaining its origin and complications in each particular case. The following circumstances will generally aid him materially in forming his diagnosis. If the face be pale, the temperature of the surface equable and moderate, the pulse feeble, and there be no paralysis, the coma not profound and the attention of the patient can be momentarily arrested; the attack may be generally referred to exhaustion in consequence of prolonged mental or bodily effort, or the endurance of severe pain. A sudden attack of coma, the loss of consciousness and motion, a labouring pulse and stertorous respiration, indicate cerebral congestion or apoplexy; the former if the symptoms are transitory, the latter if they are protracted. When coma supervenes gradually, following pain in the head, fever, delirium, and spasms, it is a sign of effusion consequent upon meningeal inflammation.

The foregoing remarks are sufficient to show that the importance of coma as an element of prognosis depends in a great measure upon its cause. It may perhaps be stated in general terms that when this symptom is associated with a low pulse, laborious or irregular respiration, a tracheal rattle, coldness of the extremities, paralysis of the organs of deglutition and excretion, profuse and viscid perspiration, and insensibility of the eye to light, it is an almost unfailing precursor of death; and that, on the other hand, when it is associated with regularity of the pulse and respiration, a proper distribution of heat, and degree of moisture, it is not only unattended with danger, but sometimes even salutary, by recruiting the exhausted vigour of the system. Aside from exceptional cases, it must, however, be admitted that comatose sleep is dangerous, while the nearer a patient approaches to his natural manner of sleeping the greater is his chance of recovery. These circumstances are important to be noted in the diseases of infancy, as, indeed, are all the automatic or instinctive acts of infants, for they constitute almost the only language in which these little sufferers express their feelings. It is sometimes of consequence to be informed of a patient's habits of sleeping, lest the not unexampled error be fallen into of attributing a natural disposition to snore to cerebral oppression, or a dry mouth and tongue, depending simply upon a habit of sleeping with the mouth open, to a dangerous degree of fever.

CHAPTER V.

SIGNS FROM THE CIRCULATORY APPARATUS.

The heart, with the arteries and veins, constitutes the mechanism by means of which blood adapted to the purposes of nutrition is distributed over all the body, and having performed its office and passed through the lungs to be depurated, is carried back to its starting-point, and is then again despatched upon its life-giving errand to every molecule of the economy. In health this indispensable function is performed with extreme regularity, an equal amount of blood having the same composition is every minute propelled into the arteries, undergoes the same unvarying changes in the capillaries, and with unfailing regularity returns through the veins to the right side of the heart. The same series of motions in the heart and vessels perpetually recurs; the central engine which irrigates the whole system, gives out the same incessant sounds, while the stream which it propels glides noiselessly through its appointed channels. But this regularity, this moderation, this rhythm of sound and movement, may be impaired by disease; certain alterations result from disease affecting the circulatory apparatus itself, others from the *consensus*, or sympathy, of this apparatus in the disorders of other portions of the organism; a part of them are vital, and the symptoms by which these are revealed cannot be explained; a part, also, are physical, and can be directly traced to physical causes. For the comprehension of these latter an evident prerequisite is a knowledge of the mechanism by which the natural movements and sounds of the organs of circulation are effected. The normal sounds and movements being known, any departure from these indicates disease, and experience, including a study of symptoms, and of lesions revealed by dissection, teaches what particular modification of either is the attendant of a given disease. Before proceeding, therefore, to a history of the signs of disease furnished by the circulatory apparatus, it becomes necessary to propose a theory of the sounds and movements of the heart. We say *a* theory because there are several, all of which it is believed contain some elements of truth, but none embrace the entire truth. That which is set forth in the following pages appears to unite all that is demonstrable in the current theories, and at the same time to avoid most of their inconsistencies.

*The natural position of the heart, &c.**—The heart is attached to the lungs by the veins supplying the left auricle; these veins issue from each lung at about an equal distance from the centre of the left auricle, which is in front of the sixth and seventh dorsal vertebræ. The outer boundary of the right auricle is from one to two inches to the right of the sternum. The right ventricle lies immediately behind the lower half of the sternum, and the third, fourth, and fifth costal cartilages of the right side. The left ventricle usually projects an inch beyond the right. Its outer bound is usually behind the left nipple, and its apex is behind the lower edge of the fifth rib, close to the costal cartilage. The valves of the pulmonary artery are commonly behind the sternal end of the second left intercostal space. The aortic valves are nearly behind the centre of the sternum, and opposite the third costal cartilages. The arch of the aorta, in its passage backwards and to the left, is behind the first bone of the sternum, and in front of the fourth dorsal vertebra. After leaving the pulmonary artery, the aorta passes to the right, and upwards, along the edge of the sternum, to about the middle of the first intercostal space, where the arch, strictly speaking, commences. It then passes in *front* of the trachea, and lies close behind the sternum near its upper edge. The tricuspid valve lies behind, and a little to the right of the centre of the sternum, somewhat lower down than the aortic valves; the mitral valve is at the same level, but is more deeply seated. These are assigned as the average positions of the parts enumerated, but they are by no means literally exact; for even the healthy heart changes its place

* Many of the particulars relating to the normal situation of the heart and lungs are borrowed from a very original and interesting paper by Mr. Sibson, published in Vol. XII. of the Transactions of the (English) Provincial Medical and Surgical Association.

according to the capacity of the chest, the degree of repletion of the stomach, the activity of the circulation, &c., but they will serve as guides for examining into the condition of the several portions of the heart and great vessels which are most frequently the seat of disease.

On applying the ear to the præcordial region of a healthy person two sounds are heard, and an impulse is felt. The first of these sounds is duller, more prolonged, and seems more distant than the second; it is loudest between the fourth and fifth ribs, and a little below and external to the left nipple, or about an inch above the point where the impulse of the heart is most distinct. It is heard at the same instant when the impulse is perceived, and a moment before the radial pulse can be felt. The second sound is shorter, clearer, seems more superficial than the first, and is most distinctly audible at the junction of the third left rib with the sternum. The impulse is strongest about an inch below, and a little exterior to the left nipple. These sounds, and this impulse form a little series of phenomena which is repeated from sixty to eighty times a minute in a healthy adult, each repetition of it corresponding to one beat of the artery at the wrist. The series is made up in the following manner. First, the dull, prolonged sound, coinciding with the impulse; next a brief interval of silence; then the short, sharp, or second sound; then a longer interval, at the conclusion of which the first sound is again heard. As the whole of this series is accomplished in less than one second of time, the difficulty of analyzing it must appear to be very great, and yet the practised ear finds the task an easy one. It results from such an analysis that the first sound consumes about *one-third* of the time employed by the entire series; the short interval nearly *one-sixth;* the second sound *one-sixth;* and the long interval *one-third.* Hence, it is perceived, that the duration of each sound is equal to that of the interval of silence immediately preceding it; the short silence and the short sound are equal, and so also are the long silence and the prolonged sound.

The question now presents itself, how are these sounds and this impulse effected? In man, the heart is double. There are the systemic and the pulmonic hearts, identical in all essential points of structure and function, and differing only in strength, because the one has to supply the remote parts of the body with blood, and the other adjacent parts only, to wit, the lungs. For the present purpose then, the pulmonic heart may be left out of the question.

The movements of the heart cannot often, it is plain, be studied upon the human subject; experimentally, never. Observers have therefore been obliged to resort to vivisections of the lower animals, or to dissection of them immediately after their being destroyed by a blow upon the head or by poison, the circulation being maintained meanwhile by artificial insufflation of the lungs. The last-mentioned procedure is liable to many objections, the most prominent of which are the exposure of the lungs to the air by opening the chest, and the consequently imperfect action of these organs, on which account the cavities of the heart become gorged with blood. The dissimilar results, in some respects, which have been obtained by the vivisections of frogs and other cold-blooded animals, in which the movements of the heart are naturally very slow, only tend to strengthen these objections. The minuteness of the organ in the case of the animals just named must be admitted as adverse to the reception of the results of experiments upon it, so far, at least, as the rhythm and mode of generation of its *sounds* are concerned, but the smallness of its bulk presents no obstacle whatever to a satisfactory analysis of its *motions*. On the other hand, the movements of the hearts of large warm-blooded animals, when the circulation is maintained by artificial respiration, are so tumultuous and irregular that the order of their succession cannot be clearly determined, while the sounds produced in such hearts can be readily localized, because the points at which they are chiefly generated are at an appreciable distance apart. In seeking for the cause of a cardiac sound, it is evidently no matter how irregular the movements of the heart may be, provided that the point at which it is formed, and the uniform coincidence with it of a given movement can be ascertained. The rhythm of the heart's movements may therefore be determined with greatest certainty by inspecting the hearts of reptiles and other cold-blooded animals, while for that of the sounds, the hearts of large warm-blood animals afford the safest data. The hearts of the amphibia and of some of the larger fishes, the sturgeon for example, would probably serve to illustrate the mechanism, as well of the movements, as of the sounds of the heart, but it is believed that no experiments have been made upon these animals with reference to the point in question.

The heart consists essentially of two muscular cavities, an auricle and a ventricle, the former receiving blood from a vein, the latter receiving its blood from the auricle, and propelling it into an artery. A set of valves exists between the auricle and ventricle, opening towards the latter, and another set between the ventricle and the artery, opening towards this vessel. The auricle throws its contents but a short distance, into the ventricle, its muscular walls are therefore comparatively feeble; the office of the ventricle is to force the blood through distant vessels, its walls are therefore thick and strong. Now by what succession or combination of movements is the blood transmitted from the entrance of the auricle to the outlet of the ventricle? Ever since the time of Harvey and of Haller, it has been universally admitted that the auricle contracts and throws its contents into the ventricle, which, in its turn, expels the blood into the arteries, and that then a momentary pause ensues. Observers are not unanimous respecting what takes place during this interval of the heart's repose. Several of the most distinguished insist that the ventricle remains contracted and empty, while the auricle becomes distended during this pause, and at the end of it throws its entire contents forcibly into the ventricle; but the modern English, Irish, and American experimenters declare that no sooner has the ventricle expelled its blood, than it begins to relax, and to fill up partially with blood, which runs into it from the auricle, *without any active contraction* on the part of the auricle. At the end of the pause, they further mention, the ventricle being nearly full, and the auricle quite so, there is a slight contraction of the auricle, followed immediately by the contraction, or systole, of the ventricle. The difference between the two parties, is, summarily, this: the one maintains that the dilatation, or diastole, of the ventricle is instantaneous, and caused by its sudden reception of the whole contents of the auricle; the other, that the ventricular diastole is gradual, occupying the whole of the pause, and that it *precedes* the auricular systole, whose only office, according to this theory, is to *complete* the distention of the ventricle, and stimulate it to contraction. Or, to express the difference in other terms : it is affirmed, on the one hand, that the diastole of the ventricle is wholly and entirely dependent upon the auricular systole ; and on the other, that the consummation, only, of the ventricular diastole is dependent upon this cause. It is agreed upon both sides, however, that no sooner has the diastole of the ventricle taken place than this cavity contracts, and with such rapidity, that no interval whatever between its diastole and its systole can be perceived. The contraction of the auricle, the entire, or complementary, dilatation of the ventricle, and the contraction of this latter, succeed one another so immediately as to form but one continuous movement, during the performance of which the first sound of the heart is heard, and its impulse felt.

What, now, gives rise to this impulse? The more generally received opinion is that of the party maintaining the diastole of the ventricle to be slow and gradual, and is that the impulse is due to the shock of the apex of the heart against the parietes of the thorax, during the systole of the ventricle, and to this cause alone. The doctrine which appears to be most strictly in accordance with facts, is, that the cause of the impulse is the diastole of the ventricle, its force being proportioned to the power with which the auricle propels its contents into the ventricle. Independently of all experiment, it would be difficult to comprehend how the contraction of a hollow muscle could have any other effect than to diminish its volume, or that it could, while contracting, give a blow to a body external to itself. But vivisections of cold-blooded animals confirm the justness of this objection to the received doctrine. When the heart of a frog, which is transparent, is examined, the apex is seen to be thrust forward at the same instant that all the dimensions of the organ are enlarged, and its colour shows it to be distended with blood, while the apex is retracted simultaneously with the lessening of the size, and the disappearance of the colour of the heart. In other words, the projection of the apex corresponds with the diastole, and its retraction with the systole of the ventricle. Certain cases of malformation go to confirm this view. One such is reported by Cruveilhier, to this effect. A child was born with a deficiency in the upper part of the sternum, through which the heart projected. It lived nine hours. In this case the contraction of the auricles was exactly synchronous with the dilatation of the ventricles. During the ventricular systole, the heart contracted in *every* diameter, and no part of it was thrust forward except the apex, and that only with a slow spiral motion. The ventricular diastole, on the other hand, "had the rapidity and energy of an active movement triumphing over pressure made upon the organ, so that the hand closed upon it was opened with violence." This movement was accompanied with a strongly marked projection of the heart downwards. The rapidity, energy, and direction of the ventricular diastole here observed, demonstrate this movement to be the cause of the cardiac impulse. Very similar phenomena were presented in an analogous case reported by Dr. Robinson, of Petersburg, Va., in 1833; and both cases, it is plain, are in every respect confirmatory of the results obtained by vivisections of cold-blooded animals. The combined evidence thus very summarily and imperfectly produced, warrants, it is believed, the conclusion, that actual inspection of the movements of the heart, when made under favourable circumstances, teaches that the *impulse is synchronous with, and caused by, the diastole of the ventricles.*

There is another proof of the same proposition derived from considering what takes place in hypertrophy of the ventricles. It is commonly taught, that hypertrophy of the heart is accompanied with augmented impulse. Laennec, Corvisart, and nearly every writer upon diseases of the heart, and upon the application of physical methods to their examination, affirm it; and Dr. Latham goes so far as to say, that "hypertrophy cannot exist without excess of impulse." One would suppose that such uniformity of doctrine could only result from great clearness and constancy in the evidence of facts; that it was a legitimate induction from many well-observed cases of hypertrophy. And yet it is no more than a deduction from an imperfect theory; the testimony of observation is directly adverse to its truth. Indeed, several observers have pointed out the fact, without succeeding in explaining it, that the impulse is not always proportioned to the degree of hypertrophy. Thus, Dr. Pennock, in his valuable edition of Hope, says, "that hypertrophied hearts do not always beat with the force that might have been anticipated." Dr. Corrigan, of Dublin, in analysing a number of cases of ventricular hypertrophy, declares that "in all of them the impulse of the heart was *less* than natural, and in some could not be felt at all." Andral asserts that "the impulse is not necessarily increased in every case of hypertrophy; . . . and that in some cases of concentric hypertrophy, there is no perceptible impulse." Chomel, in like manner, informs us "that patients are not unfrequently met with, in whom the heart has become uncommonly developed from hypertrophy and dilatation of its cavities, and yet without the energy of its impulse being increased, and even with a positive decrease of its normal force." These citations might be multiplied, and confirmed by the analysis of cases of ventricular hypertrophy; but they suffice to show that if, as a general rule, increased development of the ventricle coëxists with an augmented impulse of the heart, this coincidence is far from being uniform.

Now, from what does this discrepancy arise? How does it happen that hypertrophy of the ventricle is sometimes accompanied with diminished, and sometimes with augmented, impulse? It evidently cannot be explained upon the supposition that the impulse is due to the systole of the ventricle, and proportioned to the muscular power of its walls; and it must remain inexplicable, so long as this theory of the impulse is adhered to. But if, laying theories aside, we compare any number of cases of cardiac hypertrophy, showing increased impulse, with another series in which the impulse is diminished, we arrive at a curious result, viz.: that in every one of the former class of cases, there is *auricular* hypertrophy, either alone or in combination with a like state of the left ventricle; and that where the impulse is not augmented, or feebler than natural, there is either dilatation and thinning of the auricle, or the hypertrophy is altogether confined to the ventricle; in one word, we find that *permanently augmented impulse of the heart coincides with auricular hypertrophy.*

A further confirmation of this proposition is derived from the following pathological fact. It is well known that, under several circumstances, the pulsations of the heart do not agree in number with those of the arteries; that two or three of the former may be felt for one of the latter. Now, if the impulse of the heart were owing to its systole, the cardiac and arterial pulses should coincide exactly, since the heart cannot contract without throwing some blood into the arteries, and producing a pulse in them; but as there may be several cardiac impulses felt, for one that is arterial, it is plain that the prevalent theory is at fault, while that which has been proposed in the foregoing remarks furnishes an adequate solution of the difficulty. The want of correspondence between the cardiac and arterial pulses is observed chiefly in two cases; first, when the heart is feeble; and, secondly, when its mitral orifice is obstructed. In both cases, a smaller quantity of blood than natural is at first thrown from the auricle into the ventricle, a quantity insufficient to distend the latter cavity, or to stimulate it to contract; at each contraction of the auricle, the ventricle is partially filled, and each time strikes against the ribs; but its own systole does not take place until its repletion is accomplished.

If, then, it may be regarded as proven that there is a constant connexion between augmented cardiac impulse and *auricular* hypertrophy, on the one hand, and between this hypertrophy and the energy of the ventricular diastole, on the other,—and further, that the cardiac impulse is synchronous with the ventricular diastole—the conclusion is irresistible that *the impulse of the heart is caused by the diastole of the ventricle, and proportioned to the muscular power of the auricle.*

The cardiac murmurs.—It has already been stated, that while the auricle is contracting, and the ventricle dilating and again contracting, not only is an impulse felt, but a sound is heard, a dull, prolonged, and distant sound. By what mechanism is it produced? Those who believe that the sound in question coincides with the systole of the ventricle *alone*, differ somewhat from the advocates of the theory which has just been illustrated. Both parties, however, agree in the following points, viz.: 1st. That one cause, and a principal one of the first sound of the heart is, the contraction of the ventricle; because that sound is audible even when the heart of an animal is removed from its body, and its cavities emptied; and because all muscular contraction is sonorous. 2d. That the first sound is augmented by the impulse of the heart against the ribs. 3d. That it may, perhaps, be increased by the sudden closure of the mitral valve, and the friction of the blood, during the ventricular systole. But, upon a fourth point, the two parties differ. The one which maintains the diastole of the ventricle to be slow and gradual, refuses to this movement the power of generating any sound; the other, insisting upon its rapidity and energy, and attributing it to the sudden irruption of the contents of the auricle through the auriculo-ventricular orifice, naturally infer that the chief causes of the sound in question are, the passage of the blood through the orifice mentioned, and the shock of this fluid against the parietes of the ventricle. The first sound has a greater duration than the impulse, and even than the diastole. It is prolonged during the systole, upon the one hand, and when the auriculo-ventricular orifice is narrowed, becomes audible before the impulse is felt. It may, therefore, be admitted, that all of the causes mentioned conspire to form the first sound.

As regards the *second sound* of the heart, there is but one mode assigned for its production which is inaccessible to criticism, although several others have been set forth and ingeniously defended. When the heart of a large animal, which has been rendered insensible, is exposed by opening the thorax, and a hook is introduced into the aorta in such a manner as to prevent the closure of the aortic valves, the second sound ceases to be heard; if the hook be withdrawn, the second sound again becomes audible. This experiment is conclusive, for its evidence is both positive and negative. It was several times performed by Dr. Pennock, and always with the same result; and it would be difficult to imagine that it concealed any possible sources of error. It teaches that the second sound is due to the closure of the semilunar valves, the column of blood being thrown back upon them by the resiliency of the artery.

To combine in a few words the conclusions of the preceding argument. The time occupied by one revolution of the series of phenomena which are constantly occurring in the heart, may be divided into four stages or periods. In the *first* period the auricle contracts, causing the diastole of the ventricle, the first part of the first sound and the impulse, and the ventricle contracts, causing the prolongation and conclusion of the first sound. In the *second* period, or short pause, the ventricle remains contracted, and the auricle begins to fill. In the *third* period, the semilunar valves are thrown against one another, producing the second sound. In the *fourth* period, or long pause, the ventricle remains contracted while the auricle becomes fully dilated. At the end of the long pause, the auricle contracts anew, and the series is repeated.

Signs from disease of the heart.—Beginning with the signs drawn from inspection and percussion of the præcordial region, it may be remarked that this region is sometimes observed to project, or to present a convexity different from that of the rest of the thorax. It is generally due either to an effusion in the pericardium, or to an enlargement of the heart. In both of these cases, the dulness on percussion, which naturally does not extend beyond a space of two inches square, is much more extensive, and may even reach from the right side of the sternum to beyond the left nipple. The chief distinguishing characters of the two affections is, that the former, except when it accompanies general dropsy, is the consequence of an acute attack of inflammation of the pericardium, and is therefore comparatively sudden in its invasion, while the latter is a disease of gradual and extremely slow growth. In emphysema, too, the præcordium may be prominent; but in that case the projection is not distinctly circumscribed, and percussion upon the part is resonant, and not dull. Præcordial dulness may also be due to tumours occupying the mediastinum, either tuberculous, cancerous, aneurismal, or purulent. In such cases, however, the diagnosis must be settled by the commemorative and other symptoms which are detailed in works on the Practice of Medicine.

In health, the *impulse* of the heart is felt, and indeed seen, between the fifth and sixth ribs, and a little exterior to the line of the left nipple; but the point where it strikes the chest varies a good deal, simply by a change of position. Mr. Sibson gives a striking illustration of this fact in the case of an adult male. When the "man lay upon his back, the impulse of the apex was felt between the fourth and fifth ribs, just below the nipple; the fifth rib was slightly heaved up. When he lay on the left side, the apex was felt beating strongly between the fifth and sixth ribs, an inch or more to the left of the nipple. When on the right side, the impulse of the apex could not be felt: there was a gentle heaving of the lower part of the sternum. When he lay on his abdomen, the apex was felt to beat over the third and fourth intercostal spaces. When he sat up, the apex descended from the fourth to the fifth intercostal space." Dr. Stokes has, more precisely than any one else, pointed out the occasions of displacement of the heart by disease. He has seen it thrust down from the fourth to the eighth rib in a case of bronchitis. The most frequent cause of its displacement is effusion into the left pleura, by which the heart is sometimes thrust entirely to the right of the mesial line of the sternum. More rarely, effusion into the right pleura has been followed by a like displacement of the heart, but not until the decline of the disease. The progressive contraction of the parts within the right side of the thorax has then drawn the mediastinum, and with it the pericardium and the heart, to that side, so that it could be felt pulsating distinctly between the right nipple and the sternum.

The real, or apparent force of the heart's impulse depends on several circumstances. Thus in thin, narrow-chested persons, and in the young, it is very distinct; but whatever adds to the thickness of the thoracic parietes, or interposes a non-sonorous body between them and the heart, diminishes its impulse. Its impulse may be very feeble, or quite imperceptible, in very fat persons, and in those who have a capacious chest; also when the subcutaneous cellular tissue is distended with air or serum, or when the lung, either in its natural condition or emphysematous, or an effusion into the pericardium, comes between the heart and the ribs. The same result may be induced by debility of the heart itself; this is constantly observed in petechial typhus and other low fevers, during convalescence from exhausting diseases, and in hemorrhage, provided there be no nervous complication, for in that case the action of the heart may be temporarily augmented. In persons of a nervous temperament, but otherwise healthy, the least mental emotion may, as is well known, throw the heart into such violent and irregular palpitations as to arrest its movements and produce syncope. Whatever tends to accelerate the circulation, and especially violent muscular action, may induce the same result. But palpitations arising under these circumstances are, in general, momentary, or they are at least not constant. Those, even, to which anemic and nervous females are subject, are more or less paroxysmal, and usually cease during complete repose. Permanent palpitations, on the other hand, which are never wholly quieted even by rest, are of much more serious significance, for they nearly always attend inflammatory or structural disease of the heart.

Changes of structure in the heart and great vessels are unquestionably the most ordinary causes of its permanently increased action, an action not always confined to the præcordial region, but sometimes making the whole chest, head, and trunk, and even the patient's bed to shake. A patient once assured the writer that the palpitations of his heart, and the throbbing which attended them, were so violent as to raise his head from the pillow. The statement was of course exaggerated, but it serves to convey some idea of the energy which occasionally marks the arterial pulsations. These latter are not to be confounded with increased præcordial impulse: they are entirely owing to augmented capacity and power of the left ventricle, or hypertrophy with dilatation, while it, as has been shown, depends upon auricular hypertrophy. One may exist quite independently of the other, although it is true that in a majority of cases of strong arterial pulsation, there is also strong præcordial impulse, because both auricle and ventricle are hypertrophied. The facts connected with this subject lend an important confirmation to the theory of the heart's impulse which has been advocated in the preceding pages. The force of the arterial pulse bears no fixed proportion to that of the heart, which it should do if they both depended upon the power with which the ventricle contracts. The pulse "bears strict relations in strength and size to the thickness and capacity of the left ventricle;" but neither does the pulse nor the development of the left ventricle, bear a constant relation to the force of the heart's impulse. One reason why ventricular hypertrophy has been so confidently and so generally asserted to be the cause of the præcordial impulse, is that this lesion has usually been found where the impulse was augmented: it was natural to regard them in the relation of cause and effect. Observers had their theory of cardiac sounds and movements already settled, and in their dissections they too commonly neglected everything which had not some direct bearing upon this theory. Thus, Dr. Hope published about 22 fatal cases of organic disease of the heart, in his treatise, in 4 only of which is a single word said about the state of the auricles, and that little as if by accident. And yet this much-slighted appendage of the heart, which, according to the current theory, performs no office which the veins could not equally well fulfil, has been considered, by the Creator, of such importance that it is found not only in animals with double hearts, but throughout the whole range of vertebrated animals, and even amongst the invertebrated, in all indeed which possess a proper central organ of circulation. Such prominence and constancy in all the grades of animal organism bespeak for the auricle more consideration than it has hitherto received from physiologists and cultivators of pathology.

The sounds of the heart are subject to numerous modifications which it is of the highest importance to be acquainted with. The points at which they are most distinctly heard may vary; they may be audible in a greater or less extent; they may be louder or feebler; the order of their succession may be changed, their tone altered, or other, and abnormal sounds, may take their place.*

The points at which the sounds of the heart are most distinctly heard are changed through the influence of the same causes which affect the seat of the impulse, a part of which have already been enumerated. They are rarely heard at a lower than the normal place, unless the heart is thrust down by a tumour developed in the superior mediastinum; much more frequently they are heard at a higher point than natural, even at the third or second rib, in consequence of the diaphragm being pressed upwards by a large effusion in the abdominal cavity. Still oftener they are detected at some distance either to the right or left of the præcordial region, owing to the displacement of the heart by gaseous or liquid effu-

* For many of the succeeding details relative to the physical signs of the heart and lungs, the writer is indebted to the excellent Treatise of MM. Barth and Roger. A translation of these authors' summary of their work has been made by Dr. F. G. Smith, of this city.

sions in one of the pleural cavities. Excessive hypertrophy and dilatation of the left ventricle may render the first sound audible at a point lower and more to the left than where it should be heard.

The limits within which the cardiac sounds are audible, vary a good deal even in healthy persons, according to the natural energy of the heart, and the capacity of the individual's chest. They generally grow less and less distinct as they are listened to in the following regions, respectively: the left side of the chest anteriorly; the right side anteriorly; the left and then the right side posteriorly. They are more feeble than natural when the heart is affected with softening, muscular debility, auricular thinning, concentric hypertrophy of the ventricle, or when fluid in the pericardium or an emphysematous lung deadens the sonorous vibrations. On the other hand they are more distinct whenever the heart acts with unwonted energy, whether from excitement of the nervous system, or from increased development of the organ itself, or when the lungs are solidified by disease, and thereby become better conductors of sound. Thus when either lung is hepatized, or infiltrated with tuberculous matter, the sounds are audible, even distinctly so, at points where, in health, the closest attention could not detect them. In tuberculization of the upper lobe of the right lung, the sounds are more distinct under the corresponding clavicle than under that of the left side.

The *rhythm* of the sounds of the heart, that is the proportion which each one bears to the series of sounds and pauses which have been described, may be variously modified by disease. Increased *frequency* of the heart's pulsations forms one of the principal elements of fever, and its degree, in affections of an inflammatory type, is pretty accurately proportioned to the severity, extent, and danger of the lesion, and to the importance of the organ involved. It is also met with in certain states of debility consequent upon anemia. But in all of these cases of general disease, the number of pulsations in a minute does not often exceed 160, at least in adults; if it reaches 170 or 180 it is one of the most unfailing signs that a fatal issue is at hand. In affections of the heart itself, however, its throbbings are so continuous, or irregular and tumultuous, that they cannot be counted, and the finger applied to an artery perceives only a quivering movement. The sudden occurrence of these symptoms in an individual whose heart had previously acted with perfect regularity, is very justly regarded by MM. Barth and Roger as indicating the formation of a fibrinous clot within the central organ of the circulation. Unusual *slowness* of the heart's movements is much less frequently dependent upon disease affecting itself. It is chiefly met with in chronic softening and in tuberculous affections of the brain, and after the use of digitalis.

The *relative duration* of the sounds and pauses may be altered. The first sound is most commonly affected, and its prolongation is usually ascribed to ventricular hypertrophy; but of this the evidence is by no means conclusive. The greater or less rapidity of the heart's movements chiefly affects the duration of the pauses. Sometimes the pulsations are irregular: thus there may be five or six in as many seconds of time, and immediately afterwards double the number in an equal period. Or, again, the heart may stand still during the whole period of one of its revolutions, and then resume its regular beats. Such an intermission may occur at fixed intervals, every fifth, sixth, or tenth pulsation, for example. Hence the necessity in feeling the pulse to keep the finger upon it long enough to detect such irregularities, should any exist. Occasionally the second sound is wanting. This is chiefly confined to cases in which the action of the heart is so feeble that it hardly distends the arteries with blood, and consequently fails to produce the sound which depends for its formation upon their elasticity. In other and still more unusual instances, three and even four sounds are heard in the præcordial region. The most plausible explanation that has been given of the last phenomenon is, that the two sides of the heart no longer act in unison, whence the sounds made by each are heard separately. These various modifications of the heart's rhythm are of very uncertain semeiological value. If they are uncombined with abnormal sounds they may commonly be referred to neuralgia, disorder of the nervous system generally, or anemia, otherwise they more usually indicate organic disease of the heart itself, and are consequently of more sinister meaning.

The *tone* of the cardiac sounds may become graver or more acute than natural. The former change is commonly held to be the result of thickening of the muscular walls of the heart; the latter, of their attenuation, or of a diminution in the plasticity of the blood. The first sound is almost exclusively that which becomes graver than natural, and the second most frequently assumes a shriller tone. The latter is one of the peculiar symptoms of anemia and chlorosis.

Abnormal murmurs.—Besides the numerous changes in the order, frequency, and character of the sounds of the heart, which have been described, there are other auscultatory symptoms of the highest importance; murmurs, which mask, or take the place of the natural sounds. These are divided into *endocardial* and *exocardial*, according as they are formed within the heart, or exterior to it, in the pericardium; the first include the several varieties of the blowing murmurs, the second the friction sound properly so called, the creaking sound, &c.—The *blowing*, or *bellows' murmur* is by far the most frequent of all the abnormal sounds, for besides having an independent existence, it is usually the first stage of the other and harsher murmurs. It may exist only for a definite period, when the cause producing it is capable of removal; its duration is very transitory in plethora, and when heard in certain females at the menstrual period; it may attend an attack of endocarditis and disappear soon after its cure; and in like manner cease upon recovery from anemia or chlorosis. On the other hand when uncombined with any of these temporary conditions, it may gradually be supplanted by a rougher and louder sound, audible over the heart alone, or also in the great vessels of the neck, and the epigastric region. Sometimes it comes on suddenly, and sometimes its increase is gradual and progressive. Generally, there is but one bellows' murmur, and then it masks the first sound, while the second retains its natural characters; or it is so much prolonged as to take the place of the second sound also. This prolongation, however, is more apparent than real. There are, in reality, two murmurs, one formed in the auriculo-ventricular, and the other in the aortic orifice, and which are so fused together as to give the sensation of one continuous sound.

The mechanism of these abnormal sounds, the mode in which they are produced, is next to be explained. It is evident that whatever tends to increase beyond a certain point the friction of a given quantity of blood against the edges of the openings through which it has to pass must produce sound. In the natural state of the organ, there is a just proportion maintained between the quantity of blood propelled and the orifice it traverses; but when any of the cardiac orifices are contracted, this proportion is destroyed, the current of blood is subjected to unwonted friction by the hard and inextensible edges of the orifices, and vibration with sound results. The same effect should, of course, be produced if the contraction in question exists, not in the direction of the natural current of the blood, but as a deficiency in a valve, permitting regurgitation into the cavity which the blood has just left: and equally so when, although the orifices remain natural, an augmented quantity of blood is projected through them with increased velocity at every systole, as when a cavity is at the same time dilated and hypertrophied. So that a bellows' murmur in the heart is possible whenever the natural relations between the capacity and contractile force of the cavities, the size of the orifices, and the rate of the blood's movement are suspended or destroyed.

It is only by keeping before the mind this law, that apparently exceptional cases can be explained, those, for instance, in which the lesions of the valves are found after death, without there having been any abnormal murmur in the heart during the lifetime of the patient, and those in which such murmurs have existed, but no lesion of the heart could be detected. The orifice may be contracted, but the quantity of blood diminished, or the heart weakened; in this manner the abstraction of blood may cause the bellows' murmur to disappear for a time. In other cases the cavity may contract several times before expelling the whole of its contents, and then, the proportion being maintained between the amount of blood propelled and the diameter of the contracted orifice, no murmur may result, but several pulsations of the heart will be perceived, for one that can be felt in the arteries. In others, again, no unusual murmur is audible so long as the heart beats moderately, either through the influence of rest or of sedative medicines, but produces more or less of the blowing sound when its action is augmented by exercise or by diffusible stimuli.

But independently of any valvular lesion, the condition of the blood influences the production of the bellows' sound. It has been asserted to exist in cases of plethora, but whether from a positive increase in the quantity of the blood, or from that augmentation in the proportion of its red globules which Andral has shown to exist in this affection, or from what other cause, it is not easy to decide. It is difficult to understand how this sound should arise from two opposite causes; for it is said to accompany plethora, and nothing can be more certain than its common occurrence in anemia, chlorosis, pregnancy, and other disorders and states in which the proportion of sanguine globules is greatly diminished. If the quantity of blood in the vessels be held sufficient to account for the murmur in question, it may be objected that the same mode of reasoning would be inapplicable to those cases of anemia in which the amount of blood is certainly below the natural standard, as, for example, when this state is the direct result of profuse hemorrhage. It cannot, therefore, be received as a *demonstrable* conclusion, that the mere quantity or a particular quality of the blood is capable of generating the bellows' sound. It is sufficient for practical purposes to know that this murmur, so far as it depends upon the composition of the blood, is nearly always allied to a deficiency of the red globules. When detected in any case, the observer can be at no loss to decide, from the general symptoms, whether it depends upon plethora or the opposite condition, the only difficulty consists in distinguishing it from the analogous murmur occurring in the first stages of valvular disease.

In relation to the *rasping*, *filing*, and *sawing*, or harsh murmurs, their physical causes are essentially the same as those of the blowing sound which has been discussed; their peculiarities are supposed to depend upon the greater force with which the blood is propelled through the heart, and the greater roughness of the edges of the cardiac orifices, and to be more distinctly marked in proportion as these conditions are more strongly developed. When these murmurs exist in their highest degree, and particularly when they are formed in the aortic orifice, they give rise to a tremulous motion of the præcordium, readily felt on applying the hand, and which, from its resemblance to the sensation experienced on caressing a purring cat, has been aptly termed the *purring tremour.* Certain *musical sounds*, resembling the cooing of a dove, the distant whining of a dog, &c., are sometimes heard in disease of the heart. These sounds are regarded as identical with those already described, except that they are in a higher key, for they have in *nearly* every instance been found to coincide with similar lesions of the valves and orifices. In exceptional cases, no lesion whatever of these parts could be found to account for them.

Semeiology of Cardiac Murmurs.—Since it must now be admitted that the bellows' murmur, variously modified, may exist in numerous and very dissimilar affections, the question naturally presents itself, are there any circumstances accompanying this murmur which give it a definite value as a sign of cardiac disease? Upon what grounds must the opinion be based that it depends upon a structural lesion of the heart, upon an alteration of the blood, or upon some other cause? To answer these and similar questions, it becomes necessary to consider in succession and conjointly, the tone of the murmur, its coincidence with either of the natural sounds and pauses of the heart, its duration, its progress, and the other symptoms with which it is allied.

As regards the *tone* of cardiac murmurs, it may be remarked that when soft and breath-like, without partaking at all, or only at intervals, of the harsher characters, it usually depends upon a mere imperfection of the valvular apparatus, or the simple narrowing of an orifice without roughness, or else upon an alteration of the blood or nervous over-excitement of the heart. If, on the other hand, the murmur is harsh, and that permanently, there is but little doubt of its resulting from an obstacle of irregular form in the current of the blood, a lesion of a valve or orifice, for instance.

The occurrence of an abnormal murmur simultaneously with the first or second sound is a valuable element of diagnosis. Thus, a murmur which is independent of structural lesion in the heart is uniformly coincident with the first sound, and one which is heard with the second sound only, depends almost invariably upon a deficiency in the semilunar valves of the aorta. But a murmur of harsh tone, and audible during the first sound alone, may be generated either at the auriculo-ventricular, or at the aortic orifice; the exact locality of the lesion producing it must be inferred from other considerations.

The signification of the longer or shorter *continuance* of a murmur, as regards its dependence upon structural lesion or other causes, and that of its *progress* from a softer to a harsher tone, have already been pointed out. Permanence and harshness are the two chief characteristics of valvular murmurs. The *concomitant symptoms* call for especial attention in every suspected case of heart disease. In addition to the existence of a murmur, the other local and general signs of cardiac disease should be sought for, such as extensive dulness on percussion, purring tremour, alterations in the rhythm of the heart's movements and sounds, irregularity of the pulse, marked œdema of the ankles, &c., symptoms which, taken collectively, are never met with in functional disorders of the heart.

But when it has been fully ascertained that the structure of the heart is changed, the question still remains to be settled, What is the seat and character of the lesion? It is admitted by all competent authorities that a murmur taking the place of, or obscuring, the second sound, is due to an imperfection of the semilunar valves, which allows the blood to regurgitate from the artery into the ventricle; but some of them, reasoning from an erroneous theory, rather than drawing their conclusion from facts, maintain that the murmur in question may also be owing to contraction of the auriculo-ventricular orifice. This notion is sufficiently refuted by the fact that there is no case on record of a murmur in the second sound with no other lesion of the heart than narrowing of the auriculo-ventricular orifice; on the contrary, it is the uniform result of observation, that when such narrowing is accompanied with a murmur, it coincides with the *first* sound of the heart, or rather precedes it a little. But a murmur accompanying the first sound has also been found to coexist with two other forms of valvular disease, viz. imperfection of the auriculo-ventricular (mitral or tricuspid) valve, and narrowing of the aortic orifice by adhesion between the semilunar valves. Here is to be found a strong confirmation of the theory which has been adopted in the preceding pages. According to that theory, the first sound of the heart coincides with the systole of the auricle, the diastole, and then the systole of the ventricle, so that if either the orifice by which the blood enters, or that by which it leaves the latter cavity, is narrowed, a murmur may ensue; and the same result takes place if the auriculo-ventricular valve performs its office incompletely, and allows blood to regurgitate into the auricle during the systole of the ventricle. It is characteristic of the murmur produced by the cause last mentioned, that it is soft. Such might, indeed, be anticipated as its character; for if the arterial orifice is free, the blood which regurgitates into the auricle from the contracting ventricle must be small in quantity, and urged with but a moderate force.

If, then, a harsh murmur is heard during, or immediately preceding or following, the first sound of the heart, it must be due to contraction either of the auriculo-ventricular, or of the arterial orifice; and the only remaining question is, in which of them it is formed? When heard at the commencement of the first sound, and most distinctly near the apex of the heart, it is caused by an obstacle to the passage of the blood from the auricle into the ventricle; but when audible towards the termination of the first sound, and opposite the junction of the third ribs with the sternum, it is produced by a narrowing of the arterial orifice.

It must not, however, be supposed, because the murmurs when heard are referrible to the several lesions which have been enumerated, that these lesions necessarily occasion the murmurs, or that all of them do so to the same extent. It has already been insisted upon, that a disproportion between the diameter of the several orifices, the size of the column of blood traversing them, and the force with which that blood is propelled, is essential to the production of morbid murmurs. Hence, although an orifice may be greatly narrowed, if the walls of the cavity behind it are comparatively feeble, no murmur will result from the passage of blood through the contracted opening. On this account it is, most probably, that contraction of the semilunar valves is much more constantly attended with abnormal murmurs than that of the auriculo-ventricular orifice; for the power driving the blood through the former, (the systole of the ventricle,) is much greater than the power which propels the blood through the latter, namely, the systole of the auricle. But, whether the explanation be correct or not, the fact cannot be gainsayed, that the abnormal murmur is much more frequently wanting in mitral than in aortic contraction. MM. Barth and Roger even allege that, if a patient presents general symptoms of organic disease of the heart, such as disorder of the circulation, palpitation, dyspnœa, a contracted pulse, and œdema of the lower extremities, the absence of a murmur in the heart ought not to be held as conclusive against admitting the existence of valvular disease; and that they have, more than once, under these circumstances, asserted the auriculo-ventricular orifice to be narrowed, and had their judgment confirmed by subsequent dissection.

When it has been satisfactorily determined to what lesion and to what orifice an abnormal murmur is to be referred, it must still be ascertained which side of the heart is the seat of disease. And, in the first place, in the absence of any definite signs, it must be remembered that lesions of the left side of the heart are far more frequent than those of the right, and the presumption is consequently in favour of the former. Again, in valvular lesions of the left side, whether by contraction or imperfection, the arterial pulse is affected, having, when there is a defect of substance in the semilunar valves, a characteristic jerking movement, and in the other valvular alterations a smaller volume than natural; while in valvular lesions of the right side, the obstacle to the regular passage of the blood is mainly shown by pulsation, or at least turgescence, of the jugular veins. In addition to these marks, there is another which may facilitate the diagnosis, and which is derived from the fact that the normal sounds of the heart are audible to a greater distance than such as are the consequence of disease. On applying the ear to the chest, about the level of the heart, and at points gradually receding from it, both on the right and the left side, it is evident that the side on which the morbid murmurs first cease to be heard, while the normal sounds remain distinct, is the healthy side. Thus, in the most common case, valvular disease of the left side, as the ear recedes towards the right nipple, it will reach a point at which the murmur becomes inaudible, although the *tictac* of the uninjured side can still be heard. This method is not applicable to the diagnosis of lesions of the pulmonary artery and aorta, on account of the proximity of these vessels, and their relative situation—the one being behind the other; nor is it to be depended upon, unless the lungs are healthy: for the solidification of one of these organs may cause a murmur to be heard at a more distant point than the normal sound of the opposite side of the heart.

The simpler instances of cardiac murmurs have been now considered. The rules laid down for their detection, are the only guides which exist for analyzing those complicated cases in which three, and even four, abnormal murmurs are generated in the same heart; as when the valves, which guard both orifices of the ventricle, are at the same time adherent, so as to impede the passage of blood, and defective, so as to permit its regurgitation. It must be admitted, that success in unravelling so intricate a combination of murmurs, is chiefly to be coveted as an evidence that the skill of the observer is not likely to be at fault in simpler cases.

The following is a concise summary of the semeiological values of the different endocardial murmurs:

1st. A soft, irregular, or intermittent bellows' murmur, accompanying or masking the *first* sound of the heart, and existing without any symptoms of inflammatory or organic disease, should be attributed either to an alteration of the blood, or to irregular nervous action.

2d. A gentle but regular murmur with the first sound, may be owing to the formation of soft exudations on the valves, as in rheumatic endocarditis; or, possibly, to the mere inspissation of the blood by fibrin, in febrile affections; or, when permanent, to insufficiency of the auriculo-ventricular valves.

3d. A permanently harsh murmur indicates organic lesion of an orifice or valve.

4th. A murmur in the second sound is invariably a sign of permanent opening of the aortic valves, permitting regurgitation.

5th. A more or less harsh murmur *preceding* the first sound, and most audible at the apex of the heart, is a sign of auriculo-ventricular contraction.

6th. A soft murmur, audible at the *close* of the first sound, and near the apex of the heart, indicates permanent opening of the auriculo-ventricular orifice, permitting regurgitation to take place into the auricle.

7th. A harsh murmur, commencing at or near the close of the first sound, and most plainly heard at the upper part of the sternum, denotes contraction of the arterial orifice.

8th. In the present state of our knowledge, organic affections of the right, cannot be, with absolute certainty, distinguished from those of the left side of the heart. The former chiefly disturb the venous, the latter the arterial system; and the murmurs caused by the lesions of the left side, are not audible so far to the right of the sternum as are the normal sounds of the right side of the heart, and *vice versa*.

Exocardial murmurs.—These, which are symptoms of one disease only, pericarditis, vary in strength and tone, and, according to Dr. Hope, result "from attrition of the opposite surfaces of the pericardium roughened by lymph, and also in some cases from the roughened surfaces agitating or churning a little serum between them." They have generally a rough, rustling, or grating character, sometimes a creaking tone like that of new sole-leather, and again a rumbling or churning sound. The exocardial murmurs are generally double, coinciding with both sounds, or with both the diastole and systole of the ventricle, but are always most distinct during the first sound; they are occasionally however heard during this sound alone, less frequently along with the second, and sometimes even in the interval between the two.* The friction sound of pericarditis seems to be formed closer to the surface than the endocardial murmurs. It may be audible either in a very narrow space, or throughout the whole præcordial region, but is always most distinct near the apex of the heart.

This attrition murmur may assume several, or most of the characters, above described, during the progress of the same case. It is usually mild at the commencement, and if an effusion of serum take place into the pericardium separating the two serous surfaces from one another, it ceases to be heard altogether; it is again au-

* Dr. Sargent, of this city, informs the writer that in a case of pleurisy of the left side, he has heard, while the patient held his breath, a friction-sound which was evidently caused by the movements of the heart.

dible when the effusion is so far reduced as to allow the opposite false membranes to come into contact with one another, and once more ceases when adhesions are formed between these membranes. It is believed to acquire a harsher tone in proportion to the roughness and dryness of the false membranes.

Signs from the arteries.—These may be studied under two heads, 1st, the characters of the pulse; and 2d, auscultation of the arteries.

The pulse.—In entering upon this subject, it may be well to guard against a misapprehension very generally entertained. We hear constantly of an arterial wave, of a wave of blood, &c., as if the arteries and veins were half-filled canals. These vessels are always full, and may be fitly represented by an elastic tube bent in the form of a circle, so that a movement communicated to any one portion of the fluid contained in it is propagated to all the other portions. If the blood-vessels were not elastic, for every ventricle full of blood thrown into the aorta a precisely equal quantity would be poured from the venæ cavæ into the right auricle, and at the same intervals of time. There would, moreover, be a venous as well as an arterial pulse, and both produced by the same cause. Although the blood-vessels are elastic, the momentum given to the blood in the aorta is not the less propagated to that in the large veins, but the elasticity of the vessels, a constant force maintained in activity by the intermittent action of the left ventricle, intervenes between that ventricle and the veins, and in them substitutes a continuous for what would else be an interrupted current. Just as, in an ordinary fire-engine, the intermittent action of the piston produces a continuous stream from the branch-pipe through the intervention of the air-chamber. In the latter case the agent effecting this object is the elasticity of the air within an inextensible cavity; in the former, it is the inherent power of extension and contraction, i. e. the elasticity, of the walls of the cavity itself.

Now, because the arteries are elastic they are always full; they enlarge and diminish in size according to the amount of blood they have to transmit. But this elasticity is limited in both directions; they cannot be stretched beyond certain limits without bursting, nor on the other hand contract so as wholly to obliterate their cavities. The more distended they are the harder they will feel;

the less distended, the softer. But the distending cause, the systole of the ventricle, acts at intervals, so that the degree of arterial hardness, or resistance to pressure, can only be measured at the moment of the ventricular systole. If the latter cease, the elasticity of the vessel at once acts without opposition, and the artery contracts as far as possible upon its contained blood, which flows into the more extensible veins. Hence, it is plain that hardness and fulness of the pulse depend not only on the amount of blood in the artery, but also upon the force with which that blood is propelled by the ventricle. The manner in which this cavity contracts, gives to the pulse many of its peculiarities; the power of the one is pretty fairly indicated by the force of the other, so long as the circulating fluid is equably diffused. But if a large portion of the blood in the body gorge the liver, the lungs, the spleen, or any other parenchymatous structure, that portion may be regarded as temporarily withdrawn from the blood-vessels. In this way chiefly, must be explained the small and feeble pulse which is observed in the cold stage of intermittents, and other internal congestions. The quantity of blood in the body is by no means, therefore, to be estimated by the pulse alone, unless this fluid is diffused in due proportion to the several parts of the system.

The physical cause of the pulse is indeed, as was stated, the systole of the ventricle, but the apparent force of the arterial pulsation is very much augmented by the pressure made upon it by the finger. The finger partially obstructs the calibre of the vessel, and therefore receives a smart blow from the column of liquid behind the obstruction, and at the same time perceives the rapid flow of the blood through its narrowed channel. This consideration should induce caution in estimating the force of the pulse.

The mode of examining the pulse has been pointed out in a previous chapter. This examination should be made towards the close of the physician's visit, as well as at its commencement, in order that the patient may have time to recover from the agitation which he usually experiences on such occasions; it should, also, when two visits a day are paid, be made both morning and evening, for the diurnal changes of the pulse are often considerable in disease. The number of the pulsations in a minute, their force and rhythm, and their modification under pressure being ascertained, it is well to note the influence of the sitting posture, of accidental excitement of mind, &c., upon its frequency, regularity and other characters. The pulse at both wrists, and sometimes that of the carotids, ought to be felt, for an abnormal distribution of the radial artery, its partial ossification, or obstruction, may lead into serious error. The writer had under his care a young woman who was subject to hysterical paroxysms, and whose pulse presented a curious phenomenon. The pulsations of the left radial artery were generally imperceptible, or very feeble, while those of the right side were proportioned to the activity of the heart. At the same time a distant blowing sound was to be heard under the left clavicle. Occasionally, however, this sound became inaudible, and the artery of the left arm pulsated almost as fully as the corresponding one of the opposite side. No satisfactory explanation of this singular state was ever obtained; the patient ultimately recovered her health.

Varieties of the pulse consistent with health.—Age, sex, temperament, exercise, sleep, food, &c., exert considerable influence upon the condition of the pulse, and must be known before any just inference can be made from its condition in disease.

The frequency of the pulse in infancy has been very diversely stated by different authors. Since the more accurate observations of later years have been made, it may be adopted as a general rule, that the pulse increases in frequency from the period of birth to the fifth month, when it becomes gradually slower until the close of the second year, and continues at nearly the same point until the approach of the second dentition. During all this time, however, the variations of the pulse run through so wide a range, and are due to such slight causes, that its frequency is of little or no value as a symptom of disease, when unaccompanied by heat of skin and other general symptoms. Thus M. Trousseau has shown, that during the first two weeks of life, it varies from 78 to 150; in the second half of the first month, from 129 to 164; between one and two months, from 96 to 132; between two and six months, from 100 to 162; between six months and one year, from 100 to 160; between one year and twenty-one months, from 96 to 140. These higher numbers appear to have been due to the influence of the waking state, of muscular exertion, of heat, of temper, &c., for when the pulse of infants has been examined during their sleep, its average has been shown by M. Valleix to be considerably below that of the observations last named. M. Valleix gives the average during the first six months after birth as between 90 and 100. He also confirms the statement of other writers, that sleep renders the pulse slower, and that it is a good deal more frequent in female than in male infants. From the seventh to the twenty-seventh month, he finds the average frequency of the pulse nearly uniform, or about 126.

Between the ages of two and seven years, the pulse is somewhat over 100, and after that period continues to grow less frequent until it reaches the adult standard, or about 70. In old age, it again becomes somewhat more frequent, contrary to the prevalent belief upon this subject, according to which, after adult life the frequency of the pulse gradually declines. Dr. Pennock, of this city, has published (*Am. Jour. of Med. Sci.*, July, 1847) an account of a series of very interesting and accurate observations made by him upon this subject, from which it appears, that in 170 men whose average age was 64·09 years the medium pulse was 71·83 per minute; and that in 203 females, whose average age was 70·57 years, the medium pulse was 78·02 per minute. But Dr. Pennock did not find that the pulse became more frequent as old age advanced, except within certain limits. Thus in males, between the ages of 50 and 60, the pulse was more frequent than at any subsequent age; but that beginning at the age of 60, and going on to 90, the frequency of the pulse gradually increased. In females, on the contrary, the frequency of the pulse began to increase between the ages of 50 and 60, and maintained that tendency till the age of 80, when it declined. It may, therefore, be laid down as a general proposition, that both in old age and infancy the pulse is more frequent than in adult life.

Sex influences the character of the pulse. In females it is quicker, harder, smaller, and more frequent than in males, and is more liable to be affected by trifling causes. According to Dr. Guy, the pulse of women is more frequent by 10 or 15 per minute than the pulse of men.

Persons of a sanguine *temperament* have generally a full, strong, and resisting pulse; the lymphatic, on the other hand, a soft and compressible pulse; and the nervous a small, quick, and frequent pulse. In warm climates, and under the influence of heat generally, the frequency of the pulse is augmented; cold, on the other hand, renders it slower. Blumenbach relates, that the ordinary pulse of the Greenlanders does not exceed 30 to 40 per minute.

Position modifies the pulse. In healthy and unexcited persons, Dr. Guy found that the pulse which was at 79 in the erect posture, fell to 70 in the sitting, and to 67 in the recumbent posture. The difference between the two extremes, as influenced by position, is always greatest when the patient is very weak. The acceleration of the pulse observed under these circumstances is, no doubt, owing to the muscular effort required to keep the trunk or the whole body erect, for it is found that all muscular exertion augments the frequency of the pulse. Of this, Dr. Nick of Tubingen has furnished many illustrations. He states that dancing, for example, will raise the pulse from 75 to 124, and even 148.

The same author confirms by his observations, the well-known fact, that the pulse is lowered by sleep, or rather during sleep by the cessation of muscular action and mental excitement, and by the recumbent posture. In regard to the diurnal variations of the pulse, observers are not agreed, some having found it more frequent in the morning, and others in the evening. Those who make the former statement, appear to have confined their experiments to selected cases, to healthy persons confined to bed, and examined while fasting. Amongst men placed in ordinary circumstances, the acceleration of the pulse towards the close of the day cannot be called in question.

Eating and *drinking* have a sensible influence on the frequency of the pulse. It is said to be accelerated by as many as 12 beats per minute after an ordinary meal, and to continue above the average standard during four or five hours. Warm food and drinks especially affect it, and amongst drinks, those which contain the largest proportion of alcohol. Water, in small quantities, has no perceptible effect on the pulse; but, when taken copiously, has a somewhat depressing influence.

In addition to the foregoing circumstances, the characters of the pulse peculiar to the individual should always be taken into account. It is said that Napoleon's pulse was naturally weak, and beat but 40 times in a minute; Chomel mentions having witnessed a like degree of slowness of the pulse in a lady, and Whytt one whose ordinary pulsations were 120 per minute. Regular and irregular intermittence of the pulse are by no means uncommon during health. A case is narrated by a Dr. Bidart (*Gaz. Méd. de Paris*) of a man who was under his notice for nearly twenty years, and in whom, after every second pulsation, there was a complete intermission of one beat. This condition had existed from infancy, and when the subject of it died his heart presented no lesion whatever.

Of the Pulse in Disease.—A great many varieties of pulse are described by authors; Galen mentions thirty-six, and Bordeu conceived that there was a condition of the pulse peculiar to the disease of every organ of the body. Such refinements are neither founded in nature nor useful in practice. Whatever changes are effected in the arterial pulsation by disease, may all be included under two general divisions: 1st, changes of strength; and 2d, changes of rhythm.

The pulse is said to be *strong*, when it forces back the finger which is pressed upon it, and *feeble*, when it does not resist such pressure. The former variety is generally noticed in inflammations of organs largely supplied with blood-vessels, as the lungs and liver, and is the more strongly marked in proportion to the degree of plethora of the patient. In plethoric individuals this state of the pulse is an ordinary forerunner of hemorrhage. The feeble pulse is met with in nearly all diseases attended with exhaustion, and is common in the diseases of children, old persons, and women. It is most common in affections of a typhoid character, or in those which in their advanced stages assume this type, in typhus, puerperal fever, phlegmonous erysipelas, gangrene, &c.

The *full* pulse gives the sensation of the artery being larger than usual; the *small* pulse, of its diameter being less. The pulse is full as well as strong in plethoric individuals; it is simply full in those who are tall and thin. In disease, it occurs under all the circumstances in which the pulse is strong. Smallness of the pulse often depends upon narrowing of one of the orifices of the left side of the heart; it should therefore always suggest the propriety of examining the heart. Before its connexion with this lesion was known, the small pulse was regarded as a sure sign of debility, and sometimes led to a plan of treatment directly opposed to what was required. This state of the pulse is generally observed in inflammation of membranous parts within the abdomen, and particularly of the peritoneum, in which case it is combined with hardness. It is more common without the last-named quality in nervous affections, in chlorosis and anemia, and during violent paroxysms of pain. Under these circumstances, the artery may be so reduced in size as to feel like a mere thread beneath the finger; this is the *filiform* pulse. The pulse is both small and feeble in most of the cases mentioned as characterized by debility of the circulation induced by excessive discharges of any kind, whenever, in other words, the amount of blood in the vessels is greatly reduced. It acquires these characters, also, when the blood is removed from the ordinary channels of the circulation, and accumulates internally, as in the cold stage of febrile diseases. Such a pulse is an unfavourable sign, unless it speedily assume more natural characters.

The pulse is said to be *hard*, when its resistance to the finger is prolonged, or when it gives a sensation like the vibration of a tense cord; and is termed *soft*, when it yields readily to pressure. The former condition, also known as the *contracted* pulse, is commonly met with in membranous inflammations and rheumatism, and often during the paroxysms of convulsive disorders. So long as the pulse retains its hardness, the activity of the inflammation is unabated. The *soft* pulse exists in petechial typhus with such marked characters, that the artery appears to be distended with air, and not with a liquid; it is full, and yet the slightest pressure arrests it. The pulse after exhausting discharges is soft, but is usually small and feeble at the same time.

Quick and *slow* are terms used to describe a pulse in which the stroke is either given sharply, with a fillip, as it were, or else with a prolonged and deliberate movement. A pulse may therefore be quick without being frequent; but the two characters are very generally united.

The most important modification of the *rhythm* of the pulse consists in its increased *frequency*, i. e. in its beating more frequently than usual in a given space of time. To measure with accuracy the degree of its frequency, a watch furnished with a second-hand should be used. It is customary to count the pulsations during a quarter of a minute only, and after a short interval to count them again; in this way the second estimate serves to correct the errors of the first. When the pulse is beating very rapidly, it is best not to count beyond ten, noting the number of seconds required for that purpose, and renewing the count until a quarter or half a minute has elapsed. The advantage of this plan is, that having to name, or think of, numbers expressed by words of one syllable only, the operation is more rapidly performed than when the dissyllabic numbers above ten are employed. Chomel states that in this manner he has succeeded in counting 180 and even 200 pulsations in a minute.

Acceleration of the pulse is the common symptom of all febrile disorders; it augments with their increase, and subsides with their decline. It is generally proportioned to the heat of skin, and the frequency of the respiration. Its diminution is often one of the first signs of the decline of the disease. When the pulse continues to be frequent without appreciable cause, although the other symptoms appear to improve, no permanent amelioration is to be anticipated; either the original disease will resume its course, or some intercurrent complication be developed. When this acceleration occurs at regular intervals, it forms one, and a principal, sign that the attack is assuming a remittent type, and is therefore of paramount consequence in relation to treatment; but if it take place in the evening, it is rather an evidence of hectic fever, and must be regarded as an unfavourable sign; and particularly so, if preceded by chilliness, and followed by perspiration. It is difficult to fix any point above which the number of pulsations ought to be regarded as febrile; for the state of nervous excitability which exists during the decline of many acute affections renders the pulse frequent and the skin slightly warm; and in order to prevent these effects, nutritious food is often required, instead of sedatives and abstinence. In adults, the pulse rarely exceeds 120 per minute, even in pneumonia, which, more than any other inflammatory affection, increases the frequency of the pulse. The pulse of an adult above 150 in a minute, is one of the most unequivocal signs of a fatal issue.

An infrequent or slow pulse is an ordinary symptom of diseases attended with coma, when this results from concussion, compression, or other disturbance of the brain. It is one of the earliest and most certain signs of tubercular meningitis; it is occasionally observed in diseases of the heart, and after profuse hemorrhage. Several cases are reported of the diseases mentioned in which the pulse fell to 25 per minute. It should be remembered that this state of the pulse may be produced by an over-dose of digitalis.

The pulse may be called *irregular*, either from a want of uniformity in the intervals between the beats, or from inequality in the strength, fulness, quickness, or hardness of the successive pulsations. Irregularity may be confined to the pulse of one side of the body. Albers, of Bonn, declares that in certain cases of nervous disorder he has found five or six pulsations more upon one side than the other. This phenomenon is wholly irreconcilable with the only theory of the pulse which is in the least credible.

The *dicrotic* pulse is that in which the finger is struck twice at each pulsation; or, rather, in which the pulsations succeed one another in pairs. The ancients regarded it as a precursor of hemorrhage; an opinion, to some extent, confirmed by modern observation. The *intermittent*, another variety of the irregular pulse, is so called from the omission of a beat at intervals, which are sometimes perfectly uniform. As already stated, such irregularity is by no means inconsistent with perfect health; nevertheless, it is more commonly an indication of disease of the heart. It occurs, however, in other affections: in pericarditis, in large pleural effusions, and whenever the freedom of the circulation or of the respiration is interfered with. In connexion with the last-mentioned symptoms alone, can it be considered an unequivocally dangerous sign.

In general, the pulse presents more than one of the characters which have been described. In plethora, and in febrile and inflammatory diseases, the pulse is frequent, full, strong, and hard. In the collapse which often attends suppuration and disorganization of internal parts, the pulse is small, weak, and soft, and often irregular and intermittent. In syncope it has these characters. The jerking pulse, which is at once quick, hard, and strong, and ceases abruptly, is regarded by Hope, and many other good observers, to be characteristic of a deficiency of the semilunar valves of the aorta. It is alleged that, in abdominal inflammations, the pulse is commonly small, quick, and hard; while in those occurring above the diaphragm, it is usually full and strong. The statement is probably correct, so far as regards intestinal and peritoneal phlogoses on the one hand, and inflammations of the lungs and pleura upon the other. In most acute diseases, it may be stated, as a general rule, that the pulse is frequent, quick, and strong, during the active stage; and at the height of the attack, fuller and softer, without being less frequent. During the decline, it is less frequent, slower, and softer, if convalescence is approaching, but more tense and frequent if suppuration threaten; weaker and smaller, if gangrene be about to take place; soft, feeble, and irregular, if the attack assume a typhoid character; and, finally, if after being frequent, full, and hard, it should become sharp and small, without signs of collapse, there is reason to apprehend that the disorder will become chronic.

The preceding remarks are believed to embody the most important facts of the present subject. The art of interpreting the pulse is still very imperfect. The movement of the circulation is subject to so many variations from inappreciable, or extremely slight causes, that it would be very unwise for a practitioner to ground his opinion of the nature or probable issue of a disease, upon the characters of the pulse alone. It is more than probable that those who have attached most importance to its presumed indications, have, in reality, formed their judgment from the concomitant symptoms, as well as from the pulse; for, if it were otherwise, their precepts in diagnosis and prognosis, alleged to be founded upon this symptom alone, would not have been so generally contradicted by the experience of other observers.

Signs from auscultation of the arteries.—When the stethoscope is applied over an artery, in a healthy person, a peculiar, dull, short sound is heard, varying with the size of the vessel, its distance from the heart, the thickness of its coats, and the quantity, quality, and velocity of the circulating fluid. In the thoracic aorta and the carotids, a double sound is perceived, which appears to be merely the reverberation of the normal sounds of the heart. Elsewhere, the sound in question is generally attributed to the shock of the blood against the walls of the artery. But there are two capital objections to this explanation. In the first place, the sound generated by the passage of a fluid through a tube is prolonged; it continues as long as the liquid moves with a certain velocity, and is not, as in the present instance, a momentary and abrupt sound, resembling that produced by a slight blow with the end of the finger. It is certain, also, that when the artery is in a condition favourable to the generation of sound by its contained blood, as when its interior surface is roughened, a murmur of a very different sort from that made in a healthy artery is heard; it is one of equal duration with the first sound of the heart. In the second place, if it be said that the normal arterial sound is due to the *lateral* shock of the blood during the diastole of the artery, it may be asked, how can such a shock take place in a vessel which is constantly full? It is not easy to conceive how the sudden distention of a tube can produce sound, unless it throw into vibration something external to itself, either the air, or some solid body. This condition undoubtedly exists at the moment of the arterial diastole; the vessel strikes against the muscles, or other firm parts in contact with it, and may thus produce the normal sound of the artery. But we are disposed to question the probability even of this explanation; it may be true, but it is not sufficient. We have again and again brought the stethoscope within a hair's-breadth of a large artery, without being able to distinguish the slightest sound; but one became audible the moment the instrument was placed near enough to the vessel to receive its impulse, and appeared to be entirely due to the blow received by the stethoscope. For these reasons, we feel compelled to dissent from the prevalent doctrine, and to doubt the reality of the alleged arterial sound, so long as the vessels, and the composition and velocity of the blood deviate in no respect from their condition in health.

But, whatever may be the truth as regards the existence or the theory of the so-called normal sound, it is certain that abnormal arterial murmurs are generated by a different mechanism. If the stethoscope be pressed upon an artery so as to diminish its channel, a blowing or bellows' murmur results. The sound thus produced artificially and at will, is identical with that heard under several morbid conditions, and may be generated by any cause which excites unusual vibrations in the walls of the arteries. Such cause may be the increased force and rapidity of the heart's contraction, the consistence of the blood remaining the same, or being increased, as in plethora; diminished consistence of the circulating fluid, as in anemia; roughness or irregularity of the lining membrane of an artery; or valvular disease, especially disease of the semilunar valves, of the left side of the heart. When the cause of this murmur is one affecting the whole circulatory system, either through disease of its central organ, or an alteration of the blood, it is more frequently audible in the vessels of the right, than of the left side; a fact which must be admitted as the result of observation, but which, in the present state of our knowledge, cannot be explained. It is more frequently met with in females than in males, because its most ordinary cause (anemia) is an affection to which the former are peculiarly subject.

The bellows' murmur of the arteries may assume any of the characters described as belonging to the corresponding cardiac murmur, being soft or harsh, single or double. The morbid sounds heard in ausculting the *aorta* are sometimes entirely transmitted from the heart, sometimes generated in the vessel, and sometimes result from both of these causes combined. They accompany lesions of the aortic orifice, and pseudo-membranous, cartilaginous, and atheromatous degenerations and erosions of the internal surface of this artery, contraction of its calibre, simple dilatations and aneurisms, and communications of the aorta with an adjacent vein, forming varicose aneurism.

When there is simple contraction of the aortic valves, the murmur is heard along with the first sound of the heart; deficiency of these valves is accompanied with an aortic murmur in the second sound of the heart, and when there is both contraction and deficiency, a double murmur is perceived. Unevenness of the internal surface of the aorta gives rise, in general, only to one murmur, corresponding to the first sound of the heart, and it is soft or harsh in proportion to the degree of roughness of the channel occupied by the blood. When the aorta is not only roughened but also dilated, as in aneurism, the murmur is generally single, but in some instances double; and in the latter case its second part is due either to the transmission of a morbid sound from the heart, or wholly to the reaction of the vessel upon the column of blood within it. The latter cause is, at the least, very problematical, for when the aneurism is remote from the heart—when it is seated in the abdominal aorta, for example, it gives rise to one murmur only. In varicose aneurism, which is an extremely rare disease, the interchange of currents between the vein and the artery occasions a continuous harsh murmur, resembling the sound produced by sawing.

A harsh murmur confined to the line of the aorta, and heard at remote parts of this vessel, is nearly always owing to roughness of the inner face of the artery. In old persons, with ossified radial arteries, and in persons of any age who have long had valvular disease, this murmur indicates the existence of calcareous deposits; but in cases where the murmur has suddenly appeared, along with high fever and œdema, acute inflammation of the aorta with formation of false membranes is most probable.

A like murmur, strictly limited to a small space upon the front or back of the chest, without corresponding dulness on percussion, is indicative of roughness or stricture of the aorta at that point, and particularly the latter, if the intercostal arteries above this level pulsate more actively than those below.

When a double bellows' murmur is heard in the course of the aorta, it probably proceeds from an aneurism with a large cavity, especially if the purring tremour, dulness on percussion, and a strong impulsion exist at the same point. A double sound, resembling the normal sound of the heart, with signs of a tumour, is indicative of an aneurism with thick and solid walls.

A continuously whirring, or strong blowing murmur, which is not synchronous with the cardiac sounds, and heard at a point in the course of the aorta, where this vessel lies in contact with a large vein, or venous cavity, renders probable a communication between the arterial and venous systems. If deductions from cases which have been accurately observed, are sufficient to establish a special diagnosis, it may be presumed that when this murmur is heard near the right side of the sternum and the second intercostal space, a communication exists between the aorta and the vena cava superior, or the right auricle; when at a corresponding point on the left side, an opening from the aorta into the pulmonary artery, or the right ventricle, may be suspected. These probabilities acquire greater strength when the murmur has been detected after a severe pain in the part, and syncope, following excessive muscular exertion. The murmur in question, when heard in the course of the abdominal aorta, leaves but little doubt of the existence of a communication between the descending vena cava and the aorta.

A simple harsh murmur in the region last referred to, if accompanied with a tumour which pulsates with a heaving or expansive movement, denotes the existence of capacious aneurismal sac; if the tumour merely rise and fall with the diastole and systole of the artery, and continue to do so in all positions of the body, it is probably aneurismal, but nearly filled with fibrinous layers; if, on the other hand, the murmur ceases when the position of the body is changed, or when the tumour is lifted from its seat, it is probably owing to some unnatural formation pressing upon the aorta. Finally, a bellows' murmur, if heard only at a fixed point, where no tumour exists, may be attributed to stricture of the aorta; for, if dependent upon an alteration of the blood, it would be audible in other arteries.

Mere augmentation of the pulsatory movements of the abdominal aorta, without murmur or swelling, is to be referred to functional nervous disorder. These movements are sometimes so violent as to raise the head of the stethoscopist forcibly, and to annoy and distress the patient exceedingly. They bear no proportion whatever to the degree of the heart's action.

The diagnostic signs which have now been enumerated as referrible to disease of the aorta itself, are also to be met with, and have the same signification, in the secondary arteries. They have also the same origin, narrowing and roughness of the vessel at the points where they are heard, and are therefore to a great degree local. But, as was before hinted, there are other murmurs which may be audible throughout the entire arterial system, and which depend upon causes affecting the composition of the blood, or the velocity with which it moves. Of these important signs an account will now be given.

One of the murmurs produced by deficiency of the aortic valves belongs in part to this category, the one, namely, which corresponds with the first sound of the heart and with the pulse. In deficiency, *without* contraction, of these valves, there are two murmurs; but one only of them is very loud opposite the origin of the aorta, that which is formed by the regurgitation of the blood into the ventricle through the abnormal opening in the aortic valves; the other is most distinct in the arteries, and can sometimes be detected even in those of the lower extremities. The latter is formed where it is heard, and in the following manner:—The semilunar valves being perfectly supple, but not closing entirely the aortic orifice, the ventricle is obliged to propel not only the blood received by it from the auricle, but that also which returns into it from the aorta; this additional quantity requires that the capacity of the ventricle should be increased for its reception, and the power of the ventricle augmented for its propulsion. Such, at least, seems to be the explanation of the dilatations and hypertrophy which affect the ventricle under the circumstances referred to. The result of this change is, that at every systole of the ventricle, a larger amount of blood than natural is thrown with unwonted force into the arteries, augmenting the friction of this fluid in its channel, and generating a bellows' murmur. The insufficiency of the semilunar valves for the performance of their function is, therefore, not the direct, but the remote cause of the abnormal sound. This sound, like the others to be noticed, is never, unless some complication exist, of a harsh tone. It is strongest in the vessels nearest the heart, in the carotids, for example, and decreases in the remoter arteries, because, as has well been suggested by M. Beau, the capacity of the arterial system becomes greater and greater as it recedes from the heart, and therefore the friction between the blood and the vessels, and the resulting sound must diminish in the same proportion.

A bellows' murmur, it has been alleged by several authors, is audible in *plethora*, and they explain the supposed fact by assuming that in this state the heart acts with such augmented energy as to produce sonorous vibrations in the arteries or their contents. But it was not known, or was forgotten by these writers, that two opposite states of the blood might exist in plethora, one in which the blood is actually denser than natural, owing to the increase of its proportion of red globules, and the other in which this element of the fluid is diminished, although the vessels appear to be, and are, unusually full. The latter condition belongs to pregnancy, which is often accompanied with a soft blowing murmur in the arteries. If the term plethora be restricted, as it now is by some pathologists, to the former state, it is not, perhaps, attended with any arterial murmur.

Anemia and *chlorosis*, on the other hand, are very uniformly characterized by an arterial blowing sound, which may be either *intermittent* or *continuous*. In these diseases, the density of the blood, and in many cases its quantity, are diminished, and the nervous excitability of the patient is so much augmented, that the heart contracts more frequently and actively than in health. These conditions, it must be admitted, comprise all that are essential to the production of sound by a fluid moving through a tube with a certain velocity. The causes of the intermittent bellows' murmur have been sufficiently discussed. The continuous murmur, so called, is, in fact, composed of two separate sounds. The one is synchronous with the first sound of the heart, and the other fills up the whole interval between the repetitions of the former, and having much the same tone, forms with it a prolonged and undulating murmur, which sometimes resembles the blowing of a blacksmith's bellows, sometimes the sound of a humming-top, (*bruit de diable*), the cooing of a dove, the whistling of the wind,

&c. Its first part, which is the loudest and most prolonged, is due to the passage of thinned and impoverished blood through the arteries, and is synchronous with the pulse. The second part is ascribed by some writers to the contraction of the artery upon this altered blood, but by others, and with better reason, it is asserted to take place in the veins, particularly in the internal and external jugulars. Or, more correctly, it is said that in anemic cases, where this murmur exists, it is constant in the veins, but being masked at every moment by the louder sound which takes place in the arteries, the resulting impression upon the ear is of two distinct sounds running into one another.

The following experiment, proposed by M. Aran, proves the correctness of the above explanation. The stethoscope being placed over the carotid artery, just above the internal extremity of the clavicle, and in the triangular depression which there exists, the murmur is distinctly heard; if, then, the circulation in the external jugular vein be arrested by pressure with the end of the finger, at a point above the stethoscope, the murmur at once becomes intermittent; or if this do not succeed entirely, in consequence of the continuous sound being formed in the internal jugular vein, the result is certainly obtained by pressing at the same time slightly with the forefinger, at a point on the edge of the sterno-mastoid muscle, just above the middle of the neck. The continuous murmur immediately ceases, while the arterial sound remains unaltered.

The intensity of these sounds is always directly proportioned to the impoverishment of the blood. It has been amply demonstrated by MM. Andral and Gavarret, that they not only depend upon a decrease of the proportion of the red globules of the blood, but that, taking a series of chlorotic cases, these murmurs are almost uniformly heard whenever the proportion of globules does not exceed 80, but that between this and the normal proportion, 127, the bellows' murmur is more frequently intermittent.

The soft blowing murmurs, whether continuous or intermittent, deserve to be regarded as of the highest importance in determining the diagnosis of anemic cases, and particularly as a means of distinguishing the palpitations, syncope, dyspnœa, &c., which are apt to attend them, from analogous symptoms due to organic disease of the heart. MM. Béhier and Hardy relate a case in point. A lad fourteen years of age, and of a sanguine temperament, presented nearly every symptom of organic disease of the heart, dyspnœa, violent palpitations, præcordial impulse, and a bellows' murmur in the first sound. A diagnosis of hypertrophy was already made out, when a continuous humming over the right carotid artery revealed the error. Similar mistakes are of very frequent occurrence in this country, and patients are subjected to sedative medicines, repose, and depletion, for disorders which a little more accurate knowledge would have led the physician to cure with tonics, exercise, and nutritious food.

Cerebral auscultatory signs.—As the vascular murmurs are the most numerous of those discoverable by cerebral auscultation, this appears to be the proper occasion for a brief notice of their character and semeiologial value. Dr. J. D. Fisher, of Boston, is entitled to the credit of discovering that, in certain morbid states of the contents of the cranium, peculiar sounds are generated. He first announced the fact in 1833, and five years afterwards published several cases confirmatory of his original statements. In 1843, Dr. Whitney, of Newton, Mass., published an account of his observations in the same field, corroborating the views of his predecessor, and furnishing some novel results.

It appears, from the essays of these gentlemen, that on ausculting the head of a healthy person, and particularly the region of the anterior fontanelle in a young child, the sounds of the heart, of respiration, of the voice, and of deglutition, are more or less audible. But, whenever the blood within the cranium is increased in quantity, its movement accelerated, or it is thrown into unusual vibration by the roughness of its channel, or its own tenuity, all the physical conditions exist which are requisite for the production of abnormal murmurs.

Of the morbid cephalic sounds, the most common is the bellows' murmur, which, it is stated, may be heard in simple and ephemeral congestion of the brain, such as exists directly after a paroxysm of whooping-cough; in "acute cerebral inflammation; hydrocephalus; compression of the brain; scirrhous induration of the substance of the brain with softening; ossification of the arteries of the brain, and the hydrencephaloid disease." This murmur is described as being synchronous with the pulse; as sometimes continuous and sometimes interrupted, and as either abrupt and blowing, coarse and rasping, soft and diffusive, or somewhat musical. The last-mentioned character is noticed only when there is well-marked anemia. In a case of aneurism of the basilar artery, related by Dr. Whitney, the murmur was harsh and rough, accompanied with a diffused and purring vibratory thrill, and became much softer when pressure was made upon the carotids.

The physician just named has described a murmur called cephalic ægophony, which he believes to be pathognomonic of serous effusion within or upon the brain, as thoracic ægophony is of effusion into the pleural cavity. "It resembles very much," he says, "the shrill brazen sound produced by speaking through the teeth of a comb covered with paper or thin cloth." Supposing this sign to have the value which is attached to it by its discoverer, it certainly possesses some importance in practice, as a differential sign between the hydrencephaloid symptoms of anemia, and true hydrocephalus, conditions which are often confounded by the best practitioners.

The purring murmur may be useful in distinguishing aneurismal from other tumours within the cranium. But, as regards the bellows' sounds, it is not easy to perceive to what extent they facilitate the diagnosis of cerebral affections, since they exist equally in simple congestion, and in various inflammatory and structural diseases of the encephalon. A sign which is equally characteristic of the state of cerebral excitement which occurs during dentition, and of positive meningitis, abscess of the brain, and hydrocephalus, cannot, certainly, be of great importance. If we rightly appreciate auscultatory signs in thoracic and cardiac affections, they are valuable as indicating the seat, nature, and extent of the existing disease; but, with the exceptions already pointed out, it does not appear that the cephalic murmurs reveal either the part of the brain which is affected, or the particular change which it has undergone. A cephalic blowing murmur seems to stand in a relation to cerebral diseases, very much like that of a cough to pulmonary disorders;

as a symptom which may depend upon any one of a great variety of dissimilar causes, and therefore inviting investigation in regard to them, although in itself of little semeiological importance. But even in this view, the murmurs in question are of secondary consequence, because they do not appear to have existed in any case in which attention was not already drawn to the brain by other cerebral symptoms.

The writers on cerebral auscultation do not mention having listened for the bellows' murmur in cases of fever, whether essential or symptomatic of inflammation seated elsewhere than in the brain. If the phenomena, described by them, occur from moderate concussion, or from momentary congestion after coughing, they, in all probability, would be present whenever the brain is sympathetically affected.

Signs from the veins.—Amongst the symptoms belonging to the venous system, is *pulsation* of the jugular veins, an occurrence already adverted to, and which is due to some obstacle to the passage of the blood through the right side of the heart, and causing a reflux into the descending vena cava. This obstacle may consist in narrowing of the tricuspid orifice, in which case the reflux is occasioned only by the systole of the auricle; in a patulous state of this orifice, or in stricture of the pulmonary artery, causing the blood to regurgitate, during the ventricular systole; or, finally, in congestion of the lungs, such as takes place in asphyxia, when the blood accumulates in the right cavities of the heart, and the contraction of the auricle tends to force its contents into the vena cava rather than into the ventricle.

An abnormal communication between a vein and an artery, or *aneurismal varix*, is accompanied with pulsatory movements in the vein, in consequence of the blood being driven into it during the arterial diastole; but this pulsation does not extend beyond two or three inches from the abnormal opening. These are the only circumstances in which a true venous pulse exists. This name is incorrectly given to the rising and falling of a vein which happens to lie over a superficial artery. Sometimes, in consequence of the juxtaposition noticed, when phlebotomy is performed in the median-basilic vein, the jet of blood, instead of being perfectly continuous, may have an intermittent or jerking movement, which is very apt to alarm the inexperienced practitioner with the apprehension that he has wounded the subjacent artery. The dark colour of the blood is sufficient evidence that the artery is unhurt.

The subcutaneous or superficial veins are usually distended under the influence of heat, and in plethora; and contracted by cold, and in anemia. But the local alterations in the size of these vessels are more directly connected with the present subject. They may be enlarged when an unusual amount of blood is thrown into a part, as in active congestion, or when an obstacle arrests the return of the blood through one or more venous trunks. The former case is illustrated by that turgidness of the veins of the neck and head which sometimes precedes apoplexy, and that of the back of the foot when gout attacks the joint of the great toe. Fulness of the veins of the face and neck is very common in diseases of the lungs impeding the circulation through these organs, provided the amount of blood in the body be not much reduced; in severe cases the entire venous system becomes turgid, forming an acute variety of cyanosis. In the ordinary congenital form of this latter disease, the same result ensues from contraction of the pulmonary artery, or some analogous lesion, preventing a free circulation through the right side of the heart.

Distension of the superficial veins of the abdomen is frequently due to some impediment to the portal circulation, particularly to that form of hepatic atrophy called cirrhosis, and which is one of the most ordinary causes of ascites, when this affection is independent of general dropsy. Distension of the veins of the lower extremities may arise, either from pressure upon the venous trunks within the pelvis, by the gravid uterus, a pelvic tumour, collections of fæces in the rectum or colon, or to the habit of standing when fatigued. This distension may become permanent through the prolonged action of any of the mechanical causes mentioned, and the walls of the vessels become thickened and indurated.

Signs from the circulation in the gravid uterus, and the fœtal heart.—In connexion with the preceding account of the semeiology of the circulatory apparatus, it seems proper to notice briefly the sounds which are detected in the uterus during pregnancy. These are chiefly two: 1st, the uterine bellows' murmur, and 2d, the sounds of the fœtal heart.

The *uterine bellows' murmur* is heard by applying the ear, either directly, or through the medium of a stethoscope, to the walls of the abdomen, where they come, or can be brought into contact, with the uterus. Its tone resembles closely that produced by compressing with the stethoscope a large artery, but differs from this in being unaccompanied with pulsation or heaving. It is sometimes very abrupt, and sometimes so prolonged as to be almost continuous. Generally it is distinctly audible, and does not seem to be distant from the ear; but occasionally it is so feeble as to be heard with great difficulty. Its tone varies considerably, not only in the same individual, but even during an examination, being sometimes sonorous, sometimes acute, or whistling, &c. The following propositions, which are taken from the recent work of M. Dépaul,* present a summary of all that need be said of this murmur.

1st. This murmur is generated in the uterine arteries, and not in the placenta, and may be heard at all points of the organ accessible to the ear or the stethoscope.

2d. It is proved by incontestable facts, that the uterine murmur has been heard at the middle of the eleventh, and even at the close of the tenth week. But, in general, it cannot be detected until somewhat later.

3d. It grows progressively louder until the end of the seventh month; after which it usually remains unaltered.

4th. It is incorrectly regarded by many physicians as a certain sign of pregnancy. Of itself, it has not a much higher value than the rational signs; but combined with several others, it gives to them, as well as acquires, importance.

5th. It cannot be doubted that a murmur perfectly analogous to the one under consideration may exist when the uterus is distended under any other circumstances than pregnancy.

6th. The death of the fœtus in nowise alters this sound, still less arrests it. Its absence, therefore, is no proof of the child's death.

* Traité Théorique et Pratique d'Auscultation Obstetricale, par J. A. H. Dépaul. Paris, 1847.

7th. It is equally uninfluenced by the diseases which may affect the fœtus.

8th. Admitting that the size of the placenta bears some proportion to that of the child, the size of the child cannot be predicated upon the loudness of the uterine murmur, inasmuch as this sound is independent of the placenta. On this account, also, the tone, &c., of the murmur, afford no indication of placentary disease, nor can the situation where the former is heard determine at what point the placenta is attached.

9th. It is an error deduced from a false theory, to assert that double pregnancies may be inferred from the existence of several uterine murmurs. Anatomy teaches that even when there are two fœtuses there is usually but one placenta, and experience shows that there may be two, and even three, distinct murmurs, although the womb contain but a single fœtus.

10th. It results from the foregoing summary that the practical value of the uterine murmur, as a sign, is very restricted indeed.

The sounds of the fœtal heart.—These sounds resemble very much the ticking of a watch, except that they have not its metallic tone. They are two in number, are very close together, and yet perfectly separate. The first is louder and longer than the second, which occasionally grows very faint or quite inaudible. The number of these pairs of sounds, so to speak, varies from 120 to 150 per minute, and, according to some writers, remains the same throughout pregnancy, but according to others, becomes less during the last few weeks. In general, they grow more distinct as gestation advances, but various causes may modify their distinctness. Such, for example, are a profusion of *liquor amnii*, unusual thickness of the abdominal walls, great mobility of the womb, and that position of the fœtus in which its back is towards the spine of the mother. During uterine contractions, also, there is a muscular sound which masks that of the fœtal heart. Disorder of the mother's circulation has no direct influence on that of the child.

The following conclusions are chiefly borrowed from the work of M. Dépaul, already quoted. It is generally stated, that the fœtal pulsations are not audible before the middle of the fifth month, but they may very commonly be heard at three months and a half, and even earlier. M. Dépaul claims to have distinguished them at the end of the third month, and of the eleventh week.

During the last three months of pregnancy, these sounds are almost always present, unless the fœtus has perished. They are not wanting once in a hundred times.

The region of the uterus where they may be heard, depends chiefly upon the position of the fœtus; its left scapula is believed by M. Dépaul to correspond, in the immense majority of cases, to the point at which the sounds in question are loudest.

The presence of these sounds of course establishes, not only the fact of pregnancy, but that of the fœtus being alive, and has, therefore, this great advantage as a sign, that it may be detected while other symptoms are indistinct and lead only to a doubtful conclusion. On the other hand, the absence of the sounds is more to be depended upon as a sign of the death of the fœtus than any other symptoms whatever.

Two sets of pulsations, heard at different points, and not precisely simultaneous, should be regarded as an unquestionable sign of double pregnancy.

According to M. Dépaul, it is possible, in the vast majority of cases of advanced pregnancy, to ascertain the position of the fœtus in utero. Indeed, if the sounds of the fœtal heart are most distinctly heard at points of the uterus to which the left scapular region of the fœtus is nearest, and this region is nearer the cephalic than the pelvic extremity of the child, it follows that when the fœtal sounds are heard loudest below the middle horizontal line of the uterus, there will be a presentation of the head; when heard above such line, there will be a presentation of the pelvic end of the fœtal ellipse; when heard to the right or to the left of the middle vertical line of the uterus, a first or third position of one or the other extremity, may be presumed to exist.

But, to confirm the correctness of these results, it is necessary that auscultation be practised carefully, and no point assumed to correspond to the fœtal heart unless it be well ascertained that the maximum loudness of the fœtal sounds exists there. It is also necessary that the examination be renewed from time to time, for it is certain that the position and presentation of the fœtus may both change spontaneously.

That these minuter details of diagnosis are not attended to by a larger number of obstetric practitioners, is probably owing to their not having the experience or the skill in the art of auscultation which a methodical application of them demands. Those who have enjoyed the best opportunities for testing the method, ascribe to it the highest value.

CHAPTER VI.

SIGNS FROM THE RESPIRATORY APPARATUS.

THE morbid phenomena presented by the organs of respiration are very numerous, but by far the greater number of them are direct indications of thoracic disease; very few, indeed, arise from sympathy with the disorder of other systems. For the purpose of study, they may be conveniently divided into those which are detected by the ordinary methods of observation, and those revealed by physical examination alone. The former class includes the various alterations of the act of breathing, dyspnœa, expectoration, cough, and several forms of pain; the latter comprises the modifications of the resonance of the chest, of the respiratory sounds, and of the voice, with the several rhonchi or rattles which may be discovered by auscultation.

SECTION I.

THE SO-CALLED RATIONAL SIGNS OF PULMONARY DISEASE; INCLUDING RESPIRATION, DYSPNŒA, COUGH, THE SPUTA, ETC.

Respiration consists of two parts, inspiration and expiration. By the healthy adult, this act is performed from 12 to 20 times in a minute, by the infant from 20 to 30 times in the same space, during a state of perfect repose. Respiration is rendered much more frequent by exercise, by emotion, by the process of digestion, &c.; but the action of these causes is very brief, and, when it has ceased, the breathing resumes its previous moderation. Inspiration occupies about thrice the time of expiration; some writers, however, regard the two acts as equal, and others assert that the former bears to the latter the proportion of 5 to 1. Unquestionably, all these proportions are quite compatible with health, and may be noticed in the same individual, in the course of a few minutes' observation ; but the one first mentioned will be found to express most accurately the average standard.

In disease, the respiration may be preternaturally frequent or slow, rising to 60 or 80, or falling to 8 or 10, in a minute. The former condition is common to all febrile and inflammatory affections of a sthenic type, especially when they attack children. As a general rule, however, extremely rapid breathing is a sign of thoracic disease ; but even then it is proportioned to the grade of fever present, unless when associated with dyspnœa, in which case its degree more directly depends upon the amount of pulmonary tissue withdrawn from the purposes of respiration, by disease. When, from any cause, the inspirations are short and very frequent, and particularly when this effect is produced by extensive effusion into the pleural cavities, the breathing resembles that of a person who is "out of breath" with running, and is called *panting respiration*. As mental emotion quickens the respiration temporarily, so do certain nervous diseases increase its frequency more permanently. It is not uncommon for hysterical females to breathe 60 or 70 times a minute, during an entire paroxysm of the disease. *Slow* respiration is seldom, if ever, an attendant upon pulmonary disease, but nearly always of some affection, either structural or functional, of the nervous system. It is observed in apoplexy, effusions of serum within the cranium, and softening of the brain, and in most of the circumstances which occasion coma. In nearly all of these cases, not only is the respiratory act very slowly performed, but the intervals between the inspirations are unusually long. A similar condition is met with in catalepsy, extasis, melancholy monomania, and in persons under the influence of depressing passions.

Inspiration, it was stated, is naturally longer than expiration. Sometimes this proportion is exaggerated, and sometimes reversed. For example, in œdema of the glottis, the swollen edges of this opening are drawn downwards, so as to obstruct, and therefore prolong the passage of the air into the larynx, but they offer no impediment to its escape, so that the expiratory act is short and easy. On the other hand, when the lungs are emphysematous, the air enters them readily, but in consequence of their rigidity, they contract slowly, and therefore a prolonged expiration is produced.

Normal inspiration is uniform and continuous; but when the pleura is inflamed, or the muscles of the chest are affected with rheumatism, the pain caused by drawing the breath arrests the expansive movement at every instant, and renders the inspiration jerking and irregular.

Many varieties of morbid respiration, besides the above, are described by authors, but the following are the most important:

Abdominal respiration, in which the diaphragm chiefly exerts itself, causing the abdomen to rise and fall considerably, while the walls of the chest are nearly at rest. This usually occurs in acute pleurisy, rheumatism of the chest, pericarditis, and fracture of the ribs; in all of which affections, movements of the chest excite pain.

Thoracic, or *high* respiration, when the abdomen does not move, but respiration is performed entirely by expansion of the chest. This is found, in a marked degree, when the peritonæum, the diaphragm, or its pleural covering, is inflamed. Distention of the abdomen, by wind or water, or by tumours, will have the same effect.

Cervical respiration, and *cephalic* respiration, are terms denoting the part taken by the muscles of the neck, and those which dilate the nostrils during the struggles for breath, which mark the severer forms of dyspnœa.

In health, respiration is performed noiselessly; but not always so in disease. It is *wheezing*, in simple laryngitis and in croup, and generally has a clear *whistling* tone in stridulous laryngitis, and nervous asthma. It is *suspirious*, or sighing, when the inspiration is short and quick, and the expiration prolonged, as happens during recovery from syncope, in low forms of fever, and often on the approach of death from asphyxia. It is plaintive or *moaning*, either from extreme debility or from pain. When it arises from the latter cause, it is not a sign of peculiar gravity; but when it occurs during sleep, unless excited by an unpleasant dream, it is a most unfavourable indication. *Stertorous*, or snoring respiration, is one of the frequent attendants of coma, and adds to the gravity of this symptom, whenever the latter depends upon congestion, or any other mode of pressure upon the brain. It may depend merely upon the habit of the patient, or upon a polypous tumour in the nostrils, cases which are of course to be distinguished from those where it forms an incident of the principal disease. *Cold* respiration, in which the expired air is below the ordinary temperature of the body, is nearly always a mortal symptom; yet it has occasionally been met with in the cold stage of intermittents, and in the collapse of cholera, without being followed by death.

Dyspnœa.—Under this title is included every form of laborious or difficult respiration, accompanied with a sense of constriction or oppression around the base or on the front of the chest. In its slightest degree, there is some panting, and an unwonted effort to expand the chest, but only after some unusual exertion. When more marked, the ribs are raised by a still stronger effort, and the diaphragm is greatly depressed; yet the air does not seem to reach the pulmonary vesicles. The voice is faltering or gasping, and the patient cannot lie in bed unless the head is propped up high with pillows.

The causes of dyspnœa, although very numerous, may, perhaps, be all resolved into one general and essential cause: *an obstacle to the due aeration of the blood.* A healthy person, exhausted by exercise or running, has dyspnœa, because the natural supply of air, afforded by the lungs, is insufficient to modify the blood which rushes, in a greatly augmented quantity, into those organs. The increased action of the chest, the hard breathing, is nature's method of maintaining the balance between the functions of the heart and lungs. But, whether the circulation be increased in activity, or the lungs so altered as to admit but little blood to come in contact with the air, or the heart or great vessels so changed as to impede the passage of the blood towards the lungs, or the respiratory muscles so feeble as to be unable to dilate the chest, one and the same result ensues: enough blood is not aerated to supply the wants of the economy, and a more or less vigorous and successful effort is made, by means of the voluntary muscles, to expand the chest, and relieve the sense of suffocation which incites to this effort. Consequently, whether the disease be an effusion of blood or serum into the pericardium, compressing the heart, or such a state of that organ as causes it to propel an undue quantity of blood into the lungs, or such disease of its valves as either prevents the blood from reaching the lungs, or from passing freely through them;—whether the lungs themselves be hepatized or infiltrated with tubercles, or have their cells thickened by emphysema, or choked up by mucus or blood, as in bronchitis and pulmonary hemorrhage, or compressed by gas, pus, or serum, as in pneumothorax, empyema, and pleurisy; or whether, finally, the respiratory muscles be debilitated by cerebral or any other disease—the consequences are still of the same kind: the blood fails to undergo the changes for the accomplishment of which the pulmonary circulation exists, impending suffocation gives warning of the mischief, and a laborious attempt is made to overcome the incompleteness and inadequacy of the inspiration, generally by rendering them more frequent.

Such are extreme cases. But, when any of the causes enumerated act with less energy, an involuntary increase in the frequency of the respiration will usually take place, sufficient to overcome the difficulty at least for a season. The patient is scarcely conscious of breathing more actively than usual, unless when he exerts himself beyond his strength; he feels no oppression, no shortness of breath. But as the disease which occasions the dyspnœa advances, the involuntary acts of respiration are no longer sufficient to introduce into the lungs the necessary amount of air, and the patient's attention being aroused by a sense of oppression, he endeavours to make up for the deficiency by assuming such positions as favour the action of the respiratory muscles. He leans forward and grasps his knees, or some article of furniture, so as to make his head and shoulders fixed points, and bring into play the pectorales, and other muscles which pass from the chest to the humerus. The degree of oppressed breathing, in which no relief is found, except in the partially erect posture, is called *orthopnœa*, (from ορθοσ, straight; and πνεω, I respire.)

Dyspnœa is more or less severe, according to the nature of the disease, and especially the extent of the lesion. Pneumonia may invade one, or even all the lobes of a lung, without producing any notable shortness of breath, or increased frequency of the respiration. In acute pleurisy, the dyspnœa is more considerable, but chiefly because the act of breathing is painful; for in chronic pleurisy there is no pain, and often but little oppression. In double pneumonia or pleurisy, on the other hand, when hardly any of the pulmonary tissue is left in a condition to perform its function, the oppression is extreme. Phthisis, also, induces very little dyspnœa, except what arises from debility, until tuberculization of the lungs has taken place to a great extent. Diseases of the heart, and emphysema, when general, create very distressing shortness of breath, (orthopnea,) because they influence the function of the whole pulmonary tissue.

In most of the affections of the lungs and heart, attended with dyspnœa, this symptom is of gradual growth, and its increase shows the progress of the original disease. This is its course in inflammations of the lungs and pleuræ, of the fauces and the air-passages, in pulmonary phthisis and dropsy of the pericardium and chest, in acute as well as structural diseases of the heart and great vessels, and in anemia and chlorosis. Sometimes, on the contrary, the invasion of this symptom is sudden and justly alarming; for, if accompanied with sinking or collapse, it nearly always indicates a rupture of the heart or aorta, or perforation of the pleura by a pulmonary vomica.

In nearly all acute inflammatory affections, and in phthisis, anemia and chlorosis, dyspnœa has seldom a paroxysmal character, although it may be aggravated by exercise, emotion, &c. But in most of the organic diseases of the heart, and in emphysema, with which they are so often connected, paroxysms may occur at regular intervals, particularly at night, or rather, early in the morning. In the suffocative diseases of the larynx, also, there are paroxysms of dyspnœa, even in those which run their course in a few hours or days: as pseudo-membranous laryngitis (croup), stridulous laryngitis, and œdema of the glottis. There are two diseases, (nervous asthma and angina pectoris,) of which almost the only essential phenomena are, paroxysms of dyspnœa; for although, in the former malady, there is the most intense suffering for want of breath, and in the latter, the most excruciating pain extending from the breast to either arm, yet in the intervals between the attacks, the patients may enjoy excellent health.

Yawning is a deep and prolonged inspiration with the mouth wide open, and followed by a short and strong expiration; often it is accompanied with a slow but complete stretching of the limbs, especially the upper limbs, which is called *pandiculation*. The whole act is involuntary. It is an ordinary precursor of acute attacks of febrile disease, and is then generally attended with chilliness; it also is apt to precede paroxysms of nervous disorder. Gaping, in diseases of a typhoid type, is a sign of great prostration, and one, therefore, of unfavourable import.

Hiccup or *singultus*, already noticed under another head, is a momentary convulsion of the diaphragm, accompanied with a constriction of the glottis, which prevents the entrance of air into the lungs. It is often a slight and temporary disorder, caused, usually, by the pressure of undigested food in the stomach, or the over-distension of this organ with flatus. It becomes, however, a sign of importance, and is most unpropitious, when it occurs in low fevers, after surgical operations, and in inflammations of the abdominal viscera. In the first of these cases it may last for several days, and by its perpetual annoyance, and its rendering sleep impossible, augment very considerably the danger of the patient. After surgical operations it is indicative of the failure of the patient's strength, and sometimes of the occurrence of metastatic abscesses. In strangulated hernia, intestinal obstructions, and visceral inflammations, if hiccup supervene along with feebleness and increased frequency of the pulse, gangrene is to be apprehended.

Cough.—Coughing consists in the rapid and noisy passage through the glottis of air driven out of the lungs by a short, quick, and forcible expiration, and resounding in the nasal fossæ. It may be either voluntary or instinctive. It is commonly excited by a tickling in the larynx or trachea, or by a sense of fulness or oppression in the chest.

The *tone* of the cough varies considerably, and often affords valuable information to the experienced ear. Some of the more striking varieties in regard to tone are, the hoarse cough of commencing catarrh, the hollow cough of advanced consumption, the sharp ringing or crowing cough of stridulous laryngitis, the smothered cough of croup, the whooping cough of pertussis, and so on. In the last-mentioned disorder the cough is paroxysmal; in nearly all others it comes on irregularly, and is excited by the presence of secretions in the air-passages, exertion of the voice, exposure to cold air, &c.

Coughing is, for the most part, *symptomatic* of some affection of the respiratory apparatus, but occasionally, also, of disease in other organs, the liver, the heart, or the stomach, for example. In the latter case it is commonly *dry*, that is, unaccompanied with sputa. It must be borne in mind, however, that what is sometimes called a "stomach cough," and is observed in the dyspeptic, is in reality a sign of commencing tuberculization of the lungs. A very common origin of dry cough, and one which is frequently overlooked, is elongation of the uvula. This organ, in the cases alluded to, irritates the opening of the larynx, and produces a constant and very distressing cough. In opposition to the dry cough is that called *loose*, in reference to the copiousness of the secretion into the air-passages, and the facility of its removal. The latter is usually unaccompanied with pain, and is followed by a sense of relief, while the dry cough, or that in which the sputa are scanty, produces soreness, or even smarting or burning throughout the lungs, or in the trachea and larynx only, if these parts are principally involved. Violent coughing also causes pain in one or both sides, or at the point of the sternum, or around the whole line of attachment of the diaphragm, making these parts feel as if they had been bruised.

Of itself, cough does not afford sufficient ground for a sure *diagnosis*, but is chiefly valuable in this relation when considered along with other symptoms. To this rule there is, perhaps, one exception. In pertussis, the cough is not only paroxysmal, and attended with extreme congestion of the blood-vessels of the face, but it consists of several successive and quick expirations, followed by a long, sonorous, and "whooping" *inspiration*, unlike what takes place in any other disease whatever.

The croupal cough, so called, in which there is a shrill, ringing sound during *expiration*, is far from being characteristic of true croup; it is, in fact, far more common in spasmodic or stridulous laryngitis, and when it does accompany the pseudo-membranous affection, it is only at the commencement of the attack; when once false membranes are exuded, the cough becomes dull and smothered.

Cough excited by laryngeal disease may generally be recognised by its being often a voluntary act, performed for the purpose of expelling a body that seems to be sticking in the throat, and chiefly through the action of the muscles of the throat, while that which depends upon pulmonary or bronchial disease is louder, more instinctive, and effected mainly by the muscles of the chest and the diaphragm. Inflammatory affections of any part of the air-passages or lungs excite very frequent coughing, while in pleurisy, whether acute or chronic, the cough is infrequent, and in the former variety, short and irregular. Besides the cases mentioned above, the cough is dry in the commencing stage of nearly all pulmonary affections, and becomes humid at the height, and loose, especially during the decline of these maladies.

In *prognosis* this symptom has not a definite value, aside from its aiding in the discrimination of the disease; but as it may exist almost alone, in one affection at least, it becomes important, by drawing attention to the state of the patient. In phthisis, it is very frequently the first, and for a long time the only distinct symptom, and should lead to inquiries concerning the hereditary predisposition of the patient, as to whether he has lost flesh, has had hemoptisis or pains in the chest, and it particularly calls for an examination of his lungs by percussion and auscultation. The suspension or cessation of cough in the latter stages of pulmonary affections attended with copious expectoration is an evil sign, for it shows the patient to be in immediate danger of suffocation from the secretions which then accumulate in the bronchial tubes.

Expectoration—Expuition, or spitting, is the act of discharging saliva, or other matters, from the mouth; *hawking* consists in forcing them from the throat into the mouth; and *expectoration*, in expelling the solid or liquid contents of the air-passages. *Sputa* are the substances rejected by these acts combined. The term expectoration is commonly used to include both of the other acts. It is quite as frequently, but much more erroneously, employed as synonymous with sputa, as in the phrases, purulent, mucous, and bloody "expectoration," instead of expectoration of pus, mucus, and blood.

The present subject may be conveniently studied under two heads; first, the act of expectoration; and second, the matters expectorated, or sputa. Expectoration is nearly always produced by coughing, although, as has been shown, there may be cough without sputa. A sensation, capable of exciting cough, is produced at some point in the air-passages, the opening of the glottis contracts, and the air in the lungs is forced along the bronchial tubes, carrying with it the mucus or whatever else obstructs its passage, which it throws into the posterior fauces and mouth. On other occasions, as when profuse pulmonary hemorrhage occurs, or an abscess or aneurism breaks into the air tubes, a portion of the fluid is rejected by the simple compression of the lungs during expiration; when no more can escape in this manner, coughing comes on, and expels the remainder. This explanation of the mechanism of expectoration affords a reason for the difficulty with which the act is performed under certain circumstances. Thus, in capillary bronchitis, œdema of the lungs, and other affections where the offending substance occupies the ultimate ramifications of the bronchia, the cough is hard, and continues for some time before the successive compressions of the lungs succeed in forcing forward the mucus, &c., to a point where the air can act upon and propel them towards the fauces. The same explanation applies equally to cases in which the secretion into the bronchia is very scanty, and to those where it is profuse; for in the one the substance to be removed does not present a sufficient surface to the current of air in which it is placed, as in the first stage of nearly all pulmonary affections; and in the other the mass to be removed is out of proportion to the volume of air which acts upon it. This latter difficulty is greatly enhanced when the patient is already weak, and cannot, either instinctively or by an effort of the will, contract the expiratory muscles of the chest with sufficient energy. The want of this power is a frequent cause of death in old persons, in debilitating fevers, in apoplexy, &c.; although, at the same time, the power of living seems far from extinct in the rest of the organism, the lungs fill up with mucus, the cough grows feebler, and at last ceases, and the tracheal rattle announces that but a few moments more of life remain. The difficulty of expectoration may be explained in like manner, when the secretions are so tenacious as to adhere firmly to the bronchia, and resist the action of the air. Such is the case in suffocative catarrh, in the first stages of simple bronchitis, in pneumonia also, and when, as in the chronic bronchitis which complicates emphysema, the secretion is at once viscid and profuse.

The Sputa.—In thoracic diseases, the matters expectorated are various in quantity, form, colour, consistence, smell, and composition, and offer numerous points of interest to the student of semeiology.

The sputa are scanty, as before remarked, in the forming stage of nearly all pulmonary complaints; yet occasionally, some of these complaints may run their course, even to a fatal termination, without expectoration. This has been noticed in phthisis and in pneumonia; in the latter disease, occurring as a complication of typhoid fever, the exhaustion of the patient sometimes deprives him of the power to expectorate. In other cases, again, of primitive pneumonia, the sputa have been entirely wanting.

Setting aside the cases noticed in which the air tubes have merely served as channels for the escape of the contents of an abscess, &c., the sputa are much more *copious* in chronic than in acute pulmonary disorders, and most of all in those affecting the bronchia themselves. In the disease called bronchorrhea, quarts of a watery fluid may be voided in the course of a day; and in chronic bronchitis, with dilatation of the bronchia, an almost equal quantity of muco-purulent matter. Occasionally, when there is a large tuberculous cavity in a lung, it alternately fills and empties itself, sometimes discharging suddenly a stream of pus. It should be borne in mind, that many persons past the meridian of life, expectorate most profusely, without their health in any manner suffering from this apparent waste; on the contrary, they are never so well as when the discharge is plentiful and free.

The *form* of sputa depends a good deal upon their consistence. When very firm, they are apt to exhibit ragged edges in the spittoon, and when viscid and gelatinous, as they usually are in pneumonia, they form in the vessel a homogeneous semitransparent mass, resembling the white of egg, which is often so tenacious as to retain its hold, even when the vessel is inverted. Frothy sputa, formed by the thorough admixture of mucus and air, and floating on a somewhat viscid liquid, belong to the febrile stage of bronchitis, to emphysema, and pulmonary œdema. Nummular sputa, so called from their fancied resemblance to a piece of money (*nummus*), are opaque, regularly rounded, with sharp edges, and do not run together. They are most frequently met with in pulmonary consumption, but are not exclusively characteristic of that disease; they are quite as uniformly produced by the bronchitis which accompanies measles, and sometimes occur in cases of simple chronic bronchitis. A form of sputa, which is indeed rare, but, when it exists, of much greater value as a sign of pulmonary tubercles, consists in little yellowish or whitish masses, bearing a strong resemblance to grains of boiled rice, and which swim in a turbid and watery mucus. These bodies are, in reality, tubercles, and must be carefully distinguished from others which closely resemble them, yellowish, cheesy masses, extremely fœtid when crushed, and which consist of the accumulated and putrid secretion of the crypts in the tonsils and about the root of the tongue. Small, compact, and very white sputa are seldom observed, except in chronic inflammation of the larynx. Sputa vary greatly in their *consistence*. The thinnest of all are the *serous*, which are met with in most cases of commencing catarrh, in pulmonary emphysema, and in congestion of the lungs produced by disease of the heart. Ordinary *mucous* sputa, such as accompany acute bronchitis, are somewhat more tenacious, and during the decline of this affection, much more so; they acquire their greatest degree of tenacity in the second stage of pneumonia and capillary bronchitis. Unmixed *purulent* sputa are rarely met with, except from the discharge of an abscess into the air tubes; in some cases of chronic bronchitis, and of large cavities in the lungs, they are nearly pure, and in all these affections, they approach more or less to the creamy consistence of pus derived from ordinary sources.

The *odour* of the sputa expectorated in acute bronchitis and commencing phthisis, is, generally, faint or sweetish, and during the decline of the former complaint, they acquire a sickening smell. In chronic catarrh, particularly when pus is expectorated, in advanced consumption, and in ulcerative laryngitis, they are usually somewhat fœtid. They have a decidedly alliaceous odour when a fistulous opening allows the contents of the pleura to escape through the lung, and an intolerably putrid smell in gangrene of the lung. This horribly offensive character has sometimes been observed in bronchitis, with dilatation of the air-tubes and purulent sputa.

The *colour* of the sputa is not without value as an element of diagnosis. At the commencement of most thoracic diseases, they are whitish, and assume peculiar characters at a later stage. Thus, in bronchitis, as it tends towards resolution, they generally become greenish, and at the same time more homogeneous and opaque. During the height of pneumonia they grow tenacious, semi-transparent, and of a rusty colour, caused by the admixture of altered blood; but, at a more advanced stage, they lose their viscidity, and resemble, in colour and consistence, tobacco juice. In phthisis they are whitish, and marked upon the surface by threads of a more opaque substance, which have been compared to filaments of vermicelli. Dark-coloured sputa are observed, also, in gangrene of the lung; their dependence upon this cause is inferred from the accompanying fœtor, and the prostration of the patient's strength.

The *composition* of sputa offers numerous varieties, arising chiefly from the intermixture, in various proportions, of mucus, pus, serum, and blood. The circumstances under which the first three of these substances are rejected, have been summarily pointed out. Expectoration of pure blood, or of blood mixed with the pulmonary secretions, is by no means an unfailing sign of consumption. Blood may be discharged from the lungs under various circumstances. It may be a simple exhalation from the bronchial mucous membrane, in consequence of the suppression of a sanguineous discharge, as of the menses, hemorrhoids, epistaxis, &c., or from plethora alone, as in the adolescent of both sexes; it may take place during the early stages of phthisis, before there is any destruction of tissue, or from the rupture of a vessel left bare by the evacuation of a tuberculous cavity, but the latter mode is extremely rare; it may depend upon pulmonary apoplexy, laryngeal hemorrhage, or the congestion of the lungs, produced by valvular disease of the heart; it may arise from the opening of an aneurism into the air-passages, in which case it is usually much more profuse than in the vast majority of phthisical cases. Hemorrhage from the stomach, nose, fauces, and mouth, has been confounded with hæmoptysis, from which, however, it may be readily distinguished by a careful inquiry into the particulars of the individual case.

Besides the fluids just mentioned, other substances are occasionally expectorated. Such are the plugs and shreds of fibrin which are discharged in some cases of suffocating catarrh, and in croup. Their rejection, it is evident, is favourable to the recovery of the patient. In rare instances, small masses of calcareous matter are expectorated, which, it is probable, consist of transformed tuberculous matter. In the course of laryngeal phthisis, which is nearly always either tuberculous or syphilitic, portions of necrosed bone are sometimes discharged, which are fragments either of the os hyoides, or of the ossified cartilages of the larynx. The sputa have sometimes an urinous smell, which may proceed from suppression of the renal function, or, more rarely, from the actual presence of urine in the pulmonary discharge. The following case illustrates the latter statement. In 1840, there was a sailor in the Pennsylvania Hospital who had long suffered from stricture of the urethra. He was attacked with inflammation of the bladder; the acute symptoms of the complaint were relieved, but the urine continued to present a muco-purulent sediment. Subsequently, pain began to be felt in the left lumbar region, where, also, a tumour developed itself. Then pleurisy of the left side came on, with extreme dyspnœa. About this time a profuse discharge of pus having *an urinous smell* took place from the mouth; hectic fever then sat in, and the patient gradually sank. On examination of his body after death, there was found to be a continuous passage from the bladder to the mouth, by means of the ureter, kidney, a fistulous communication between a large renal abscess and the lung, and finally the bronchia and trachea. Another patient in the same institution had received a gun-shot wound in the right hypochondrium. In course of time, there was a sudden and copious expectoration of pus, followed by that of a small quantity of *bile*, and the latter substance continued for many days to appear in the sputa. This patient entirely recovered.

The mode in which the sputa are discharged, taken in connexion with their qualities, assists in determining their source. When they are formed in the mouth, they are mucous, transparent, and abundant, and are generally due to inflammation of the mucous membrane, or of the follicles, of this cavity. They are fœtid in mercurial salivation and in necrosis of the palatine bones, and both offensive and tinged with blood in scurvy and gangrene of the mouth. They may either stream from the lips without any effort on the part of the patient, or be rejected by the mere act of spitting. When the sputa proceed from the posterior fauces, their expulsion is effected by the act of hawking, accompanied sometimes with snuffling, by which the contents of the nostrils are drawn into the throat. Sputa from this source are generally composed of ropy mucus, as in acute inflammation of the tonsils or pharynx; or of pure, but stinking pus, as when an abscess of the tonsil opens, or of streaks of pus, as in the ulcerative form of chronic pharyngitis; or of fœtid and sometimes bloody pus, as in ozæna; or of false membranes, as in pseudo-membranous pharyngitis.

Sputa from laryngeal affections are generally small, mucous, purulent, or streaked with blood, according to the nature of the disease. They are expelled by coughing, but by a short, quick cough, which speedily removes the offending substance, and is accompanied with a feeling of soreness or burning in the larynx. The voice is generally rendered less husky and hoarse by each act of laryngeal expectoration. Cough from laryngeal disease, when there are no sputa to expel, is usually severe and constant. Sputa which proceed from the lungs themselves, are nearly always more abundant and individually larger than those last mentioned, and they are accompanied with more energetic coughing, in which the whole thorax takes part.

One variety of *pain* in the thorax has already been described as a soreness around the base of the chest, due to violent coughing; and another, the stitch in the side, experienced in acute pleurisy. This pleuritic pain is felt in nearly all cases of pneumonia, because, in fact, the pleura is inflamed as well as the tissue proper of the lung. Its usual seat is about the region of the nipple. In phthisis, there is usually a lancinating pain in the chest, felt more frequently between the shoulders and below the clavicle, than elsewhere. It has been ascribed to the circumscribed pleurisy which is so generally excited by the presence of tubercles in the upper lobe of the lung, the ordinary seat of these bodies. In some cases of this disease the pain is decidedly neuralgic.

SECTION II.

PHYSICAL SIGNS IN DISEASES OF THE RESPIRATORY APPARATUS.

In a previous chapter, the methods employed for detecting, during life, the various physical alterations to which the organs are subject, have been sufficiently detailed; the signs derived from inspection of the chest have also been pointed out in their appropriate place. There only remains now to be considered the application of percussion and auscultation to diseases of the lungs; a subject which, from the accuracy and value of the practical information it includes, deserves the most thorough investigation by every medical man, and will be presented in the following pages with as much completeness as the prescribed limits of the work will allow.

Of percussion in diseases of the lungs.—It has before been stated, that mere resonance or dulness of any part of the chest, is of no positive value in diagnosis, but only the degree of either as compared with the natural resonance of that part. Thus, in the region lying along the spinal column, the ribs have but little elasticity, and are covered by thick muscles; while in that bordering on the sternum, there is scarcely any muscular development, and the elasticity of the ribs is very great. Here, then, are two points, of which one is naturally dull, and the other naturally resonant on percussion. In like manner, every other part of the chest has a degree of resonance, which it is necessary to be acquainted with in order to draw correct inferences from the results of percussion in disease.

Here it may be mentioned, that the cavity occupied by the lungs is not wholly bounded by the ribs, but that the summit of the lungs rises behind the inner end of the clavicles, to the distance of an inch or even more; a fact of much importance relatively to the first physical signs of pulmonary tubercles, but one not sufficiently regarded. The inner portions of both lungs converge, and usually come into contact (two thin layers of pleura only intervening), just behind the junction of the first and second bones of the sternum, and lie side by side as low as the junction of the fourth costal cartilages with the sternum. The sternal margin of the right lung continues almost vertically downwards to about the anterior end of the sixth rib, where it is joined nearly at a right angle by the inferior margin. The inner margin of the left lung passes obliquely outwards from the fourth rib around the præcordial region, and descends about an inch lower than the lung of the opposite side. The inferior posterior bounds of both lungs are just behind the junctions of the twelfth ribs with the vertebræ, and pass directly outwards and forwards.*

Within these limits there are many degrees of resonance or percussion, according to the thickness of the thoracic parietes, and of the tissue of the lung beneath the point percussed. The following summary, of which the principal points are derived from MM. Barth and Roger's Treatise, will be found a sufficient guide in practice:—

Anterior regions.—Above the clavicle, particularly above its sternal extremity, upon this bone, and between it and the fourth rib, the sound on percussion is clear; but in the mammary region, particularly in fat persons, it loses something of its clearness. On

* Mr. Sibson; op. cit.

the *left* side, the sound becomes dull in the præcordial region, below which it regains the proper pulmonary resonance, until the seventh rib is reached, where the tympanitic sound of the stomach takes its place. On the *right* side, the sound is clear from the neck to the sixth or seventh rib, where it becomes considerably duller, and the resistance increases, from the presence of the liver. The upper third of the sternum gives a clear sound on percussion; the lower two-thirds are dull.

Lateral regions.—The axillary portions are very resonant, and the parts below them somewhat less so, as the liver is approached upon the right, and the spleen upon the left side, except when the stomach is distended with gas. In that case, the sound is more intense than the pulmonary, and becomes tympanitic.

Posterior regions.—Directly above the spine of the scapula, percussion yields a dull sound; and below this limit, one that is somewhat less dull. Below the scapula, again, the sound is generally clear; and most so along the line formed by the angles of the ribs, until the limits of the liver and spleen are reached upon the two sides respectively. The dulness on the right side begins a little higher up than on the left, in consequence of the bulk of the liver. In the space on either side of the spinal column, the sound is tolerably clear, but gradually diminishes towards the lower part of the chest.

Besides these regional varieties in the clearness of the sound, there are others, depending upon the age of the patient and the condition of the thorax. In old persons of spare habit, it is very marked; in young children, still more so; and, as a general rule, the more capacious the chest, and the thinner its walls, the louder is the sound elicited by percussion. During complete expiration, the sound is decidedly duller than when the chest is fully distended with air.

Percussion of the chest, in disease, shows that the sound is either louder or duller than natural, or has acquired an unnatural tone. Increased loudness may be either general or local. The former, as a morbid change, is rarely observed upon both sides of the chest; never, perhaps, except in general pulmonary emphysema, and in emphysema of the walls of the chest. But even then there is a difference in the resistance of the two sides. Loud resonance is usually confined to one side, and its most striking degree is owing to the distention of the pleural cavity with air, in consequence of a tuberculous perforation of the lung. Yet, in this case, the tympanitic or drum-like resonance, does not often occupy the whole side of the chest; because, in phthisical subjects, a portion only of the pleural cavity is left free when adhesións have taken place between the pulmonary and costal pleuræ. In pulmonary emphysema, the whole of one lung may be more resonant than the other, but not equally so in every part; it nearly always affords a clearer sound about the junction of the ribs with their cartilages, than elsewhere, but at no point so loud a sound as that obtained in pneumothorax.

Local increase in loudness of sound is observed in pulmonary emphysema, and usually at the points indicated in the last paragraph. The extent of the resonance corresponds to that of the dilatation of the air-cells which constitutes the disease. When large cavities are formed in the lung, and near its surface, (conditions which seldom exist except in the superior lobes,) percussion of the chest above them produces a loud and clear sound which is almost tympanitic. A similar sound has occasionally been noticed in the same region when a serous effusion occupied the pleural cavity below this level.

Diminished sound on percussion, is a much more ordinary symptom of the thoracic disease than augmented resonance, and, like it, may be either general or partial, that is, may extend to the whole of one side of the chest, or to a part only of one or both sides. Avenbrugger, the inventor of percussion, pointed out the value of this sign so clearly that little remained for his successors but to illustrate the general proposition laid down by him. "If," says he, "at a point of the thorax which is naturally resonant when struck with a certain force, equally forcible percussion elicit an obscure sound, there is disease at that point; and if the sound produced be absolutely dull, like that from striking a muscular part, the disease occupies the whole extent of this dull space. If, then, the patient is directed to take a full inspiration, and on percussion being made while he holds his breath, the dulness is found to continue, the disease extends deeply into the chest."

Diminution of clearness is often met with in percussion of the thorax, although there may be no morbid condition present, but only increased thickness of the parietes from adipose or muscular development. This case is easily recognised by the sounds being equally obscure upon both sides. Serous or purulent infiltration, and cancerous degeneration of the walls of the chest, may diminish its resonance in the parts where these affections exist, and the suspension of the respiratory movements of one side in consequence of muscular rheumatism, or other local painful disorder, by causing the corresponding lung to receive less air than the opposite one, diminishes to some extent its resonance on percussion.

Dulness on percussion is the ordinary sign of pleuritic effusions. If the amount of fluid is considerable, the absence of sonorous sound is complete, and the finger used as a pleximeter perceives that the natural elasticity of the chest no longer exists. This dulness is first perceived at the lowest point of the thoracic cavity, (which is at its side,) and, as the effusion increases, the dulness extends upwards. The superior boundary of this zone is not, as might be supposed, a horizontal line, but one curving upwards, and the highest point of which is in the line of the axilla. The dulness is always greatest towards the base of the chest when the effusion is only partial, but in some instances it occupies the whole space where, naturally, the pulmonary sound exists, showing that the entire cavity of the pleura is filled with fluid. Generally, in acute pleurisy, and always in hydrothorax, the level of the liquid, and consequently the line of dulness, is changed whenever the posture of the patient is altered; in both of these diseases, also, when the effusion is very considerable, the organs bordering upon the lungs may be thrust from their places. The heart in effusions of the left pleura may, as before mentioned, be thrust to the opposite side of the sternum, and in those of the right side, the liver may encroach considerably upon the cavity of the abdomen.

Dulness depending upon augmented density of the pulmonary tissue undergoes no change, whatever the posture of the patient may be; it is not so perfect as that resulting from an effused liquid, nor, in general, so accurately limited, but, usually in more than one direction from the point where it is most distinct, it gradually diminishes until lost in the normal pulmonary sound. It very seldom exists over the whole of one side of the chest. Hepatization of the lung and tuberculous deposits are its ordinary causes. When due to the former, it corresponds, in a large majority of cases, to the posterior part of one lung, whence it may extend laterally and anteriorly. In a small proportion of instances it commences in, and is confined to, the superior lobe. In hypostatic pneumonia, or that which accompanies low fevers, and is due to the patient's lying constantly in the supine position, the dulness occupies both sides of the chest behind, from its base half-way, or further, towards its summit. In tuberculization, on the other hand, the dulness is generally first perceived in the neighbourhood of the clavicles, or above the spine of the scapula, and often upon both sides at once.

It was stated above, that increased resonance is sometimes met with when a large cavity exists at the summit of the lung, and the walls of the chest are thin. Under these circumstances, also, two sounds having *special characters*, or rather two varieties of the same sound, are yielded by percussion. The one is simply a somewhat metallic tone, which is attributed to the presence of liquid as well as air in the cavity; the other resembles the sound produced by striking a cracked porcelain or metallic vessel, and "is most closely imitated by the sound resulting from striking the back of the hands, loosely folded across each other, against the knee, the contained air being forced out quickly and abundantly between the fingers at each blow." To produce this sound by percussion, the cavity must be superficial, have flexible walls, and contain both air and liquid. It is, however, a sign of little value, and can often be elicited in thin, but healthy persons, by striking upon the clavicle while the mouth is open.

It must be apparent, from the preceding remarks, that percussion reveals but one symptom, furnishes but one element of diagnosis. Although that symptom is often of paramount importance, yet it is but a single one, and rarely, if ever, is of itself sufficient for determining the nature of the disease. The knowledge derived from percussion is limited to one of the three following cases: either the particular region of the chest examined preserves its natural sonorousness, proving that the parts beneath it retain their proper density; or it is more resonant than natural, and the subjacent parts have undergone a change diminishing their density; or it yields a dull sound, showing that a denser substance than natural receives the impulse of percussion. If the resonance is increased, it still remains to be inquired whether the air which produces it is contained in the lungs, as in emphysema, or in the pleural cavity, as in pneumothorax. If dulness exists, other means must be employed in order to discover whether it depends upon effusion into the subcutaneous cellular tissue; on false membranes, or on serous or purulent effusion into the cavity of the pleura; or on pneumonia, pulmonary congestion, or infiltration of the lung with serum, or with tuberculous, or cancerous matter. Percussion, in this case, merely shows when a comparatively dense body occupies the place which in health is occupied by a substance of inferior density. Auscultation, and the general symptoms, must determine what that body is, and how it affects the general system. The nature of the disease being thus ascertained, the *extent* of the structural alteration, as determined by percussion, comes in to form an element in the prognosis of the case.

Of auscultation in diseases of the lungs.—When the ear is applied directly, or through the medium of a stethoscope, to the chest of a healthy individual, there is heard, during inspiration, a soft and mellow murmur, which is called *vesicular*, because supposed to be produced by the entrance of air into the pulmonary vesicles. This sound is most distinct where the walls of the chest are thinnest, and the vesicular structure predominates, as in the axilla and the lower part of the chest, both in front and behind. At these points, no sound is audible during expiration, but a slight murmur may be perceived in the neighbourhood of the larger bronchia, at the root of the lungs, above the spine of the scapula, (especially on the right side,) and in some cases, immediately below the clavicle of the same side, as was first pointed out by Dr. Gerhard. Both the inspiratory and expiratory sounds are louder in children than in adults, and, in the former, have a peculiar shrillness of tone, which has received the name of *puerile* respiration. The character of the inspiratory murmur varies in different parts of the chest; as already stated, it is mellow in the parenchymatous structure, over the larger bronchia it is less prolonged and gentle, and over the trachea and larynx it is decidedly blowing. This blowing laryngeal sound is so loud as to be propagated to a certain distance along the air-passages, but is not, as some have maintained, the origin of the murmur called vesicular.

Many considerations might be adduced to demonstrate this proposition; but let one suffice. A case which the writer had the good fortune to witness, in Paris, in 1837, and which was reported by M. Barth, seems decisive in regard to the cause of the vesicular murmur. A man had disease of the larynx, and was in imminent danger of suffocation. His trachea was opened, and a canula introduced through the wound, enabling him to breathe freely. Before the operation, the laryngeal sounds were so loud that they could be heard at some distance from the patient, while no respiratory murmur could be detected in any part of the chest whatever. As soon as the patient began to breathe through the canula, the vesicular murmur became perfectly audible throughout the chest, and had precisely the same tone as in health, although the sounds heard in the trachea, and generated by the passage of air through the silver tube, were quite different from those naturally produced in the larynx. This case appears to render it certain, that the vesicular murmur is independent of the sounds formed in the larynx and trachea, and that the essential condition for its production is the free entrance of air into the lungs. It must, however, be borne in mind, that when a portion of the lung becomes solidified by disease, it acquires an increased power of conducting sound, and may transmit to the ear tracheal and bronchial murmurs at points where, in health, they are wholly inaudible.

We shall have occasion frequently to refer to the facility with which sounds, generated in the interior of the lung, are transmitted to the surface of the chest, when the intervening substance is denser than natural. It is true that this phenomenon is, in a great measure, due to the superior power possessed by dense bodies of conducting sound; but it is also, in part, owing to the circumstance that the bronchial tubes enter into vibration more readily when they are surrounded by an uniform and comparatively dense substance, than when the vesicular structure remains normal; that is to say, when it is composed of two substances, air and flaccid pulmonary tissue, which are not consonant in their vibrations, and are, beside subdivided as to break up and destroy the original vibration occurring in the bronchia. A compressed, or solidified lung, therefore, gives the parietes of the bronchial tubes an increased power of vibrating in consonance with the air contained within them, whether this latter be thrown into agitation by the act of inspiration, or by the voice, or other sounds generated in the larynx. Two causes, then, may be assigned for the augmented resonance of intra-thoracic sounds in the cases alluded to; first, that more sound is actually generated in the bronchia; and, secondly, a better conducting medium than natural conveys it to the ear of the auscultator.

In the further discussion of pulmonary auscultation, will be considered; 1st, the modifications of the natural respiratory sounds in *loudness*, *rhythm*, and *quality;* 2d, The sounds which may be combined with these or supersede them, called *rhonchi;* and 3d, The sounds termed by Dr. Walshe "adventitious," including the voice, cough, &c.

Modifications of the natural respiratory murmurs.—These murmurs may be abnormally strong, or feeble, or altogether suppressed. *Strong*, *loud*, or *puerile* respiration appears to be due to the entrance of air in more than usual quantity, or with unusual force, into the pulmonary cells; for whatever increases the action of the whole, or any part of the lungs, gives to the vesicular murmur more or less of the puerile character. When unwonted activity of the respiration is owing to excitement of the nervous, or circulatory system, the puerile sound is audible over the whole of both sides of the chest; when heard throughout one side only, it usually depends upon a serous effusion in the opposite pleura compressing the lung; or upon serous, bloody, fibrinous, or tubercular infiltration in that lung, or some other cause capable of preventing the free access of air into its vesicles, and consequently imposing additional labour upon the sound one. In like manner, such compression or infiltration of a portion of one lung induces puerile respiration in its remaining parts. Hence, exaggeration of the respiratory murmur at one point, indicates that another portion of the lung has been deprived of its function, and suggests a further inquiry as to the seat and nature of the thus indicated lesion.

Feeble respiration is a symptom of frequent occurrence, and of great importance in thoracic disease. It may be due, either to original faintness of the respiratory murmur, or to the difficulty this sound has in traversing the walls of the chest. The first of these cases exists either when the expansion of the chest is imperfect, when disease of the larynx impedes the admission of air into the lungs, or when a portion of the cellular structure is occupied by a solid or liquid. In the two former instances the feebleness is general, and in the last it is local. The respiratory murmur is prevented from reaching the ear when the thickness of the external integuments is very great, and also when a serous effusion, or other accidental production within the chest, intervenes between the lungs and the ear. In the case of serous effusion, however, the vesicular murmur is actually fainter than natural, because the lung is under compression, unless indeed, the effusion is very moderate; in which case it is, of course, confined to the lowest part of the chest. False membranes lining the pleura have a similar effect. The respiration is extremely feeble in vesicular emphysema, probably because the walls of the cells are too rigid to collapse and expand with the movements of the thorax, and therefore not in a condition to generate sonorous currents of air, as the healthy vesicles must do. One of the earliest signs of tuberculous deposits in the lung is local feebleness of respiration; for these foreign bodies fill up some of the cells, and compress the adjacent ones. Cancerous growths of the lung itself produce the same effect, and when such tumours in the mediastinum, or aneurisms of the great vessels, compress the trachea or the larger bronchia, the respiratory sounds are more or less diminished, according to the position of the tumour and the degree of pressure it exerts. Pressure upon the lungs from below, as in enlargements of the liver and abdominal dropsy, diminishes the vesicular murmur.

In all of these cases, while the vesicular murmur may be extremely faint, other sounds are heard in its stead, and particularly that of bronchial respiration. But, it sometimes happens, that when the ear is applied to the chest, nothing whatever is heard; all the respiratory sounds are *suppressed.* The conditions requisite to produce this result are of the same nature as those just enumerated; but they are of a higher degree, and, instead of merely enfeebling the vesicular and bronchial murmurs, suppress both of them completely.

The diagnosis of thoracic disease can be aided greatly by considering the circumstances under which feeble respiration occurs. When detected about the base of the thorax, and apparently remote from the ear, while dulness on percussion exists at the same point, it indicates pleuritic effusion. Heard over the whole of one side of the chest, with natural resonance on percussion, and a stitch in the side, but without fever or cough, it generally depends upon rheumatism of the thoracic muscles. Existing upon one side, along with elevation of the ribs, and a tympanitic sound on percussion, it is a sign of pneumothorax. When it prevails over the entire thorax, with dyspnœa, while the resonance on percussion remains natural, there is an obstacle to the passage of the air through the larynx or trachea. If it is partial and temporary, accompanied with mucous rhonchus, and superseded by the natural respiratory sound after coughing, it is due to bronchitis. When it exists over a considerable space, on one or both sides of the chest, and especially about the anterior extremities of the true ribs—when, too, it is accompanied with sibilant rhonchus, projection of the intercostal spaces, and augmented resonance on percussion—it is unquestionably produced by emphysema of the lungs. At the summit of one or both lungs, feebleness of respiration, with diminished resonance on percussion, is a strong evidence of the existence of crude tubercles at these points.

The *rhythm* of the respiratory sounds may be affected by changes in their frequency, regularity, and duration, both absolute and relative. The last of these points is the only one to be considered here, the others having already been discussed. Of the alterations in the relative length of inspiration and expiration, the only important one is *prolonged expiration.* In a perfectly healthy condition of the lung, little or no sound accompanies the expiratory act, except over the larger bronchial tubes; but in proportion as the lung is rendered more dense by disease, the expiratory murmur becomes gradually more and more distinct, so as to mask the murmur of inspiration, which indeed grows feebler as the other becomes developed. The existence and the semeiological value of this important symptom, were first established by the late Dr. Jackson, of Boston, who proved that when, from any cause, the pulmonary tissue acquires a greater density than natural, prolonged expiration is audible before the blowing sound of bronchial inspiration can be perceived. However this may be explained, and no satisfactory explanation has yet been proposed, the fact is now universally admitted. Its most valuable application is in cases of commencing phthisis. Although it is true that, at the summit of the *right* lung, a slight expiratory murmur may be heard in the majority of cases, yet if this be prolonged, and loud enough to mask the sound of inspiration, there is reason to apprehend that *tubercles* are developed at that point, and the suspicion acquires augmented gravity, if there is also diminished resonance at the sternal end of the clavicle. These signs are much more certainly indicative of pulmonary consumption, if they are found at the summit of the *left* lung, because, at this point, there is scarcely ever the least expiratory sound in health.

The *quality* of the respiratory sounds may be altered. They are still, indeed, heard, but their tone is different, for they are no longer generated in the vesicular structure exclusively if at all, but chiefly or altogether in the bronchial tubes, or in a cavity resulting from disease. These alterations have received the names of harsh, bronchial, cavernous, and amphoric respiration.

"In *harsh* respiration," says Dr. Walshe, "both murmurs have lost their natural softness; a peculiar dryness accompanies them; the breezy character of health is exchanged for one sharper and more blowing, which is generally more marked in expiration than inspiration." It is a lower grade of bronchial respiration, and the anatomical conditions essential to producing it, are the same in kind, but not in degree. When mucus in the finer bronchia, or tubercles in the parenchyma, or any similar cause, partially cuts off the entrance of air into the vesicles, the natural respiratory murmur is not wholly suppressed, but is mingled with the rougher bronchial sound, which reaches the ear all the more readily that the lung has become denser. Harsh respiration is heard over the greater part of the chest, accompanied with more or less sibilant rhonchus, during the early stages of bronchitis ; over the posterior and lower part of the chest, and attended with fever, in the commencing stage of pneumonia ; along the free margin of the lungs, with increased resonance of this region on percussion, in vesicular emphysema ; under one or both clavicles, with prolonged expiration, resonance of the voice, and dulness on percussion, in the forming stage of pulmonary consumption.

Bronchial respiration, which, with the two following varieties, may be comprised under the general head of *blowing* respiration, is so called because it takes place in the bronchial tubes alone, the parenchyma of the part where it is heard being quite inaccessible to air. A very correct idea of this sound may be obtained by breathing to and fro through the half-closed hand. It is heard both in expiration and inspiration, and is generally loudest in the former, in which, also, it is earliest manifested. Bronchial respiration may be heard at any part of the chest, but is commonly most distinct at the root of the lungs, and wherever the air-tubes are largest and most superficial. It varies greatly in tone, being sometimes merely harsh, and in other cases almost of a metallic character. This difference depends chiefly upon the greater and more uniform density of the parts intervening between the ear and the bronchia where the sound is generated.

Bronchial respiration is met with in numerous diseases of the chest, especially pneumonia, phthisis, pulmonary apoplexy and œdema, pleuritic effusions, dilatation of the bronchia, and, occasionally, in cancer of the lung. It is most strongly marked in lobar pneumonia, during the stage of hepatization ; and its degree, and the space in which it is audible, depend on the completeness and extent of the solidification. Hence, in lobular pneumonia, this sign is often wanting. It is also an ordinary symptom of pleuritic effusion, but not so constantly as of pneumonia ; for in the former disease the lung is compressed, its bronchial tubes virtually obliterated in great part, and its tissue is not so solid, and, consequently, not so good a conductor of sound as that of a hepatized lung. It is also prevented from coming in contact with the walls of the chest by the effusion, which thus, by adding to the number of media, impairs the transmissibility of the sound. Moreover, bronchial respiration may be very distinct at the commencement of a case of pleurisy, but grow fainter as the effusion increases, and at last cease to be heard altogether, if the effusion be very great. The character and coincident circumstances of bronchial respiration, in the two diseases, are different. In pneumonia it is loud, sharp, and close to the ear, and is heard throughout the whole space which is dull on percussion. In pleurisy it is heard chiefly at the root of the lung, while dulness exists over, perhaps, the lower half or two-thirds of the lung; and if heard elsewhere, it is always feeblest where the dulness is most decided. Finally, the tone of the pleuritic blowing-sound, has a certain feebleness and meagreness, very different from the sonorous character of that belonging to pneumonia.

The modified respiration in question is frequently met with in the crude stage of pulmonary tubercles, or a little later, but seldom elsewhere than at the summit of the lung, where the tubercular deposit is abundant enough to fulfil the conditions for its production. If this sound be heard at the summit of the lung, when there is no evidence of pneumonia, it affords ground for a just suspicion of tubercles; if the part be also dull on percussion, the presumption gains in strength; and if, in addition, there be heard a humid crepitus, there is no longer room for doubt.

Cavernous respiration is an exaggeration of the bronchial variety, which may be imitated by breathing forcibly into the hands half closed, and held over the nose and mouth. It is heard when a large and superficial cavity in the lung containing little or no liquid communicates freely with the large bronchial tube. Such cavities must, of course, in a vast majority of cases, be the result of the softening and discharge of tuberculous masses, and are therefore of most frequent occurrence in the upper lobes of the lungs. Hence bronchial respiration is generally heard near the clavicle, in the axilla, or above the spine of the scapula, and as it cannot take place unless the cavity is nearly or quite empty, it is suspended whenever the secretion accumulates, and may therefore be heard one day and cease on the next, or be superseded by cavernous gurgling. This sound is also occasionally heard when portions of the pulmonary tissue have been destroyed by gangrene, or pneumonic abscess, or when a bronchial tube is so dilated as to form a globular cavity. Besides other characteristic signs of these affections, the fact that they are seldom seated near the summit of the lung suffices to distinguish them from tuberculous cavities; and, on the other, hand, when these latter are detected in the middle or lower part of the lungs, the upper portion nearly always presents the physical signs of tubercles, while the general symptoms pretty clearly reveal the state of the patient.

Amphoric is another form of blowing respiration, and is so called from its resemblance to the sound produced by blowing with moderate force into a narrow-necked bottle (*amphora*). It has a more metallic tone than cavernous respiration, and sometimes even acquires a marked silvery character, which, when once heard, is not easily forgotten. Whenever it exists, it supersedes the vesicular murmur entirely, and is generally audible during the whole period of inspiration. Like the last described sound, it frequently ceases to be heard for several hours or days together. Like that sound, too, it arises from the vibration of air in a large and empty cavity, and its loudness is proportioned to the size of the cavity and the force of the respiration. It exists, but in an imperfect manner, when there is a large tuberculous or other cavity in the lungs; it is only heard in perfection when there is a perforation of the lung opening into the pleural cavity. In the former case there is more or less dulness on percussion over the comparatively restricted space within which amphoric respiration is audible; in the latter, this sound pervades nearly the whole of one side of the chest, and is everywhere accompanied with tympanitic resonance on percussion.

The Rhonchi.—This word, which, in the singular, means snorting or snoring, is used to designate certain morbid sounds in the lungs, some of which partake of this character. The French employ the word *râle*, or rattle, for the same purpose. The rhonchi are sounds which accompany, or rather take the place of, the normal sounds of respiration, and are generated by the vibration of air in the bronchia or pulmonary vesicles, in consequence of the displacement of the liquids contained therein, or the partial obstruction of their calibre. Various classifications of these sounds have been proposed. The following is probably, for the present purpose, sufficiently complete.

Dry Rhonchi.	Sibilant.
	Sonorous.
Humid Rhonchi.	Crepitant,
	Sub-crepitant.
	Gurgling.

This general division, into dry and humid, is founded on the fact that the latter naturally suggest the idea of their being due to the movement of liquids, while the former want this character.

The *sibilant* and *sonorous* rhonchi, although differing in character, are produced under circumstances so nearly identical, that they may very properly be regarded as varieties of the same sound. The former is the more acute of the two, and has a whistling tone, or resembles the chirping of a bird, the cooing of a dove, or the clicking sound of a valve. The latter is of a graver note, and often sounds like snoring. The two forms occur together, or alternate with one another, and accompany either inspiration or expiration, or both. The sonorous variety, in particular, is sometimes loud enough to be heard at some distance, and in that case produces a vibratory tremour, which can be readily perceived upon applying the hand to the chest. The dry rhonchi are generally audible over a considerable space, nearly always on both sides of the chest, and most distinctly upon its posterior surface. They are commonly ascribed to the swelling of the mucous membrane of the bronchia, or to the presence upon its surface of a certain quantity of tenacious and adhesive mucus, which the passage of air through the bronchia throws into vibration.

These rhonchi are most usually heard when the bronchial secretion is scanty, especially in the forming stage of acute bronchitis, and in that chronic variety of the disease to which the subjects of emphysema are so liable in wet and cold weather. In the latter disease the sonorous rhonchus is peculiarly distinct and loud, and has a marked wheezing character.

The *crepitant* rhonchus is composed of a multitude of little, sharp, crackling sounds, precisely like those produced by gently rubbing a lock of hair between the thumb and finger, near the ear. It is audible during inspiration alone, and, when once established, remains unchanged by cough or expectoration, until superseded by some other rhonchus. At the lower and posterior part of the chest it is heard most frequently and distinctly, and rarely upon more than one side at the same time. The mechanism of this sound is not well understood, but of all the theories proposed for its explanation that of Dr. E. A. Carr, of Canandaigua, N. Y., and that of Dr. Walshe, of London, are the only ones which unite strong probabilities in their favour. According to both of these gentlemen the crepitation in question is produced by the forcible expansion of the pulmonary tissue, and the sudden separation of the glutinous particles with which it is filled. This act Dr. Walshe represents as taking place in the parenchyma around, and immediately contiguous to, the pulmonary vesicles; but as it is difficult to conceive how such a process could generate sound where no air exists, and as it is well known that the crepitant soon merges into the sub-crepitant rhonchus, which all admit takes place in the minute ramifications of the bronchia, we fully adopt the opinion of Dr. Carr, which is, that the crepitant rhonchus is formed in the vesicles themselves. The first effect of pneumonic inflammation, in which disease the crepitus in question is chiefly heard, is to inspissate the mucus secreted in the radicles of the bronchia, and to fill the parenchyma with fibrin, thus augmenting the volume and density of the lung, and compressing the vesicles. The sides of these bodies being thus brought nearly into contact, every inspiration tends to separate them, and as the tenacious mucus which glues them together yields, the sound in question is produced.

Crepitant rhonchus is the almost unfailing index of pneumonia in its forming stage, although it is occasionally observed in capillary bronchitis, and in œdema and congestion of the lung; but, in these affections, it lacks somewhat of the fineness and dryness which characterize it in the first mentioned disease. In pneumonia it is followed by bronchial respiration, due to the hepatized state of the lung, and when resolution of this state commences, the crepitus once more becomes audible, but with altered characters. In fact it has then the qualities of the form next to be described, to wit:

The *sub-crepitant* rhonchus.—This sound is also known as the *mucous* rhonchus, a faulty appellation, since it is produced by blood and pus, as well as by mucus. Like the crepitant, it consists of a succession of crackling sounds, which approach rather to bubbling, and its different degrees suggest the idea of its being formed by the explosion of smaller or larger bubbles. They have been aptly compared to the sounds made by blowing into soap-suds with tubes of different diameters. The sub-crepitant rhonchus is most abundant when the quantity of liquid in the bronchia is greatest, and loudest in proportion to the size of the tubes where it is generated, and the force of the respiration; whence it is inferred to be produced by the passage of air to and fro through the liquids contained in the bronchial tubes. It is audible both in inspiration and expiration, is sometimes permanent, and sometimes temporarily suspended, particularly by cough and expectoration, and generally occupies the posterior and lower portion of both lungs.

The sub-crepitant rhonchus is a sign of bronchitis, and succeeds the sonorous and sibilant rhonchi heard at the outset of this complaint. Beginning at the lower part of the lungs, it may gradually rise higher and higher, until it reaches the upper lobes, but it continues to be most abundant near the base. Its "bubbles" are finest when the ultimate ramifications of the bronchia are involved, as in capillary bronchitis; they have their most ordinary character in the tubes of medium size; and in the largest, or when the bronchia are dilated, and the liquid copious, the crepitus becomes so coarse as frequently to pass into gurgling.

It has been stated that the sub-crepitant rhonchus is generally confined to the lower lobes of the lungs, or is, at least, most abundant there. Sometimes, however, it is limited to the upper lobes; but this never occurs in simple inflammatory bronchitis,—it is always an evidence that some local irritating cause exists, and that cause is almost uniformly tubercles, tubercles in a state of softening, and forming numerous small cavities. The rhonchus in question arising from this cause is most frequently confined to one side of the chest, but even when it exists on both sides, the case cannot be confounded with one of ordinary bronchitis, because the crepitus is most abundant, not towards the base, but in the upper half of the lungs.

Hemorrhage of the lungs also gives rise to the sub-crepitant rhonchus, and, if auscultation be resorted to at the moment of the attack, the exact point where the effusion has occurred may sometimes be discovered. A little later, the blood becoming more diffused through the bronchia, the sound no longer leads to so exact a diagnosis.

Gurgling.—The characters of this sound, described by many authors as *cavernous* rhonchus, are well indicated by its name. It consists of irregular, coarse, and humid " bubbles," few in number, and generally associated with cavernous respiration. It is this combination which forms its distinctive character. It is audible in inspiration, or expiration, or in both, and is loud in proportion to the size of the cavity where it originates, and the quantity of liquid therein contained. Sometimes it is loud enough to be distinctly perceived by the patient himself, and even by his attendants. After copious expectoration it ceases, and cavernous respiration is alone heard in its place; or it may be suspended, without this substitution, in consequence, probably, of the orifice of the cavity becoming temporarily closed, but in that case it is renewed by coughing. In most cases it exists only in the upper half of one or both lungs. Cavities in the lungs, whether due to suppuration, or to gangrenous, apoplectic, or tuberculous softening, equally give rise to this sound; but since tuberculous degeneration is infinitely more frequent than either of the remaining diseases, the detection of gurgling should always be regarded as *primâ facie* evidence of a tuberculous cavity. Sometimes a portion of the bronchia becomes so inordinately dilated as to possess all the physical attributes of a cavity in the pulmonary parenchyma, and to generate gurgling. There are no auscultatory signs by which these two conditions can be distinguished with certainty; their diagnosis must be based principally upon the general state of the patient, which is rarely so threatening in dilatation of the bronchia as in phthisis during the stage of softening.

Auscultation of the voice.—This method of physical examination renders important aid in the diagnosis of thoracic diseases. The hand applied to the chest of a healthy person, while speaking, perceives a distinct vibration; when the ear is applied in a similar manner, not only is the vibration of the walls of the chest perceptible, but also a buzzing and diffused sound, where the vesicular structure is most abundant; a more sonorous, louder, and clearer sound, over the large bronchial tubes; and, over the trachea, a reverberation of articulate syllables. These sounds become fainter towards the periphery of the lungs, for they are all formed in the larynx, and constitute the *resonance of the voice.* It is most distinct where the external coverings of the chest are thinnest, and, as mentioned, where the air-tubes are most capacious. Hence it is louder than elsewhere in the axilla, in the space between the scapulæ, and at the summit of the lungs, both before and behind, but on the right more than on the left side, because of the greater size of the bronchial tubes in the former region.

The natural resonance of the voice varies in different individuals, depending, not only on the physical condition of the chest, but also upon the quality of the voice. Thus, other things being equal, the voice resounds but feebly when the chest is deep and capacious; but persons thus formed, have usually a strong, sonorous voice, which more than compensates for the impediments to its vibration, presented by largely developed lungs, and thick muscular, or fatty layers upon the exterior of the thorax. A weak voice, or one of high key, resounds but slightly through the chest, even when its walls are thin, and its capacity small. So that, in general, the natural vocal resonance is loud in the male sex, but weak in the female, and in persons of both sexes under the age of puberty. It is also feeble in the old, and in them has a degree of tremulousness or quivering.

In health, the resonance of the voice in the lungs is rarely more than an obscure murmur, varying in note and intensity, but never becoming articulate, or seeming to be generated directly beneath the ear. In disease it has other characters, chiefly depending upon the changes which the lungs and pleura undergo, and which render them better or worse conductors of sound; upon the altered size and shape of the bronchia; the formation of new cavities; and the modifications of the voice itself. As regards mere loudness or feebleness of the voice, no more need be said of their causes than was mentioned in reference to the corresponding qualities of respiration. The more complete the solidity of the lung between the point where the sound originates and the ear, the louder will be the voice; and on the other hand, the more there is of air, or other fluid, in this intervening space, the feebler will the voice be, as in pleurisy, pneumothorax, and emphysema. But, as within certain degrees the natural resonance of the voice varies considerably in loudness, no degree of this quality can be regarded as morbid so long as it exists generally throughout both sides of the chest, whereas a comparatively slight departure from the average intensity of the vocal resonance, occurring on one side only, is a pretty sure indication of disease.

Four varieties of morbid vocal resonance are usually described, to wit, bronchophony, ægophony, pectoriloquy, and amphoric resonance. *Bronchophony* is so called, because it takes place in the bronchia; it consists of the resonance of the voice in these tubes, exaggerated by their dilatation, or the firmness of their walls, or conveyed with unusual distinctness to the ear through a denser and more uniform medium than is afforded by the healthy lung. Sometimes it is loud and clear, like the vibrations of air in a metallic tube, and sometimes has a shrill and quavering tone, resembling that of œgophony. It appears, also, to be formed at some distance from the ear. This sound is most frequently heard over the large bronchial tubes, on the posterior part of the chest; when audible in front, its seat is generally in the subclavicular region. The space in which it is discoverable is often sharply defined, and may be very limited, as when heard beneath the clavicles, or it may be distinct over a large portion of one side of the chest, and especially behind. It is nearly always accompanied with bronchial respiration, and continues to be heard for a longer or shorter time, according to the duration of the disease in which it occurs.

Setting aside dilatation of the bronchia, which it may accompany, and which is to be recognised by the absence of dulness on percussion, and the long continuance of the sound in question without febrile symptoms, bronchophony is a sign that the pulmonary tissue has been rendered abnormally dense by disease. Amongst the diseases producing this effect, the most common are pneumonia, tubercles, and pleurisy. In the first of these, bronchophony generally exists at the posterior and lower part of the lung, is accompanied with fever, and preceded and followed by crepitus; or, if the disease occupy the summit of the lung, the acuteness of the attack, fever, and crepitus will be equally characteristic of pneumonic inflammation. Limited to a small portion of the upper lobe of the lung, and combined with hæmoptysis, a dry cough, progressive emaciation, &c., it indicates tuberculous deposits. In pleurisy, bronchophony is rarely simple, but has generally the ægophonic tone to be presently described; nor does it extend much beyond the root of the lung. In pleuritic cases, therefore, when distinct and extensive, it very probably depends upon a pneumonic or tuberculous complication.

Ægophony, or the goat-like voice (αιξ, αιγος, and φωνῆ) is "a peculiar modification of vocal resonance, distinguished by its tremulous, nasal, and cracked character, suggestive of the bleating of a goat."—(*Walshe.*) It is an unequivocal sign of a moderate pleuritic effusion, of one, that is to say, occupying the lower half, or one third of the pleural cavity. In general, if the effusion be larger or smaller than this, the sound cannot be detected. Hence, it frequently happens, that during an attack of pleurisy, ægophony is audible at some time during the first few days, then ceases as the effusion augments, and returns as it subsides. It is always most distinct about the inferior angle of the scapula, and is rarely heard beyond the region included between a horizontal line drawn at this level and the spine of the scapula, and that only when the patient is sitting or standing; if he is made to lie upon his face, the voice loses its peculiar tone. Like pure bronchophony, it very generally coexists with bronchial respiration. The foregoing facts, as well as several direct experiments, combine to prove that ægophony is due to the vibration of a thin layer of serum interposed between the lung and the walls of the chest, at a point where the large bronchia are superficial. The flattening of these tubes by compression of the lung is supposed to aid in imparting the peculiarity of this variety of vocal resonance.

Pectoriloquy consists in the more or less complete transmission of the articulate voice from the chest to the ear of the observer. To be distinctly heard, the stethoscope must be employed, and then it seems as if the patient were actually speaking through the instrument. A correct notion of this phenomenon is readily obtained by listening to the voice through a stethoscope, one end of which is in contact with the larynx of the speaker. Pectoriloquy is rarely heard in perfection, except where there is a cavity of medium size opening freely into the bronchia, empty, superficial, with dense walls, and adhesions of the lungs to the ribs. Evidently, all of these conditions can seldom be met with in the same case; so that perfect pectoriloquy is of rare occurrence. In its imperfect form, this sign differs but little from bronchophony; yet it should be remembered that the former is heard in a more limited space, is most frequent at the upper and anterior part of the lung, is accompanied with cavernous or amphoric respiration, and preceded by gurgling; while the latter is audible over a larger extent, and, towards the root of the lung, its accompanying respiration is bronchial, and it is associated with mucous rhonchus.

The form of vocal resonance called *amphoric*, resembles the sound produced by speaking into an empty pitcher. It has a monotonous, hollow, and metallic tone, and is not articulate. It indicates an extensive excavation of the lung, or pneumo-thorax; but not necessarily that, in either of these cases, the cavity should communicate with the bronchial tubes.

Auscultation of the cough.—The signs of pulmonary disease derived from this source, are of inferior value to all of those which have been considered in the present chapter. Their chief utility, indeed, consists in their serving to determine the value of the results obtained by percussion, and by auscultation of the respiration and voice. In coughing, both inspiration and expiration are more forcible than natural, and hence the characters of the respiration become more marked during these acts, and rhonchi are sometimes developed, which, previously, were not detected. The last remark is particularly applicable to the discovery of the crepitant rhonchus in the first stage of pneumonia, when a correct diagnosis has a most important bearing upon the treatment to be pursued.

The ear applied to the chest of a healthy individual, while coughing, perceives a dull and confused sound, which is not of a blowing character, but is accompanied with a concussion of the whole chest. Both the sound and shock are most distinct, when the ear is applied over the larger bronchia. Ausculted over the trachea, the cough is hollow and tubular.

Three varieties of pulmonary cough occur in disease: the bronchial, cavernous, and amphoric. *Bronchial* cough is difficult to describe. It has the characters of bronchial respiration, with the harshness and impulse caused by the rapid and forcible passage of the air, and is met with under precisely the same circumstances as the form of respiration mentioned. *Cavernous* cough has a hollow sound, which strikes upon the ear in a peculiar and often painful manner. It is one of the most certain signs of a cavity in the lungs. *Amphoric* cough only differs from the last by its metallic tone. It occurs under the same circumstances as the vocal resonance of the same name.

Metallic tinkling.—There is another auscultatory sign of thoracic disease which, under certain circumstances, may be heard along with movements of the chest, whether occasioned by respiration, coughing, speaking, or a mere change of the patient's posture. It is called *metallic tinkling*, from its possessing a silvery tone, like that produced by striking a metallic or porcelain vessel with any small steel instrument, or letting fall into it a grain of sand. The conditions essential to its production are a large cavity containing both liquid and air, and a commotion of the contents of this cavity. These conditions are fulfilled in pneumo-hydro-thorax, with or without a perforation of the lung, and also in very large cavities in the lung containing liquid and air, and opening freely into the bronchia. It is thought that, in the latter class of cases, it is necessary for the opening of the bronchial tube to be beneath the level of the liquid. The mechanism of this sound is not well ascertained. Laennec regarded it as the effect either of the agitation of the air above the level of the liquid, or of the fall upon the surface of this latter, of a drop from the upper part of the cavity.

Others have supposed that the air entering the liquid from the bronchium, or disengaged from it by the movements of the chest, forms bubbles, which, in bursting upon the surface of the liquid, produce the sound in question. Dr. Williams considers this curious phenomenon to be due merely to the reverberation of sound, however caused, within the cavity. Although, as hinted above, this sound is reported to have been heard in close cavities, yet, certainly, in the great majority of cases, it is a sign not only of pneumo-thorax, but of this disease with a fistulous opening between the pleura and the bronchia.

Pleural friction sound.—In a healthy state, the opposite and well-lubricated surfaces of the pleura glide noiselessly over one another; but when their smoothness is impaired, their movements give rise to a sound which varies a good deal in character, but is sufficiently described by the names of its several forms, to wit: the grazing, rubbing, grating, and creaking sounds. It is heard most frequently during inspiration; sometimes during inspiration and expiration also, but seldom with expiration alone. It is most frequently heard at the sides of the chest, where the movement of the ribs is greatest, and rarely over a large space. The harsher forms of the friction-sound are not only very distinct to the ear, at the point where they are heard, but are also accompanied with a vibration of the chest, which can be readily felt with the hand, and of which the patient is often sensible. Like the exocardial friction-sound, that generated in the pleura is due to the attrition of layers of false membranes lining the pleura. The more rugged and dry they are, the harsher will be the sound resulting from their friction. Hence, in the early stage of acute pleurisy, the friction-sound is delicate, because the exudation is soft. It is also of short duration, because serum soon separates the opposite surfaces of the pleura. But when the serous effusion has been so far absorbed as once more to allow attrition to take place, the friction-sound returns, (provided that the movements of the lung are still free,) and has then, in most cases, a rougher and louder sound, which is audible during inspiration and expiration. As a sign of the progress of pleurisy towards cure, the occurrence of this sound, under the circumstances last mentioned, affords ground for a favourable prognosis.

Auscultation of the Larynx and Trachea.—Many of the sounds produced in the larynx are audible at a distance, and do not require the application of the stethoscope for their detection. Among these are the rasping sound of simple laryngitis, the wheezing or whistling sound of stridulous laryngitis, croup, œdema of the glottis, and obstruction of the organ by foreign bodies or external pressure; the croaking sound which may attend most of these affections, and which in croup assumes a clangorous tone; and the rattling sound, or laryngeal mucous rhonchus, which is so often a sign of impending dissolution, as to have acquired the name of "death rattle." The chief value of laryngeal auscultation consists in its affording an indication of the point affected. Thus, it is alleged to be capable of showing the exact place where a foreign body has lodged, by the sounds there generated, and also of determining whether the false membrane in croup is confined to the larynx or extends into the trachea. The method, therefore, may prove useful in the former case, by informing the surgeon where he should operate, and in the latter, by influencing the prognosis.

PART IV.

GENERAL MORBID ANATOMY.

CHAPTER I.

THE ORIGIN, PROGRESS, AND VALUE OF MORBID ANATOMY.

Morbid, or pathological anatomy, is that department of medical science which treats of the changes produced by disease in the solids and fluids of the body.

Morbid, like normal anatomy, may be studied from two points of view. It may be regarded either as an independent science, conversant with dead matter alone, and with the numerous abnormal forms assumed by organic texture, as an edifice erected upon the ruins of organization, and without any reference whatever to vital processes;—or it may be looked upon as standing in the same relation to morbid phenomena and actions, as the anatomy of healthy structure does to natural functions. In the latter view alone, does it constitute a branch of medicine, for it is only through the relation indicated that it influences medical doctrine in regard to the seat and nature of diseases, and guides medical practice in effecting their cure.

The science of morbid anatomy is of modern origin, yet its foundations may be said to have been laid by the earliest medical writers; for all of them, with scarcely an exception, refer to changes which they supposed to take place in internal organs, and were led, doubtless, to that assumption by the evident connexion observed by them between structural lesions of external parts and the accompanying symptoms. Thus Hippocrates, or the author of the first book, "*De Morbis*," describes the deposit of tubercles in the lungs, the symptoms occasioned by them while in a crude state, and those which attend the softening and discharge of these bodies. Still, the dissection of the dead was rarely practised by the ancients, and no attempts were made to collate the information derived from this source by later investigators, until the sixteenth century, when the first great work on morbid anatomy, the *Sepulchretum* of *Bonetus*, appeared. Even then, the principal object of research was the *cause of death*, an object, when attained, comparatively barren of instruction; nor was it until a century afterwards, (1772,) that Morgagni announced, and illustrated with all his learning and the splendour of his genius, the proper aim of morbid anatomy. To his work upon the "Causes and Seats of Diseases" the science of medicine is perhaps more indebted, than to any other single agency, for the astonishing progress it has made during the last fifty or sixty years. He first pointed out the connexion of symptoms with lesions, tracing the parallel between the progress of the former and the corresponding changes of structure through all their successive phases, and, with a searching analysis, determined what symptoms and lesions had a real and essential relation to one another, as cause and effect. Since the time of Morgagni, morbid anatomists have been constantly improving upon this system, and labouring, more and more earnestly, to render a knowledge of structural alterations subservient to the grand objects of medical art, diagnosis and therapeutics. When the lesions cognizable by the unaided senses had all been described and classified, the cultivators of morbid anatomy still further enlarged the boundaries of their survey, by employing the microscope; and, not content with tracing out even the minuter forms of disorganization in the solids, they separated the constituents of the blood, and subjected this, as well as the other fluids, to the still more intimate scrutiny of chemical reagents.

It has been objected to such investigations, that the morbid anatomist does nothing towards elucidating disease, but only describes its ravages, and that it would be as reasonable to conjecture the style of a house that had been destroyed by fire, from inspecting its ruins, as to seek a knowledge of disease in the disorganization it has wrought. Such cavils betray a want of due acquaintance with what has been achieved by morbid anatomy, and an imperfect appreciation of what it is capable of effecting. This science not only shows the condition of the diseased organ after its injury has produced death, but the changes which take place therein, from the first moment of its appreciable lesion until it becomes totally unfit to perform its function. This it demonstrates in many acute diseases by means of the various grades of textural change which exist in the same organ, between the part which still retains its healthy qualities and that which has departed most completely from its original condition. In other acute maladies it establishes a relation between lesions and symptoms, by comparing them together in cases which have proved fatal in various stages. Finally, in chronic disorders, which, at different periods of their course, have been suddenly terminated by some accident or intercurrent disease, it exhibits similar gradations of structural alterations, and analogous connexions between them and the attendant symptoms. No one doubts the necessity of following with care every successive change of structure which takes place upon the surface of the body, even when it is admitted to be a merely local manifestation of a disease involving the whole economy, such as gout, rheumatism, syphilis, cancer, eruptive fevers, &c.; it may, therefore, well excite surprise that any should regard the study of internal morbid lesions with indifference or distrust, merely because they are hidden from view, and on that account more difficult of detection. Lesions, whether internal or external, are symptoms, and not the less so because they are themselves the causes of other symptoms: from this very circumstance they acquire a superior importance. If, then, they constitute a part of the phenomena of any disease, to deny that an acquaintance with them is unnecessary in the practice of medicine, is equivalent to asserting that there is no need of understanding a disease, in order to treat it skilfully.

But it is further objected to the cultivation of morbid anatomy, that oftentimes dissection reveals no lesion whatever, capable of explaining either the fatal termination, or the symptoms observed. M. Louis has well remarked, that cases of this sort "are precisely those which prove, in the most evident manner, the indispensable necessity of this branch of science; since if all the viscera had not been examined with scrupulous care, we could not have been certain that there was no serious lesion which would explain both the symptoms and the unfortunate termination of the case." To reject this negative proof would be as unphilosophical as to refrain from studying the symptoms of diseases, because, under certain circumstances, many disorders run through their course in a latent form,—and would involve the injustice of supposing that absolute perfection is claimed for the means now employed to investigate morbid changes. Ten years ago, the anatomical characters of affections, which later examinations of the blood have rendered familiar, were entirely unknown; and it cannot be doubted that methods yet to be devised, will reveal an essential connexion between diseases now called functional, and positive physical lesions.

Since anatomical lesions constitute no less really a part of disease than symptoms, properly so called, it follows that a knowledge of both must render diagnosis much more precise than either one alone. If no other evidence of this proposition were attainable, it would be sufficient to point to the errors of diagnosis which are daily committed, and which are only shown to be errors by the results of *post mortem* examinations. These mistakes, however, fall chiefly under the notice of those who cultivate morbid anatomy, and it may, therefore, be proper to point out some of the other particulars in which this department of science has assisted in perfecting diagnosis.

Morbid anatomy has shown that symptoms are not phenomena grouped by mere accident in a particular manner. It has revealed the links which bind them together, or rather the source from which they flow. No human sagacity could have explained why one group of symptoms attends pneumonia, and another phthisis, unless the physical alterations of the solids and fluids, in each disease, had been ascertained to be different. The discovery of the law which connects symptoms and lesions, led to the minuter study and record of the former, in order to their subsequent comparison with the results of dissection, and their reference to the changes of structure in which they severally originated. As symptoms began to be more carefully recorded, and more severely analyzed, the important truth dawned upon the medical world, that diseases of a very dissimilar nature, although similar in their prominent features, had for centuries been confounded under the same name, and ignorantly subjected to the same treatment. Paralysis, for example, formed a distinct disease; whereas it is now regarded only as a symptom common to various structural lesions of the nervous centres, rupture, inflammation, softening, pressure, &c. Little or no distinction was made between pleurisy and pneumonia, or between the former of these and muscular rheumatism of the chest. All inflammations of the bowels were included under a common name, and the peritoneum supposed to be commonly involved when the mucous membrane of the intestine was affected; whereas it is now known that the serous and mucous tunics of this organ are rarely involved in the same disease. Above all, there was a large class of continued fevers, of which the names of but two or three can still be traced in medical treatises, all of the rest having been found to depend upon inflammation of some one or more organs, and especially of the brain. From these discoveries it resulted that more attention was paid to local symptoms, and consequently to local treatment, while diseases almost ceased to be regarded as entities, as malicious demons which had taken possession of the patient, and began to be viewed as mere modifications of organic structure and vital phenomena, differing only in form, and not essentially, from the growth, acts, and habits of the individual.

In the order of development, the physical methods of exploration could not fail to follow closely upon the localization of disease, since the latter directed attention to the organs which were now recognised by the symptoms as the seats of disease. By these methods, especially in pulmonary and cardiac affections, the physician is enabled, as it were, to see through the body of his patient, and to announce precisely what alteration of structure exists at the point which he examines. Without morbid anatomy, he could never have known that the friction-sound of the heart, or pleura, is a sign of pseudo-membranous exudation; that the harsh valvular murmur continuing after complete convalescence from acute articular rheumatism, is an almost infallible token that the patient will ultimately die of disease of the heart; that dulness on percussion, and harsh respiration under one clavicle, is an almost certain announcement of consumption; that ægophony makes known the existence of an effusion in the pleural cavity; or that palpitation of the heart depends as well upon disorders of the blood and nervous system, as upon organic disease. These are but a few examples of the invaluable additions made by morbid anatomy to medical diagnosis.

The advantages conferred by morbid anatomy upon therapeutics are not less real, although less obvious, than those which have been enumerated; for, if to treat a disease skilfully it must be understood, nothing can be plainer than that every step which is taken towards perfect diagnosis, is one also towards successful treatment. Morbid anatomy not only shows that in some affections there are prominent lesions whose nature it is either to remain stationary or to augment, and consequently dissuades from the employment of any but a palliative treatment in such disorders; it shows that in other disorders a cure can be effected in no other way than by a certain destruction of parts, and the arrangement of those remaining in new relations, and therefore warns the physician against active interference; it proves that, in still other maladies, a certain time must necessarily elapse before the restoration of the injured part to its original condition, and hence accounts for the continuance of certain symptoms, and counsels patience and moderation in the management of the case. Thus, too, it often checks unreasonable and false pretensions to the performance of wonderful cures; for when imperfectly educated physicians assert that they have cured in a few hours a disease in which the morbid anatomical element continues unchanged for several days at the least, there can be no doubt either that the narrators are wanting in good faith, or that they have been mistaken in their diagnosis.

Morbid anatomy not only throws light upon the diagnosis of diseases actually existing, but it reveals the laws which govern the development of diseases, and hence foretells distant and hidden results. The case of valvular transformation, already mentioned, is one in point. Another, and still more striking, illustration of the same truth is afforded by the law of tubercular development discovered by M. Louis, that "if after the age of fifteen years we find tubercles, or gray semi-transparent granulations, in any organ, they exist at the same time, and in a still more advanced stage, in the lungs." Chronic peritonitis, occurring subsequently to the age of puberty, is always tubercular, hence under the law just quoted, that disease is always connected with tubercles in the lungs. Of this fact M. Louis remarks: "I have more than once recognised and announced the existence of phthisis in cases which exhibited all the symptoms of chronic peritonitis, but in which auscultation and percussion did not indicate any appreciable lesion of the parenchyma of the lungs, and even in individuals who did not cough:—a diagnosis which some persons will call presumptuous, which, however, was not so, and which I could not avoid making, without denying the laws of the economy of the disease, the science itself, in fact; for of what does the science consist but of these laws?"

Finally, and not to dwell unduly upon this subject, important though it be, morbid anatomy teaches that as the different textures of the body have different modes of organization and growth, so, also, they are subject to different diseases; so that the same tissue in remote parts of the body is liable to identical morbid alterations. Hence, to know the seat of a disease is also to know its probable course, and the local changes which it will occasion. Everywhere serous membranes secrete fibrin, and tend to form unnatural adhesions; everywhere mucous membranes tend to secrete pus, and to become unnaturally thick, &c.

CHAPTER II.

METHOD OF CONDUCTING POST-MORTEM EXAMINATIONS.

THE almost total neglect of the subject of morbid anatomy in many of the principal schools of the United States, renders necessary some account of the manner of examining dead bodies, in order to profit by their inspection. Not a few, indeed, are "opened," as the phrase is, but seldom, unless some obscurity in the course of the fatal disease, excites the curiosity of the medical attendant, or alarms the fears of surviving friends; and even then it is too commonly the fashion to proceed at once to the presumed seat of the disease, and having detected a supposed sufficient cause of death, to abandon further dissection as useless. It may safely be said that if anatomists in general had contented themselves with such superficial inquiries, the science of morbid anatomy would not yet exist, and that so long as it is thus slightingly prosecuted amongst ourselves, we must be content to hold a very subordinate rank in the medical republic. The cultivation of this department demands unusual devotion, enthusiasm, and perseverance; private practitioners can do little more than contribute an occasional addition to its stores, which must be mainly enriched by physicians attached to public institutions. Even these, if they have not been taught by a competent instructor, must grope long in obscurity, seeing without understanding, and describing much erroneously or imperfectly, and be content, also, to devote many hours of severe and disgusting labour, to obtain a very moderate degree of proficiency. Yet, at no smaller cost than this, can the science of medicine be improved. The following directions may appear superfluous to most of those who have paid attention to the subject, but, if strictly complied with, will probably be found to promote economy of time and labour, and increase the profit to be derived from dissections.

Amongst the assistants present at the dissection, one should be charged with writing down whatever may be dictated by the principal operator, and, in order that the record may be readily referred to, and nothing omitted in the examination, an uniform rule of procedure should be adopted, and all parts of the body thoroughly inspected. The clothing of the operator should be protected by an apron with sleeves, and his hands anointed with oil, which prevents their retaining an unpleasant smell.

The date of the examination is first to be noted, with the time that has elapsed since the patient's death, and the state of the weather, as these circumstances may influence the degree of change occurring subsequent to death. In recording the appearance of the exterior of the body, its degree of emaciation should be stated, and any local tumidity which may exist, particularly of the abdomen, for if this contains air extricated after death, by putrefaction, less confidence must be placed in the changes of colour and consistence of internal organs, as evidences of disease. The limbs generally grow stiff when the body becomes cold, and the joints do not recover their pliancy until putrefaction has commenced; this rigidity is most strongly marked in cold weather, and in the bodies of persons who have died of acute inflammatory diseases. Its degree should be noted. All discolorations of the skin should likewise be recorded, whether such as arise from disease, cutaneous eruptions, wounds, bruises, &c., or those which depend upon the blood gravitating to the part on which the body happens to have lain since death. The latter are most usually found upon the back and sides, and sometimes on the neck, head, and genitals, giving the skin a purplish or marbled appearance, to which the term *sugillation* has been applied. This discoloration is distinguished from ecchymosis by its being confined to the capillary tissue of the skin, while extravasation of blood, from blows received during life, exists in the subcutaneous tissue chiefly. Sugillation is most frequently seen when, from any cause, the blood remains fluid after death, and this happens in malignant febrile diseases, and typhus, after death from lightning, and in extremely hot weather.

If the dissection is intended to be complete, (and in the present description that is taken for granted,) the brain is next to be examined. This is commenced by an incision from ear to ear, over the top of the head, and dissecting these flaps so as to turn them, the one over the face, and the other upon the neck. If it is not intended to preserve the body, an easier method is to make an incision at right angles with the first, and extending from the root of the nose to the occipital protuberance. The calvarium is then removed by sawing through it, as nearly as convenient to the base of the skull, making the incision anterior to the ears form an obtuse angle with that through the occiput, so that when the bone is replaced it may not slip from its position. Great care must be taken that the saw do not wound the soft parts within the skull, an accident which may be prevented by not sawing entirely through the bone at all points, and by using a dull-edged chisel as a lever to complete the removal of the skull-cap.

The dura-mater is then opened by two parallel incisions, one on each side of the middle sinus, and extending from the crista galli to the posterior incision through the skull, after which the grand falx may be removed by detaching its anterior connexion with the ethmoid bone. The condition of the meningeal veins, the amount of fluid in the cavity of the arachnoid, the flatness or proper contour of the convolutions of the brain, the character of the effusion into the pia-mater, the adhesion, if any, of this membrane to the surface of the brain, the existence of tumours or abnormal productions of any kind within the cavity of the cranium, should all be passed in review. The brain is then to be examined by removing successive slices of its substance from above downwards, proceeding cautiously as the ventricles are approached, so that the amount of fluid contained in them may be justly estimated. The colour, consistence, &c., of the cerebral tissue are at the same time to be observed.

At this stage the remainder of the brain may be removed by raising its anterior lobes, cutting through the nervous trunks as they enter their respective foramina in the skull, dividing the tentorium where it is attached to the edges of the petrous bone, the ridges which guard the lateral sinuses, &c., and then introducing a scalpel into the spinal canal, and cutting off the spinal marrow as low down as possible. The central portions of the brain, the cerebellum, and the membranes covering both, should then be minutely examined in every part.

The neck and the great cavities of the trunk are next to be opened. Some anatomists prefer that these should be examined before the cranium, but without assigning any sufficient reasons for their preference. To inspect the pharynx, and its connexion with the larynx, a vertical incision must be made, extending from the mouth to the upper edge of the sternum, and the lower jaw sawn through at its symphysis; or, what answers the purpose equally well, the attachments of the tongue and pharynx to the circuit of the lower jaw, the hard palate, and the base of the skull, divided by an elliptical incision, and the parts drawn out by the hand while they are set free from their posterior and lateral connexions. The mucous membrane of the pharynx, the state of its follicles, that of the epiglottis, of the edges of the laryngeal opening, the vocal chords and the aperture between them, the mucous membrane of the larynx, its cartilages, &c., should be examined after this latter organ has been opened, by a vertical incision passing through the angle of the thyroid cartilage.

To open the thorax and abdomen, the integuments are divided from the top of the sternum to the pubis, and the flaps dissected from the ribs to a line a little beyond that of the junction of the ribs with their cartilages; or, when neatness is not imperative, lateral incisions may be made along the edge of the false ribs to either side of the body. The cartilages are then divided as near their costal articulations as possible, and the attachments of the diaphragm and mediastinum having been severed, the sternum is disarticulated from the clavicles, care being taken not to open the subclavian veins. The lungs and pericardium are in this manner exposed to view.

The heart is first to be examined. The pericardium is slit open, and the quantity, colour, &c., of its fluid contents, if any, the condition of its lining membrane, noted, and the origin of the great vessels observed. The latter are then divided as far as possible from the heart, this organ being drawn gently forwards at the moment, and the characters of the blood which escapes remarked. The finger is then passed into the large arteries to feel if the valves are pliant, and water poured into them to ascertain whether they fulfil their office; a similar procedure should be instituted in the case of the auriculo-ventricular valves. After opening and inspecting the auricles, their capacity, thickness of their walls, condition of their septum, and fibrinous or other contents, the ventricles are conveniently opened by a longitudinal incision, extending from the apex to the outlet of each. This is readily made by introducing one blade of a pair of scissors into the aorta or pulmonary artery, and cutting forwards through the anterior surface of the heart, and parallel to the ventricular septum. The thickness of the walls is to be carefully measured, exclusive of the columnæ carneæ, and at several points between the base and apex; their power of resisting force is likewise to be noted, with the colour, pliability, incompleteness, adhesions, &c., of the valves. It should be remembered that these organs, as well as the lining membrane of the arterial system, when stained with dark blood, soon acquire a vivid colour on being exposed to the air.

After removing the heart, the pleura is examined, and its contents, adhesions, and condition noted. If the case be one in which a perforation of the lung is suspected, the pleural cavities ought, even before dissection of the heart, to be filled with water, and the lungs inflated, when, if there be any aperture upon their surface, the air escaping from it will bubble up through the liquid. In other cases, the most satisfactory mode of examining the lungs is to remove them both, along with the trachea, from the chest, which can be done by dissecting the trachea from its connexions first, and drawing upon it while severing the vessels, &c., about the roots of the lungs. The pulmonary tissue is then felt, to learn whether it crepitates and is permeable to air, or any portion of it is hardened; in the latter case the part should be incised and minutely examined, so as to learn the nature of the substance occasioning the hardness. The bronchia are next laid open to their remotest extremities, by means of probe-pointed scissors; the state of their mucous membrane, and that of the secretion contained in them, their deviation, if any, from the usual diameter, and their communication with cavities, if these exist, are all to be recorded, together with the size, position, contents, and connexions of the latter.

The greater number and complexity of the abdominal organs, render an examination of them somewhat difficult. After ascertaining the condition of every part of the peritoneum, its liquid contents, the general development of the intestinal canal, the condition of the mesenteric glands, the relations of tumours, if any, to the adjacent organs, *in situ*, the next step is to remove the intestinal canal. In order to prevent the escape of its contents, a double ligature is applied at the commencement of the jejunum, and another at the caput coli, and the intestine divided between the two threads at each point, and then an oblique incision being made along the root of the mesentery, the whole of the small intestine, except the duodenum, is at once removed; thus affording room for subsequent operations, and allowing the stomach and colon to be readily taken away. The mesentery is next divided by numerous cuts perpendicular to the bowel; so that this latter, instead of hanging in loops, forms a straight tube. The bowel should be divided longitudinally by the *enterotome*, (or large blunt-pointed scissors, having one blade longer than the other,) *along the attachment of the mesentery*, so as not to cut through the glands, which are, for the most part, seated upon the free side of the intestine. The stomach and colon are to be treated in a corresponding manner; the character of the contents of these cavities is to be particularly noticed; the colour, thickness, and resistance, of their mucous membrane, at different points, carefully tested; search made for ulcerations, enlargement of the secernent follicles and glands; and every deviation from the natural state of the parts accurately described.

The spleen, the biliary organs, with their ducts, the pancreas, the kidneys, ureters, and bladder, and, lastly, the internal organs of generation in the female, are all to be examined; the solid organs by numerous incisions with the scalpel, and the interior of the hollow viscera laid open with probe-pointed scissors, or by the enterotome.

Finally, the spinal marrow is to be inspected. The spinal canal is most conveniently opened by laying bare the spinous processes of the vertebræ in their whole extent, and sawing through on each side the bony bridge from which these processes project. A chisel and mallet perform the work rather more expeditiously, but with greater risk of wounding the parts within the canal. The same method is to be pursued in examining the spinal marrow and its membranes, as was recommended in the case of the encephalon.

The following points should be constantly borne in mind, and noticed, in relation to every organ that is dissected; although, as will be seen, all are not equally applicable to every organ. 1st. The position and connexion of organs, and the morbid deposits which exist upon or within them. 2d. Their dimensions, shape, weight, and density, or degree of hardness. Under this head are included all comparisons to familiar objects, as seeds, eggs, nuts, &c.; a mode of estimation much inferior to that of referring these qualities to known standards of weight, measure, and shape. The form of the surfaces, whether concave or convex, puckered, &c.; of the edges, whether sharp, serrated, indented, &c. 3d. The degree of cohesion possessed by the molecules of an organ; its elasticity and toughness; whether its divided surfaces are smooth, granular, fibrous, or splintered, according as they are torn, broken, or cut; and the degree of adhesion of membranes to subjacent parts. 4th. The colour, polish, and translucence of organs; the colour of their proper tissue, divested of its outer covering; the shade of colour, and whether it resists washing, and the depth to which it extends. It is important to know that a small quantity of diluted blood gives a pale yellowish or greenish tinge to white tissues, which ought not to be, as it often is, mistaken for the hue of jaundice or that of pus. The colour of concentrated bile closely resembles that of thin blood. Putrid blood is of a dirty or raspberry red colour. 5th. The contents of organs, their quantity, colour, viscidity, smell, chemical reaction, and variety; and, 6th, the proportions of the elementary constituents, whether fibrous, cellular, vascular, or the peculiar normal tissue of the organs, with any abnormal or heterologous deposit which may be present.

CHAPTER III.

OF THE CHANGES PRODUCED BY DISEASE IN THE NORMAL CONSTITUENTS OF THE BODY.

The morbid conditions which form the subject of pathological anatomy, are divided into two great classes, one of which comprises all the changes and transformations affecting the solids and fluids of which the body is naturally composed; and the other those morbid deposits and growths which "penetrate amongst the previously existing elements of the body," having a composition and mode of growth different from these latter, and not arising, as was formerly supposed, from a transmutation of the normal tissues. These two classes will be considered in the present and following chapters.

SECTION I.

OF THE BLOOD IN DISEASE.

As all the tissues originate in the blood, and grow by the materials which it furnishes, the morbid relations of this fluid have a primary claim to be examined. It is not uncommon for writers of the present day to speak of the importance now attached to the morbid states of the animal fluids, as indicative of a return to the old humoral pathology; but, in doing so, they confound things essentially different. The humoral pathology adopted in the Hippocratic writings, and servilely followed in succeeding ages, was a pure hypothesis, which, as was stated in another place, assumed that the body was composed of four humours, whose various combinations produced diseases. These combinations were, at the commencement of the seventeenth century, estimated by Sanctorius at eighty thousand! In the last century or two, much, indeed, was said of the acridity and putridity of the blood, and some imperfect notices of the physical changes occurring in that fluid were recorded. But there is little analogy between the views now entertained, concerning the influence of the blood in disease, and those speculative notions which ruled so long in medicine. The ancients not only imagined the humours, but also their qualities and effects. With inquirers of the present day, the subject is simply one of observation, experiment, and induction. If here and there a medical chemist, impelled by the force of genius, and elated by the wonderful results of his favourite science, overleaps the bounds of legitimate reasoning, and wanders in the trackless field of speculation, but few among the more eminent pathologists are tempted to follow his erratic course. The soundest thinkers receive his revelations with distrust. There is in fact a general unwillingness to adopt them as settled principles, until they have been tested by men of large experience in studying and treating disease; by men who regard the animal economy as something more than a machine, and the stomach as something different from a chemical retort; who recognise in it a *vital* chemistry, and vital dynamics, governed by other laws than prevail amongst the instruments of the laboratory and the workshop.

The morbid relations of the blood, investigated in the spirit which alone could lead to valuable results, are still very imperfectly known. MM. Andral and Gavarret, Simon, and MM. Becquerel and Rodier, are indeed almost the only original authorities whom it is profitable to consult upon the composition of the blood in disease, and all of these have published their researches within the last ten years. The memoir of the last-named gentleman, as being the most recent and complete, will be especially referred to in the following pages.

It is difficult to ascertain the composition of perfectly healthy blood, because few persons will submit to be bled without believing themselves sick; and hence the nearest approach to what may be employed as a standard, whereby to judge of the changes of this fluid in disease, is that obtained by the depletion of those who are either suffering from plethora, but otherwise in perfectly good health, or of those who desire to lose blood in the spring, as a measure of precaution against fulness of the circulation. Analyses of the blood of such persons, have shown that there is a striking difference in its composition in the two sexes. The following are the results of MM. Becquerel and Rodier. In 1000 parts there are, on an average, of

	Males.	Females.
Water	779	791·1
Globules	141·1	127·2
Albumen	69·4	70·5
Fibrin	2·2	2·2
Extractive matters and free salts	6·8	7·4
Fatty matters	1·600	1·620

These results differ chiefly from those previously obtained, in the proportions of the globules, of which the average was stated by Andral and others at 127; but this has been attributed, by the writers quoted, to a neglect of the difference between the two sexes; a difference, we repeat, bearing almost exclusively upon the proportion of globules.

Pregnancy, although a physiological condition, induces remarkable changes in the composition of the blood. It has long been known, that a degree of plethora sometimes accompanies this state, which requires, for it is relieved by, depletion. When, however, the blood of pregnant females came to be examined, it was found to be generally impoverished: that is, to contain a diminished proportion of globules. The same observers who determined this fact, also concluded from their experiments in cases of plethora unconnected with pregnancy, that in plethora the proportion of globules is increased, and that the symptoms of the affection depend upon this increase, and not on any augmentation of the mass of the blood, as was previously believed. They found, therefore, the fact, that pregnant females are subject to symptoms of plethora, one of difficult solution. As will be presently shown, the proportion of globules in plethora is *not* increased, and the plethoric symptoms depend upon over-distention of the vessels. This distention may take place under any circumstances of the composition of the blood; and that it does occur in pregnancy, is abundantly proved by the turgidness of the vessels and all the tissues, the headache, disorders of vision, heaviness, vertigo, &c., which sometimes attend it. But when blood is drawn from a pregnant female, it is found that the mean proportion of the globules does not exceed 112·6, and that this change becomes more marked as gestation advances. At the same time, the quantity of fibrin either remains normal, or is slightly augmented. Pregnancy, then, is allied to plethora as well as to anemia. In it these two conditions may actually coexist, if the meaning of the latter is restricted, as it usually is, to a deficiency in the proportion of globules in the blood.

No matter what the disease in which the blood has been examined, this fluid has uniformly been found to undergo some change. The proportion of fibrin varies according to the nature of the disease; but, independently of this condition, certain changes rarely fail to take place. These are, a marked diminution of the globules; one, less in degree, of the albumen of the serum; and an increase of the fatty matters, particularly of the cholesterin. It is not easy to decide whether these alterations of the circulating fluid are owing directly to the disease in every case, or to the diet which, in acute affections, cuts off the supply of nutritive materials, and, by suspending digestion, makes smaller demands upon the liver, and allows the cholesterin to be retained in the blood. In chronic maladies, alterations of the blood take place more slowly, but are, on the other hand, more complete. In either class of disorders, the changes are greatly hastened by depletion; after each bleeding, the blood grows more watery, and its globules are sensibly diminished, but its fibrin undergoes no change. Becquerel and Rodier give the average quantities of the several elements of the blood in persons who had been bled three times. In these cases the proportion of globules fell from 129·2 to 99·2.

The authors just mentioned have established, by their experiments, that the *plethoric condition*, and the symptoms incident to it, are probably the effect of an increase in the mass of the blood, and in nowise of any change in its composition. The average proportion of globules found by them in six cases of well-marked plethora, in males, was 138, or rather less than the normal average. MM. Andral and Gavarret found the average, in thirty-one plethoric persons, (sex not mentioned,) to be 141, or precisely the average for healthy blood obtained by Becquerel and Rodier. If, then, this latter number be admitted to be correct, it is clear that the blood undergoes no change of composition in plethora, and the symptoms of the disorder can only be referred to the excessive quantity contained in the vessels.

By *anemia* is generally meant a condition marked by paleness of the tissues, torpor of the digestive functions, palpitations, dyspnœa, a bellows' murmur in the cervical vessels, &c. In this affection, taking chlorosis as its type, MM. Andral and Gavarret determined that the proportion of globules is considerably below the normal standard. But as in regard to plethora, they fell into the error of attributing the symptoms of the disorder to an excess of globules, so, on the other hand, they equally erred in regarding the phenomena of chlorosis as due to a deficiency of globules alone. There are, in fact, two sorts of cases comprised under the head of anemia. They have in common the anatomical character, deficiency of globules; but in one, the mass of the blood is augmented, and in the other, diminished. The former often accompanies chlorosis; the latter results from frequent and profuse losses of blood, or other fluids of the economy, the slow poisoning of saturnine emanations, protracted intermittent fevers, scanty and unwholesome food, living in dark and ill-ventilated places, and, in general, whatever slowly exhausts the system. In none of these cases, except chlorosis, does plethora occur, but on the contrary, a permanent diminution of the mass of the blood. It was from analyses of the blood of thirty-five chlorotic persons, that MM. Becquerel and Rodier drew the following averages:

Water	824
Globules	94·7
Albumen	68
Fibrin	3·5
Extractive matter and salts	8
Fatty matter	1·806

In every one of these cases depletion was called for by plethoric symptoms, and gave decided relief. It will be observed that in the above table the deficiency of globules is exactly compensated for by the excess of water, the other constituents of the blood remaining nearly unaltered. It is further to be noticed, that the *mean proportion* of globules there given, affords no precise notion of the extreme alterations of this element by disease. There are cases of chlorosis in which the proportion of globules is but little, if at all, depressed. There are others, again, in which it has fallen from 127 to 28, according to MM. Andral and Gavarret. These authors mention a case of excessive metrorrhagia in which the globules formed but 21 out of 1000 parts of blood. Dr. Frick mentions a case of anemia in which the proportion of globules had fallen to 14. The patient was a female, and for three years had laboured under the disease, which followed an attack of malarious fever.*

The *fibrin* of the blood remains unchanged in the affections marked by an altered proportion of globules, yet it is, of all the elements of the blood, the one most frequently modified by disease, because affected by both of the two classes of maladies which are oftener met with than all of the rest united, inflammations and fevers. Inflammation appears to be always productive of an increase in the fibrinous element of the blood, just as the opposite condition, existing in adynamic affections, seems to diminish it. The operation of these antagonizing causes is well seen in typhoid fever complicated with inflammation of the lung. The blood of the patient which, before the appearance of the intercurrent malady, was found deficient in fibrin, and therefore imperfectly coagulable, immediately afterwards shows an excess of this element, and that not only by analysis, but also by the formation of a buffy coat. The average proportion of fibrin in inflammatory diseases may be stated at 6, and the range of this element between 4 and 10½. The degree of its increase is directly proportioned to the extent and activity of the inflammation, and the constitutional reaction, a fact which, as well

* "Of the Relative Proportions of the different organic and inorganic Elements of the Blood, in different diseases. By Charles Frick, M. D., of Baltimore." Am. Jour. of Med. Sci., January, 1848. This excellent paper, which gives a strong impression of its author's industry and skill, we trust is only the forerunner of many original essays by the same, and other American hands, in the rich field of humoral pathology.

as the more general one stated in the preceding sentence, is proved, not only by a comparison of the result in particular cases with the standard proportion, but also by direct analysis of blood taken from the same individual before and after the development of the inflammatory attack. The diseases in which the greatest amount of fibrin has been detected in the blood are pneumonia and acute articular rheumatism. As already mentioned, bleeding does not tend to diminish the proportion of fibrin; hence the relief which so often follows the operation, in acute disorders of an inflammatory type, must be attributed to some other cause than a reduction of this element, which cannot, therefore, as some conjecture, be regarded as the source, but only as a consequence of the accompanying morbid state.

The class of diseases in which the fibrin of the blood falls below the normal standard comprises all of those in which the blood drawn from a vein coagulates imperfectly, or, as was said in former times, is in a state of putridity or dissolution. Of this sort are typhus, typhoid and miasmatic fevers of low grade, including yellow fever and the plague, also contagious febrile diseases such as variola, scarlatina, rubeola, and glanders; together with the state produced by infection of the blood with pus, the matter of dissection, the venom of serpents, &c. In mild cases of such affections the fibrin can scarcely be said to have diminished, but in the more severe, and particularly in those which terminate fatally, the blood shows no disposition whatever to coagulate, and its proportion of fibrin may not exceed one part in a thousand. This alteration of the blood appears to explain the occurrence of hemorrhages, congestions of internal organs, petechiæ, &c., which are so common in the complaints referred to.

Besides the increased proportion of fibrin which all recent observers admit to be characteristic of inflammatory diseases, MM. Becquerel and Rodier have pointed out two other changes which occur in these affections, to wit, diminution of the albumen, and increase of the cholesterin, the latter being usually twice as abundant as in health. The bearing of these facts can, at present, be only conjectured.

The *albumen* of the blood is diminished in granular disease of the kidneys, and dropsy connected with certain diseases of the heart. It is supposed that the escape of alburnen by the kidneys is the cause of the falling off in the proportion of that element of the blood.

The suppression of a secretion is often followed by an accumulation of the essential ingredients of that secretion in the circulating fluid: thus urea and cholesterin are abundant in the blood when they are no longer duly evacuated through the kidneys and liver, but the latter substance appears to be sometimes *generated* in excess, and to abound in the blood, producing general jaundice, while there is at the same time a copious discharge of bile from the bowels.

The peculiarities in the coagulation of blood drawn from a vein have long been regarded as important to be studied; the results of analysis, which have been stated above, aid materially in interpreting these peculiarities. Blood obtained by venesection usually separates into two parts, a disc-shaped mass called the clot or coagulum, and a yellowish serum in which it floats. The process sometimes begins within a minute or two after the blood is drawn, and sometimes not for fifteen or twenty minutes, and is generally attributed to the influence of the atmospheric oxygen. A case lately occurred to the writer in which this contact appeared to determine the coagulation of blood which had remained fluid for several hours. On dissecting the body of a person who had died of the low typhus fever which prevailed during the autumn of 1847, in a district inhabited by the lowest class of negroes, the blood was quite fluid although death had taken place from six to eight hours before, but when allowed to stand in a cup, or in the chest whence the lungs had been removed, it speedily formed a dark and moderately firm coagulum.

The size, shape, and colour of the clot are worthy of attention. It consists chiefly of fibrin, containing more or less serum, and globules. In diseases of a low or adynamic type, the blood coagulates imperfectly, or not at all. If any clot is formed, it is voluminous, extending across the vessel in which the blood is received; its edges are not elevated, it is often very soft and loose, forming a slightly consistent gelatinous mass like currant-jelly, which breaks up at the slightest touch; in extreme cases no true clot is formed, but only a few flocculent coagula. In such blood the principal alteration is deficiency of fibrin, the other elements remaining, for the most part, normal. The clot of inflammatory affections, on the other hand, is usually cupped, tough, and firm, yellow upon the surface, and red towards the bottom, where the globules accumulate. Here the fibrin is in excess, the other elements remaining normal.

From these illustrations it may be inferred that the existence of fibrin in the blood produces its coagulation, and that fibrin forms the yellow or buffy coat of the inflammatory clot. But it has been ascertained that the buffy coat is very far from being the index of inflammation alone, or from constituting an indication for depletion, as was formerly supposed; that it may exist in pregnancy, anemia, and chlorosis, in all conditions, namely, in which there is a deficiency of the globules, while the fibrin remains unchanged. Hence it appears that it is the quantity of fibrin *relatively* to that of the globules, and not the positive quantity of the former, which occasions the buffy coat. The fibrin may even be somewhat in excess, yet, if the globules are abundant, as when slight inflammations attack the plethoric, there will be no buff, but the clot will be broad, thick, moderately firm, and saturated with serum.

It should not, however, be supposed that the presence or absence of the buffy coat *infallibly* shows that any of the above-mentioned relations between the fibrin and globules exist in a given case. The globules, being specifically heavier than the fibrin, subside to the lower part of the clot, and favour the formation of a buffy coat, when coagulation proceeds with only a moderate degree of rapidity. But that degree may not exist in the particular case; causes which cannot be discovered heighten or lessen it; others influence it which are better known. Thus if the blood flows in a small stream, there will be a succession of small coagula, and not one large clot; or if it falls into a cold and shallow vessel, the same blood will have no buffy coat, which, directly afterwards received into a warm bowl, will present a well-marked buff.

The tough, white, and sometimes partially organized coagula which are frequently found in the heart after death, are probably formed before this event; their density, freedom from globules, and their structure, are inconsistent with any other supposition.

Several substances foreign to the blood are occasionally found in it. One of these is *sugar*, which has, however, been detected in one disease only, diabetes mellitus. *Pus* is of more common occurrence in the circulating fluid, and is either generated within the vessels, or enters them from without. Andral found pus globules in the blood in a case of adynamic fever, with numerous abscesses of the solid organs; in another of a wound of the leg, terminating fatally in three days; and in a third of psoas abscess, with purulent collections in both lungs. In the last case, many globules of pus were found in the right, and some in the left ventricle of the heart, showing that they had passed through the lungs. The same pathologist found that fresh pus mingled with blood, in a glass vessel, had no perceptible influence upon it, not even preventing its coagulation; while putrid pus, on the other hand, destroyed in a few hours both the globules and the fibrin of the blood. If decomposed pus, or rather its ammoniacal product, have such an effect when directly mixed with the blood, and if, as is probable, a similar product forms the basis of the deleterious emanations from the bodies of the dead, and of the sick when crowded together, an explanation is afforded of the type assumed by diseases in hospitals, jails, ships, &c., of which the principal anatomical character is fluidity of the blood. So destructive to fibrin is the formation of pus, that an excess of this element in the blood, produced by an abscess with inflammation, will disappear, and the blood lose its power of coagulating, if the contents of the abscess become putrid and infect the system.

Next to alterations in the composition of the blood, the varieties in its *distribution* require consideration. There are several degrees of activity attending the local increase of blood in the vessels. In the lowest, the increase takes place in obedience to merely physical laws; in the next, the blood is determined to a part by a vital power; in a still higher grade, it is not only so determined, but is held there permanently, and produces more or less permanent changes in the structure of the part; these conditions, which are called, respectively, stasis, congestion, and inflammation, will be now summarily reviewed.

Stasis, stagnation, and passive congestion, are synonymous terms, implying that the vessels of a part contain an excess of blood, in consequence either of weakness of the propelling force, or of an obstacle to the exit of blood from the congested organ. It is very apt to occur in states of constitutional debility, during or immediately after attacks of disease, in very young and very old persons, and at a distance from the heart. Its mechanical causes are, 1*st*, the mere weight of the blood, when the circulation is feeble. Hence this cause, along with the partial dissolution of the blood, occasions ecchymoses in dependent parts of the body, during fevers of a low type, and accumulations of blood in the posterior part of the lungs, when feeble persons lie upon the back. It is passive congestion, also, which frequently gives rise to hemorrhoids and varicose veins of the legs, in persons accustomed to sit or stand for a long time together. 2*d*, An obstacle in or near the right side of the heart, preventing the return of the venous blood to that organ, causing distension of the veins, and giving the skin a bluish or purple hue, as in cyanosis. 3*d*, The compression of one or more venous trunks by a tumour or ligature; from this cause varicose veins arise in pregnant females, in whom the uterus compresses the iliac vessels; from this, also, the sense of fulness in the head, injection of the face and eyes, &c., when tight cravats are worn, or an aneurism presses upon the jugular veins; from this, too, when the hepatic circulation is obstructed, hemorrhoids arise.

Congestion, properly so called, *active* congestion, or determination of blood, is a very different condition from the last. It is due immediately to the altered action of the capillaries, and remotely to some vital and, therefore, unintelligible change; while the form just described affects the veins chiefly, and depends wholly on physical or mechanical causes. It is most apt to occur in nervous, feeble, and irritable persons, the mass of whose blood is probably below the normal standard, and in organs the most abundantly supplied with blood-vessels and nerves, and of great functional activity. It takes place in the capillary *rete* or network, where secretion and nutrition are performed, and animal heat is generated; where, in fact, nearly all organic changes, whether natural or morbid, are carried on. This determination of blood forms the first step in the true inflammatory process, and, in a greater or less degree, precedes hypertrophy, atrophy, and many forms of hardening, softening, and transformation of the several tissues. Not that congestion is demonstrable, or can be proved necessary, in every instance of structural lesion, or that its connexion with the lesion produced can always be explained; this process, however, does precede the development of many organic changes, apparently unlike, and even the opposites of one another, and is therefore often assumed to have been present, after the development of the consequences to which it usually gives rise.

Although active congestion depends immediately upon causes existing within the part where it takes place, yet those causes would often remain inoperative, but for the occurrence of passive congestion in the same part. Thus, when cold drives the blood from the surface of the body upon the internal organs, if any one of them is weaker than the rest, it will very probably remain gorged with blood; its functions will at first be impaired, and, after a time, may be completely suspended. Thus, in congestion of the brain, the earliest symptoms may be no more than an unusual throbbing of the carotid and temporal arteries, than an unwonted activity of the senses, a keen perception of light and sound, excitement of the mind, sleeplessness, quickened play of the imagination, and irritability of temper. At a later period, the functions of the brain grow sluggish, the senses are dull, the intellect inert; there is drowsiness, heaviness, and sometimes convulsive disorders.

The consequences of congestion are, hemorrhages, fluxes, dropsies, inflammation, and disorders of nutrition.

Hemorrhage.—Blood cannot escape from the capillaries without their laceration. Supposed exudations of blood are composed of the serous portion, tinged with the colouring matter of this fluid. Effused blood is either coagulated or fluid; it is usually in the latter state, when it proceeds from the capillaries, and in the former, when its source is in the larger vessels. According to Vogel, when blood escapes into the intestinal canal, the fibrin remains fluid, while the albumen is coagulated by the free acid of the gastric juice, and encloses the blood-globules, which lose their red colour, and assume a blackish-brown tint.

The causes of laceration of the vessels, and consequent effusion, are very numerous, and may be referred to several heads: 1st, direct violence; 2d, erosion of the coats of the vessels by caustics, the mortification, suppuration, or softening of tumours, and the softening of the coats themselves, or rather of atheromatous deposits formed within them; 3d, pressure of the blood from within, in consequence of an impediment to the circulation. It is evident that the last-named cause will operate with greater readiness whenever a cause belonging to either of the other classes is already in action.

Effused blood may be entirely removed by absorption, and that very rapidly, provided that it remain fluid. When, however, a clot is formed, the more fluid parts are taken up, and the coagulated fibrin undergoes changes which will be pointed out under the head of inflammation.

The effects of hemorrhage depend upon the quantity of blood which escapes from the vessels. When this is considerable, death may at once ensue, or the functions of the whole system be disordered. In smaller quantity, extravasation of blood produces local injury; the rupture of the fibres of the organ where it takes place, as in apoplexy; the compression of the constituents of an organ, as in pulmonary apoplexy and effusion into the pleura or pericardium; a direct interference with the proper function of an organ, as when the blood fills up the pulmonary vesicles and bronchia, or coagulates in the ureter or urethra, preventing the escape of urine; and, finally, inflammation and its consequences, in the affected part.

Flux, which is regarded as another consequence of congestion, is a superabundant secretion from the skin, the mucous membranes, or from the glands connected with these latter. Such are excessive discharges of mucus, serum, or bloody fluid, (serum dyed with the colouring matter of the blood,) from the bowels; of sweat from the skin; of saliva, bile, or urine, from their respective organs, &c.

Dropsies generally proceed from congestion or inflammation; the more fluid parts of the blood transude through the walls of the vessels, but instead of being discharged externally, accumulate in the several serous cavities of the body, in the cellular tissue, or in accidental membranous sacs, forming encysted dropsies. Mechanical congestion is the most frequent cause of dropsy. It may be produced in the lower extremities (œdema) by the pressure of the uterus in pregnancy, or by surgical bandages and apparatus injudiciously applied; and it has been created artificially in the lower animals, by tying certain of the large venous trunks. So, too, when the liver is contracted, or atrophied, (in cirrhosis,) there is congestion of the abdominal veins, and frequently dropsy. Aneurisms or other tumours, near the heart, may, by compressing the ascending vena cava, produce anasarca, and effusion into the serous cavities of the belly and chest. An analogous state of things occurred in a case reported by Dr. Watson, of London, where the superior vena cava was found obliterated after death. The patient was dropsical only in the upper half of the body. "His arms were so highly anasarcous that he could not bring them near his sides; his neck and face were hideously bloated and exaggerated, and his eyes prominent and staring, while his lower limbs were of their natural size, and looked preposterously out of proportion." But dropsy takes place, not only in consequence of venous congestion, but along with capillary, arterial, or active congestion, and even inflammation. Thus, a person in profuse perspiration, exposed to a cool, moist atmosphere, may rapidly become anasarcous from head to foot; or if he is recovering from scarlatina, may be attacked with ascites; or he may have serous effusion resulting from inflammation of any of the serous membranes. In the present state of our knowledge, there is no means of explaining how these dissimilar causes produce a seemingly identical effect.

The fluid of dropsical effusions is not the same in all cases. Sometimes it contains a large proportion of dissolved fibrin, which, coagulating, forms false membranes in cavities, and an interstitial deposit in parenchymatous organs; sometimes, on the other hand, the fluid is simply serous. The cases of the former kind are nearly all due to inflammation, and constitute the class of *fibrinous* *dropsies*. The effused fluid, as stated, generally coagulates within the body, but it sometimes preserves the liquid form until removed artificially, and then coagulates. This fluid is supposed to be extravasated chiefly by the capillary vessels, while that of *serous dropsy* permeates the walls of the veins almost exclusively. These two forms have been only of late distinguished from one another.

The fluid of dropsy was formerly supposed to be identical with the serum of the blood, but the analyses of MM. Andral and Gavarret have shown the incorrectness of this opinion. In sixteen cases of serous dropsy examined by them, the highest proportion of albumen in the effused liquid was 48, and the lowest 4, the average proportion of serum in the healthy blood being 70. These observers did not find that the *seat* of the effusion made any sensible difference in the proportion of albumen. The state of the constitution, however, influenced it; the less the strength of the patient, the less the albumen, and *vice versa*. Thus in six cases of hydrocele, the subjects of which were all in robust health, the proportion of albumen varied between 35 and 59; and when, in dropsy of the larger cavities, tapping was performed several times, it was found that the quantity of albumen in the fluid evacuated progressively declined. The proportion of water in dropsical effusions was found to vary between 950 and 986, the normal average in the blood being 790. All of the cases of dropsy here alluded to were due to venous congestion from mechanical causes. Had they arisen from inflammation, it is probable that the proportion of coagulable matter in the effused fluid would have been greater; since, as the authors alluded to remark, it is found to be so in the fluid obtained from the skin by vesication.

The preceding statements furnish the positive proof of what has long been alleged, that the blood is impoverished in dropsy, and show that its impoverishment is due to a loss of albumen, and in some cases of fibrin. Confirmatory negative evidence of this proposition is to be found in the fact that a decline in the proportion of neither of the remaining chief constituents of the blood, fibrin or red globules, without that of albumen, ever produces a similar result, for dropsy does not exist either in chlorosis, or in fevers and affections of a typhoid type, except as an unusual complication.

SECTION II.

INFLAMMATION.

There is but little difference between the physical phenomena of active congestion and of inflammation, except that the latter are more complete and permanent. When an irritant is applied to the web of a frog's foot examined under the microscope, the current of the blood through the vessels is at first increased in size, and its movements quickened, but, after a time, there is a slower movement of the blood, and at last its complete stasis. In this experiment, the red globules, which at first are observed to occupy the centre of the vessels alone, and are readily distinguishable from one another, by degrees fill the whole channel, and become so closely aggregated as to form, apparently, a homogeneous mass, in which the individual globules can no longer be distinguished. At this stage exudation takes place; a thin serum first permeates the walls of the vessels, and then one of somewhat greater tenacity, which is known as coagulable lymph, but in its composition and vital properties is identical with fibrin. In this substance, blood-globules gradually form, and open channels, which are new vessels intended for the organization of the recent fibrinous deposit; after which it is either absorbed, transformed, or else converted into pus.

This description, meagre as it is, comprises all of our positive knowledge of the mechanism of inflammation. Of the agents which cause more blood than usual to flow into the part, which regulate the enlargement and constriction of the vessels, which bring on effusion of serum and fibrin, and produce the subsequent changes of this latter, much has been written, very much conjectured, but nothing settled. The microscopical phenomena of inflammation, however, explain satisfactorily those which common observation has determined to belong to this process, at least in parenchymatous structures. There is first, in the inflamed part, an afflux of blood, whence arise redness, slight swelling, and heat, also, because the development of animal heat is directly proportioned to the activity and fulness of the circulation; then hardness, and increased swelling from the effusion of serum and fibrin into the surrounding cellular tissue; a sense of tension, weight, and pain, from the pressure of this effusion, particularly upon the nervous branches enclosed within it. The increased pulsation of the arteries leading directly to the affected part appears due simply to the obstruction of the channels through which blood usually circulates with freedom, while the same, or even an augmented force, continues to impel it.

Serous or fibrinous effusion may, to some extent, be looked upon as a termination of inflammation, because, when copious, the symptoms of reaction subside. The subsequent action of this product depends upon its situation, upon the circumstance of its finding a direct and ready exit from the system, or of its being confined in the cellular tissue, or in serous cavities, constituting various forms of dropsy. In certain situations the effusion is apt to produce serious consequences, as when it is poured into the parenchyma of the lungs, or into the cellular tissue about the glottis, causing suffocation. In general, the more copious and extensive effusions, if due to inflammation at all, are owing to a low grade of this action; very active inflammation, on the other hand, more commonly occasions a deposit of tenacious fibrin within or upon the affected part. Thus slow and moderate inflammation of the peritoneum distends it with a limpid and watery fluid, but after violent and rapidly fatal inflammation this membrane is more commonly dry, or covered with fibrin or pus.

Inflammation presents somewhat different features according to the structure which it attacks. The more important of these modifications are the following. In the *cellular tissue* there is swelling, hardness, diminished cohesiveness, a tendency to limit the action by the formation of abscess, or, according to the peculiarity of the constitution, to perpetuate the effects of that action by a new organization. In the *nervous* tissue, and especially in its great centres, inflammation produces softening and disorganization, sometimes with great rapidity, and sometimes with extreme slowness. In the former case there is usually suppuration; in the latter, a gradual destruction of the part, which may be converted into a sort of paste, or a still thinner fluid. Inflammation of the *arteries* is a cause of gangrene in the parts supplied by them, in consequence of their channels being obstructed with fibrinous concretions. The *veins* when inflamed are sometimes obliterated by adhesion, sometimes they suppurate, or the coagula formed in them are converted into pus, which is carried by the circulation into distant organs, and may there give rise to abscesses, called metastatic. When this event does not take place, the coagula may be gradually removed, or else remain permanently, converting the vessel into a hard cord. The *lymphatic* vessels, or rather the ganglia connected with them, tend, when inflamed, either to suppuration or induration, in which latter state they may remain for an indefinite length of time.

Inflammations of the *skin* form an extensive class of diseases, whose distinguishing features depend upon their being seated in different parts of this extremely complex structure. The minuteness and intimate connexion of its several parts render the study of their morbid alterations extremely difficult. According to M. Cazenave, the simple exanthemata (of Willan and others), are seated in the vascular network of the skin, and are true inflammations, producing, according to circumstances, exfoliation of the cuticle, serous, or purulent effusions, &c. Vesicular eruptions are regarded by M. Cazenave as affecting principally the sudiparous glands; pustular eruptions as seated in the sebaceous or other follicles; papular affections as involving principally the papillary bodies; squamæ as a hypertrophy of the epidermis; and tuberculous affections as a hypertrophy of the fibrous element of the true skin.

Mucous membranes are, more than any others, subject to inflammatory diseases, and present the peculiarities of these affections in a striking manner. Redness is found in them of every shade, from a light rosy tint to a dark brown. This colour is sometimes uniformly diffused over a considerable surface, and sometimes exists in small spots. It is never absent in acute attacks, but is often so in chronic diseases of this system. Its presence is generally inferred, rather than visible, in internal inflammations. It is seen in affections of the conjunctiva, and of the lining membrane of the mouth, pharynx, nostrils, rectum and vagina during life, and in those of the air-passages and intestines after death. In the first stage of inflammation the mucous membrane becomes unusually dry, and unirritating liquids placed upon it are rapidly absorbed. Subsequently an increased quantity of mucus is secreted, and the glands, whose excretory ducts open upon the inflamed surface, bathe it with an unwonted flow of their peculiar fluids. The mucus becomes more tenacious and opaque, and of a whitish or milky, and sometimes of a yellowish or greenish hue, or, if the inflammation is violent, the discharge is streaked with blood, or mingled with pus. As the affection declines, the secretion grows thinner, and of a lighter colour, and either returns to its normal condition, or continues in a chronic form, undiminished in quantity. In some acute mucous inflammations the effusion is fibrinous, and is either thrown off in shreds, as in certain forms of diarrhœa and dysentery, or may, when discharged, preserve the tubular form of the organ in which it was secreted. This latter phenomenon is observed chiefly in pseudo-membranous croup. No satisfactory reason can be assigned why mucous membranes should at one time secrete mucus and at another fibrin.

When a mucous membrane has been long inflamed, it sometimes becomes attenuated, and is readily torn; but, in most instances, it grows thicker, and its surface is uneven, mammillated, and covered with a stratum of tenacious mucus. The opposite surfaces of a canal lined with this membrane never adhere, but it is often reduced in size by effusions of fibrin in the sub-mucous cellular tissue, forming strictures, of which examples are most frequently found in the rectum and urethra. Loss of substance in a mucous membrane, by ulceration, or otherwise, is repaired by a new formation which the cellular tissue beneath furnishes. This new membrane is usually slow to regain the structure and functions of the original tissue, and often, indeed, fails entirely to do so, but remains smooth and compact, like a scar upon the skin. Although ulceration frequently attacks the mucous membrane where it exists in its simplest form, yet the mucous follicles are its most ordinary seat, particularly in the small intestine. Ulcers in this situation are more likely than others to penetrate deeply, and sometimes they pierce even the peritoneal coat. In mucous inflammations, the glandular organs, whose ducts open on the inflamed surface, are very generally affected; their secretion is at first augmented, and subsequently their structure may become involved. Thus, when the mouth is inflamed, the salivary glands secréte an increased quantity of saliva; when the stomach or duodenum is similarly affected, more bile than usual is secreted. Inflammations of the bladder, and urethra, and of the solitary and agminated crypts of the small intestine, are not uncommonly attended with a like condition of the kidneys, testicle, and mesenteric glands, respectively.

Serous membranes, when inflamed, are but slightly, if at all, thickened; their apparent increase of thickness depends, in almost every instance, upon the false membrane which covers them. The sub-serous cellular tissue always participates in their inflammation, and indeed shows the first signs of this process. It becomes inordinately vascular, its meshes are then distended with a serous fluid, some of which penetrates the substance of the investing membrane, causing it to swell slightly, and lose its transparency. Red patches appear here and there upon the free surface of the membrane, extending in every direction, and at last coalesce. The most intense redness has usually been found after a violent and rapid attack of inflammation; in such a case, as before remarked, the membrane is quite dry, and has a sticky feel. More commonly vascular injection is less marked, and the effusion more abundant. The exhaled fluid varies both in kind and quantity. Often it is limpid, and seems composed only of watery serum; after active inflammation it is more generally turbid or milky, holding in suspension shreds of fibrin, or possessing all the characters of thin pus. On other occasions it is nearly gelatinous, and may exist in this form between the layers of the serous membrane. Occasionally it contains blood. Its odour may be fœtid, but is in most cases slightly sweetish or nauseous. In some instances of meningitis, pure pus is effused upon the surface of the membrane, without either serum or fibrin; the same fact has been observed, but more rarely, in pleurisy and peritonitis. The *quantity* of the effusion varies according to the violence of the inflammation and its seat. It is of course less, other things being equal, in the smaller serous cavities, that of the arachnoid for example. In subacute and chronic inflammations its amount is generally greatest.

The effused fibrin, in serous inflammations, is at first soft, in consequence of its containing serum; but the latter is gradually absorbed, while the former becomes more tenacious, and by degrees glues together the opposite surfaces of the membrane, whenever it is interposed between them. Gradually this bond of union grows firmer, and the organ whose movements were originally facilitated by the lubrication of its serous investment, is now impeded in its motions, bound down in one position, and by the contraction of its adventitious covering, forced to occupy a narrower space than before. Thus robbed of its liberty, its functions are liable to be impaired, and the general health of the patient to suffer in proportion to the importance of the affected organ in the economy. The fibrin, thus effused and solidified, usually becomes organized by the extension into its substance of the capillary vessels supplying the membrane beneath it, and it in the end assumes the characters of condensed cellular tissue, or undergoes the further transformations to be pointed out hereafter.

Effusion of fibrin is not always to be deprecated. On the contrary, it sometimes forms the only obstacle to a speedily fatal issue of disease. When the pleura is perforated by the softening of a tubercle, or the peritoneum by an ulcer of the bowels, the rapid effusion of fibrin may close the opening, and prevent further mischief. Such a secretion, as is well known, is excited artificially in attempting the radical cure of hydrocele. By its means, the opposite surfaces of the tunica vaginalis testis become adherent, and the cavity of this sac is obliterated.

In the *fibrous system*, the lesions due to inflammation are not well ascertained. In the sclerotica, for example, besides vascular injection, and perhaps attenuation of the membrane, none others are clearly made out. In the fibrous tissues which form investments for the bones, and connexions between them, thickening, softening, and the secretion of fibrin, which is readily transformed into bony matter, are the principal changes known. The *cartilages* and *fibro-cartilages*, when inflamed, are affected with redness, softening, and erosion. But all of the tissues mentioned in this paragraph, possess a very low degree of vitality, and not unfrequently appear unchanged while the soft parts around them are completely disorganized. Inflammation of the *bones* may be confined to the periosteum, as already noticed, or it may affect the medullary membrane, or finally the osseous structure. In both of the latter cases, there is usually enlargement of the bone, with closure of the medullary canal, ulceration, or necrosis.

SECTION III.

ALTERED NUTRITION.

The process of growth is essentially the same in all organized structures. Even inorganic bodies, to a certain extent, come under the same law. Every solid is originally derived from a fluid. The inorganic by the mere precipitation and amorphous or crystalline accretion of the denser particles contained in the primary fluid; the organic by the generation within this fluid of new substances. In animals this fluid is fibrin. It is effused by the blood-vessels into the parenchyma of every organ, and, according to the influences acting upon it, adds to every tissue in its own kind, or produces substances different from any of the normal tissues.

It is one of the greatest of the many mysteries of life, that a fluid of apparently uniform composition should generate so many distinct and dissimilar products; that from the very same fibrin, muscle should be formed in one place, and in another, brain, bone, or glandular structure. An attempt has been made to explain this wonderful phenomenon, by supposing that parts already formed exert such a control over the fibrinous matter, in contact with them, as to determine the nature of its subsequent product. But this hypothesis is evidently inadequate to explain the original formation of the several tissues, and cannot therefore be accepted to account for their growth; for we are not warranted in assuming different causes to operate in the deposition of the first, and of the second and subsequent particles, of the several tissues.

If the powers which regulate normal nutrition are obscure, those which cause the production of new substances are still more inexplicable. Here, evidently, the supposed influence of already existing particles must be altogether null, since, from the common generative fluid, substances arise differing in every respect from the normal constituents of the body. To explain this inconsistency of the hypothesis above referred to, some pathologists invoke an altered state of the blood. This fluid, say they, has lost its natural composition, and, consequently, the same causes no longer produce on its exudation the same effects as in health. Hence, according to the particular alteration of the blood, cancer is deposited in some cases, and in others, tubercle, &c. But, if this be so, we are entitled to ask, why such deposits do not take place in all parts of the body; for if their formation is owing to an alteration of the blood alone, there appears to be no good reason why they should not be formed indifferently in any or all of the tissues and organs.

Leaving, as unprofitable, any further discussion in regard to the proximate causes of normal and abnormal nutrition, we shall regard it as settled, according to the present state of our knowledge, that in all forms of this process the new product is derived from fibrin exuded by the blood-vessels; from fibrin alone, whenever the product is similar to one of the normal tissues; from fibrin of a modified character, when the product is unlike any of those tissues. The first class of the disorders of nutrition will be treated of in the present chapter. Of these, one of the most common, as well as important, is

Hypertrophy.—This term signifies excessive nutrition. It is, indeed, a process which differs from healthy nutrition only in degree. It consists in the augmentation of one or more of the natural constituents of an organ, in such a manner that the newly formed parts are continuous with those already existing, and cannot be anatomically distinguished from them. Before the cultivation of textural morbid anatomy, it was customary to speak of an organ increased in bulk as *hypertrophied*, without reference to the element especially affected. It must be evident, however, that the latter point is the one really important to be known. To describe the liver as being enlarged or hypertrophied, is of little consequence, unless it be also stated whether its augmented bulk is due to increase of the glandular structure, to sanguineous congestion, or to the deposit of fibrin, fat, tubercle, or some other substance, in the interstitial structure of the organ.

As hypertrophy, in its restricted and proper sense, is only an exaggeration of a natural state, it is impossible to draw a distinct line between that degree of enlargement which does not affect the health, and which has been called physiological, and that which, being greater, engenders disease, and is termed pathological hypertrophy. These terms are merely relative. A heart which is of normal size in a tall and robust man, would be regarded as hypertrophied in a delicate female. An increase of muscle which would only add to the power and grace of a limb, would be a fatal disease, if it took place at the pylorus. Simple hypertrophy, without change of consistence, generally affects the essential part of an organ; the muscles, in the case of the heart; the glandular structure in that of the liver, &c.

Augmented bulk may be accompanied with induration or softening. The former is a frequent consequence of inflammation, and of the organization of exuded fibrin. In that case there is not a true hypertrophy, but an increase of bulk, owing to an adventitious deposit, and in reality an atrophy of the proper tissue of the organ, produced by the pressure of the effused fibrin. Hypertrophy of an organ, when excessive, interferes with adjacent organs by compressing them; thus, by enlargement of the liver the stomach is compressed, and the lungs are unable fully to expand.

Nearly all the tissues are liable to hypertrophy. The muscles of animal life, however much developed, never seem to exceed the physiological limits of relative size; for a corresponding development takes place at the same time in the bones, ligaments, and other accessory parts, by which is preserved that original and just harmony which is the characteristic of health. Excessive nutrition of the muscles of organic life readily assumes a morbid character. Nature has so delicately arranged the internal mechanism of the body, that even a slight increase of size or force in any portion of it may be attended with serious consequences. Of the involuntary muscles, those of the heart are most frequently hypertrophied, occasioning all the results which are attributable to an undue activity of the circulation. Among these the various forms of active hemorrhage are conspicuous. The worst consequences of hypertrophy of the heart are those which result from its complication with valvular disease of the same organ, or with aneurism of one of the large vessels in its neighbourhood.

The muscular coat of the hollow organs is often greatly thickened. That of the bladder sometimes measures nearly half an inch in thickness. This hypertrophy is due to any cause that obstructs the flow of urine, and obliges the bladder to make strong expulsive efforts. The increase of the uterus during gestation, although more apparent than real, (its bulk depending very much upon the fluids it contains,) is nevertheless a real hypertrophy, for it is only in the impregnated state that the arrangement and extent of the muscular fibres of the uterus can be demonstrated. The muscular coat of the stomach, especially around its pyloric orifice, is sometimes considerably thickened in old persons. When this opening is obstructed by cancerous or fibrous tumours, the muscular tissue of the rest of the stomach is remarkably increased.

Enlargement of the glandular organs, in consequence either of a true hypertrophy of the secernent cells, or of an interstitial deposit of fibrin, is of very common occurrence. The liver, the prostate, mammary, lymphatic, and thyroid glands, all present remarkable instances of this phenomenon. Enlargement of the spleen, the ordinary consequence of intermittent fever, depends upon an interstitial effusion of fibrin. The brain itself may grow inordinately. This seems to be usually a congenital affection, or at least to occur at an age when it can hardly be attributed to the influence of external stimuli.

Mucous membranes sometimes become thickened from chronic inflammation; but in general the contraction of canals lined by this tissue is due to a layer of fibrin in the subjacent cellular tissue. The skin is frequently thickened from similar causes. Its several constituents, the derm, the rete, the hair-bulbs, the sebaceous follicles, may each be separately increased. The epidermis, which is a product of secretion, is sometimes changed from a delicate transparent membrane into a hard, yellowish, and opaque substance, which assumes the form of scales, and when thus covering a large part of the body, forms one of the most revolting spectacles that can be conceived.

Physiological hypertrophy often takes place when one of two symmetrical organs has been disabled. This is almost constantly the case in regard to the mammæ, kidneys, and testicles.

Atrophy, or diminished nutrition, is exactly the reverse of the condition just described, but is more generally a morbid operation. Thus, when general, which hypertrophy never is, it surely indicates the presence of disease, except where directly caused by starvation. Any disorder of the digestive apparatus which prevents the food from being properly converted into chyme or chyle, or subsequently opposes the absorption of this latter, must occasion atrophy. Of such causes are chronic inflammation of the intestines, and disease of the mesenteric glands. A more obscure set of causes are those which, either by preventing the deposit of new matter in the tissues, or by giving undue activity to the removal of that which already constitutes them, produces general emaciation. It is probable that both modes of action combine to produce the loss of flesh which attends nearly every acute disease, while the second is especially operative in cases of chronic structural disease, such as tubercle and cancer, which produce a gradual and progressive wasting, even while the appetite and digestion remain unimpaired.

Local atrophy may be said, in general terms, to depend upon a diminished supply of blood. This is clearly the case when the testicle shrinks after ligature of the spermatic artery for varicocele. That the same effect is not so distinctly seen in other organs, is owing to the anastomotic connexions of their vessels, through which they receive an adequate amount of nourishment, after the supply by the principal artery has been cut off. Inaction of a part disposes it to atrophy, just as its over-action inclines it to hypertrophy. The ovaries of females past child-bearing become shrivelled, as do also the testicles of old men. The thymus gland and the renal capsules are subject to the same law; their functions cease at birth, and they soon afterwards waste away. A limb long kept at rest, undergoes partial atrophy, as may be constantly observed in the treatment of injuries of the extremities by surgical apparatus, which prevents or greatly restrains motion. Pressure also induces atrophy, as in the case just mentioned, and in those more numerous ones where an interstitial effusion of fibrin, or of some pseudo-plastic matter, such as tubercle or cancer, compresses the adjacent structure, and suspends its functions.

Induration is an abnormal increase in the consistence of an organ, and may exist under various circumstances. It may be owing merely to a deficiency of blood in a part, in consequence of which its denser particles are more closely aggregated, and therefore offer an increased resistance. Such induration is never strongly marked. Hardening is most frequently a result of inflammation, and is then owing to the deposit and coagulation of fibrin in the affected organ. A familiar example is presented by pneumonia; the hardening of the lung in this disease is called *hepatization*. Often, indeed, the grade of action accompanying this deposit can hardly be called inflammatory; but the result is the same. Thus, in cirrhosis of the liver, the organ is at first enlarged by a fibrinous deposit, which gradually contracts and hardens, rendering the liver hard and tough, and reducing its size. The same thing occurs in Bright's disease of the kidney. Other varieties of interstitial deposit produce induration. There are other instances of this condition which cannot be well explained. The brain, for instance, is sometimes unusually firm, almost as much so as if it had been coagulated by alcohol.

Softening is the opposite of the change last described, and is often due to a cause the contrary of that first mentioned as producing induration, viz.: to a saturation of the tissues with fluid. General softening is seldom met with, except when the blood is deprived of a portion of its fibrin, and is therefore more readily imbibed. This is well illustrated by the state of the organs in typhus fever. Those of them especially, which, during life, were abundantly supplied with blood, show a greatly diminished consistence. The liver and spleen are frequently so soft that they will not bear, without rupture, the handling necessary to remove them from the body. The muscles are all flabby, and oftentimes the heart is unable to retain its form when laid upon the table, and collapses like an empty bag. This form of softening is regarded by some morbid anatomists as a degree of general putrefaction commencing before death. In some acute inflammations of the intestinal canal, its mucous membrane has so little tenacity as to look and feel like an unorganized pulp. The nervous centres, and particularly the brain, are very subject to softening. In the greater number of instances, this change is clearly inflammatory. In others, attended with chronic symptoms, it has been attributed to closure of the arteries supplying the affected part, by which a condition resembling gangrene is produced. But a full investigation of the subject has led to the conclusion, that chronic softening of the brain is preceded by hyperemia, if not by inflammation, strictly so called; and that where obliteration of the arteries coincides with diminished consistence of the cerebral structure, it is the effect and not the cause of the process which results in softening.

Another form of softening is that which takes place in interstitial deposits, whether fibrinous, tuberculous, or cancerous. Suppuration, as will be more fully shown hereafter, is of this sort. In all of the cases comprised in this division, induration precedes softening. The deposit is formed within and around the elementary fibres of the tissues, and sooner or later, upon softening, carries away portions of the affected organs. In some cases, the softening is supposed to depend immediately upon an interruption of the circulation, either by pressure upon the vessels, or by inflammation of their lining membrane, and coagulation of the contained blood.

Inflammatory gangrene is a form of softening. It is produced by extravasated blood, or other fluids, which pass rapidly into a state of decomposition, and become capable of destroying the vitality of the tissues which confine them, and thus produce their discharge from the body.

Transformation of tissues.—By this phrase is meant the conversion of one into another normal tissue. All of the tissues are not equally susceptible of transformation. Cellular or areolar tissue, which is the rudiment or basis of all the rest, may undergo every known variety of this process. It is by the deposit of nutritive matter in this tissue, that all solutions of continuity are repaired, and all lost parts regenerated. But some tissues, it is believed, are never renewed in this manner ; such are the muscular, the nervous, and the glandular. On the other hand, osseous, adipose, and mucous transformations, are very frequent. The laws which regulate them are precisely the same as govern the original development of the tissues in the embryo ; as in the more complex transformations, the process advances through several successively higher grades, so in atrophy, or the degradation of compound organs, the same steps are descended, until nothing of the part is left but rudimentary areolar tissue.

Cartilage, according to many writers, is deposited in the heart and arteries, and is sometimes transformed into perfectly organized bone. This statement is erroneous. The so-called ossification of the valves of the heart and of the arteries, consists in the deposit either of a gelatinous or amorphous semi-cartilaginous substance upon the internal surface of the vessels, or of calcareous matter between its coats. In neither case is true bone formed in these situations.

The skin and mucous membrane appear to be convertible into one another. Whenever two cutaneous surfaces habitually rub against each other, they at length become soft, and secrete a fluid like mucus. This is of frequent occurrence in the groins and between the buttocks of infants, and under the mammæ of very fat females. The mucous membrane of the vagina and rectum when prolapsed, and after long exposure to the air, assumes every character of true skin.

The copious deposit of fat around atrophied organs, the heart for example, is usually cited as an instance of transformation. But here the original tissue is not transformed. It is removed, and its place supplied with adipose matter deposited in the meshes of the areolar tissue.

Cellular tissue is frequently transformed into mucous membrane. All fistulous sores formed in this tissue acquire a mucous lining. The opposite sides of such fistulæ, like those of all mucous canals, are very difficult to unite, so much so, indeed, as frequently to render necessary the destruction of the lining membrane by means of caustic, or the knife, in order to produce their adhesion.

Homologous tumours.—The alterations of nutrition hitherto considered, affect the normal tissues, chiefly by causing the dimensions of the organs to increase or decrease, or by furnishing the means of repairing their injuries; they are not inconsistent with the preservation of the natural shape of the parts where they occur. But the proper organic constituents of the body may be developed in an abnormal form, constituting one of the two great classes of tumours. To the first of these classes, Vogel, (whom we shall mainly follow in the ensuing description,) refers all tumours whose anatomical elements agree with those of the normal body, and which, being once formed, discharge the duties of the normal constituents of the body, take a part in the general metamorphosis of tissue, and are nourished and increased like other parts. They are called homologous (ὅμοιος, resembling), from the resemblance of their constituents to the natural tissues, and also non-malignant, to distinguish them from tumours of the second class, whose elements are essentially morbid, and which are called heterologous (ἕτερος, other) or malignant. This distinction is, nevertheless, in some degree artificial, since there are tumours which partake of the characters of the non-malignant as well as the malignant classes; tumours, which in their origin, and for some time afterwards, contain only tissues analogous to the normal tissues of the body, but, subsequently, in consequence of mechanical injury or some unknown cause, have tubercle, cancer, or some other heterologous substance formed within them.

The tissues of most frequent occurrence in non-malignant tumours, are the cellular, fibrous, muscular, adipose, vascular, cartilaginous, and osseous; and, in the great majority of cases, two or more of these constituents are combined. They grow and are nourished precisely as natural parts, except that their increase is at times very rapid. This circumstance may be attributed to the irritation, and consequent hyperemia, produced by such tumours, in adjacent parts. Their elements are subject to all the transformations which have been described. So long as they retain their original composition they constitute purely local forms of disease, producing no reaction in the economy, and becoming prejudicial to health chiefly through their bulk, and their pressure upon important organs. Their ordinary position exposes them to injury, and their low grade of vitality renders them peculiarly liable to destructive inflammation from such causes.

The following groups of homologous tumours are admitted by Vogel and other late pathological writers.

Vascular tumours.—These are also known as erectile tumours, aneurisms by anastomosis, &c. They are of a red or bluish-red colour, of various forms and sizes, more or less firm, and more or less capable of temporary erection. They generally appear upon the skin, and in the subcutaneous cellular substance. They are often congenital, (hence the name of one variety of them, *nævus maternus*), but may also arise at any period of life, without perceptible cause, or in consequence of mechanical injury. They consist of enlarged capillary vessels; when arteries predominate, the tumours during life exhibit pulsation; and when veins, they present a bluish colour. Vascular tumours which project above the surface of the skin, contain, in addition to enlarged vessels, areolar and fibrous tissue.

Fatty tumours.—These tumours may be composed of fat alone, and they then receive the name of *lipoma;* or the areolar tissue enclosing the fatty particles may be well marked, or even fibrous, in which case a section of the mass resembles a slice of fat bacon. This form is denominated *lardaceous* (*lardum*, Lat.), and also *steatoma* (στεαρ, suet). Sometimes fatty tumours are enveloped in a sheath of areolar tissue forming an imperfect cyst, and serving to connect them with surrounding parts. They are most frequently met with in the subcutaneous tissue of the back, but occasionally upon the face and extremities. They grow rapidly, and often attain a considerable size, weighing as much as twelve, or even twenty-five pounds. According to Vogel, many forms of malignant tumour—as encephaloid—have in their physical properties the greatest similarity to fatty tumours, and can only be distinguished from them by a microscopical examination. The grounds of this diagnosis will be subsequently pointed out.

Fibrous tumours.—Tumours composed chiefly of fibrous tissue are very frequent; they differ in their physical properties according to the stage of development of this tissue, and its combination with other organic elements. Their simpler forms may be divided into three groups, the areolar, the fibrous, and the muscular, according to the predominance of these tissues respectively. They may also be classed with reference to their density. Those in which the fibres are most loosely connected, are called *desmoid*, from their resemblance to the structure of the skin. When more solid, firm, and elastic, and creaking or grating under the knife, they receive the name of *sarcoma;* and when of a still harder texture, almost homogeneous, and of a milk-white colour internally, resembling cartilage, they are termed *chondroid.*

The connexions of fibrous tumours are various. Many of them are, as it were, fused into the surrounding parts, and consist, in reality, of normal fibrous structure in a state of hypertrophy. Others are more or less isolated, and are occasionally as much detached from the surrounding structure as a kernel from its shell. This is remarkably the case when these tumours are seated in the uterus. When developed near either surface of this organ, they are apt to become pediculated, and, when they arise from its internal face, may produce symptoms like those of threatened abortion, until the tumour escapes from the os uteri, where it may still be held by the toughness of its pedicle. On other occasions, the tumour ruptures the lining membrane of the womb, producing hemorrhage and violent expulsive pains.

Most fibrous tumours contain vessels, but some appear to be nourished by deposits from adjacent parts. In some there is a considerable deposit of fat, and in others a partial transformation into cartilaginous tissue may be detected. The tumours under consideration occur in all parts of the body where fibrous tissue abounds; "upon the skin and mucous membrane, in the form of hypertrophy, condylomata, warts, and polypi; on the muscular coat of the intestinal canal, in the muscular tissue of the uterus, and in the ovary; in the cavities of the thorax and abdomen, where they often reach a very considerable size; and in the cavity of the skull, where they frequently arise from the dura mater." They produce disorganization in surrounding parts only by their mechanical irritation. They often become transformed, wholly or partially, into calcareous concretions, improperly called ossifications, and, like other homologous tumours, may be combined with malignant elements. Of their causes, nothing more is known than has been stated in regard to tumours generally.

Cartilaginous Tumours.—Tumours composed chiefly of a tissue resembling cartilage are infrequent, except as connected with the regeneration or the abnormal growth of bones, as in callus and exostoses. In the latter cases, however, their existence is transitory, for they are ultimately converted into true bone. *Echondroma*, as the form of tumours in question is called by Müller, has a closer resemblance to fibro-cartilage than to normal cartilage. It usually appears in the long bones of the hands and feet, "as a rounded, smooth tumour of variable size, enclosed in a bony case, which varies in thickness at different points, and in some is not unfrequently absent." This form arises from the interior of the bones. Another, which is formed upon their surface, chiefly of the flat bones, is covered only with periosteum, and has a less regularly rounded shape. Both of these forms contain osseous particles. A third variety, which contains no bone, is of less frequent occurrence, and has been met with only in glandular parts. It is of very slow growth, and therefore may attain a considerable size without seriously annoying the patient.

Osseous Tumours.—True osseous tumours usually appear in or upon bones or fibrous membranes, and have all the anatomical and chemical characters which distinguish normal bone. Tumours which consist only in part of true osseous substance almost always arise from diseased bone, and usually contain fibrous tissue, vessels, cartilage, fluids enclosed in cysts, or even malignant elements, as encephaloid or tubercle. Their mode of origin and tendencies present nothing peculiar.

Melanotic Tumours.—Melanosis has generally been ranked amongst the heterologous products; but the dark pigmentary matter found in a great variety of situations, and to which this name has been applied, is now alleged to be a merely accidental constituent of a great many different sorts of tumours. "This pigment," says Vogel, "is never the sole constituent of melanotic tumours;

it forms only a portion of the whole, and is scattered amongst other histological elements, such as perfectly-developed or comparatively amorphous fibrous tissue, vessels, (which, however, are never abundant,) and malignant formations, as tubercle, encephaloid, and scirrhus." The colouring matter is not even identical in all the cases; it may consist of the peculiar melanotic pigment, or of the sulphuret of iron, or, finally, of altered blood-pigment. Hence it is evident that all which has been written concerning the habitudes of melanotic tumours, of their innocuous or malignant qualities, &c., has proceeded upon an erroneous assumption, and that the morbid relations of true melanosis are still to be settled.

Gelatinous Tumours.—A viscid, gelatinous substance is sometimes found infiltrated amongst the elementary tissues, or enclosed in appropriate cavities. Like melanosis, this substance may be associated with various normal or morbid elements, and like it, also, has generally been described as a variety of cancer, because it has been met with most frequently in conjunction with the essential constituents of cancer, in that form called *colloid*, or glue-like cancer. Under this head it will be again referred to.

Encysted Tumours.—It is characteristic of these tumours that they possess a perfectly closed membranous sac, whose contents are slightly or not at all organized, and show no organic connexion with the sac itself. They are divided by Vogel into two groups, of which the first embraces encysted tumours, with aqueous or serous contents, and the second those containing particles which render the fluid thick and pulpy.

Serous encysted tumours occur in several forms. First, as a mere local effusion of serum into loose areolar tissue, or under a thin membrane,—in fact, a form of œdema. The membrane of the sac is not, in this case, a new structure, but consists of the normal structure, distended with fluid. Many examples of so-called hydatids, as of the spermatic cord and choroid plexus, those occurring beneath serous membranes, and a large proportion of tumours known as ovarian dropsy, are referrible to this form. A second form consists in the distention of a certain portion of the duct of a secreting organ, or of the organ itself by the retained secretion. In this manner are probably formed the transparent vesicles so frequently met with upon the surface of the kidneys. The third form of the first group of encysted tumours resembles the first in its mode of development, but differs from it in possessing a more substantial cyst, which is lined by a thin, smooth epithelium, having the characters of a serous membrane. The greater thickness and denser substance of the walls of the cyst, as compared with the vesicular tumour, is supposed to depend upon the circumstance that the effused fluid is originally fibrinous, and deposits its coagulable element upon the internal face of the cyst-membrane; the fibrin thus deposited becomes organized, grows, is susceptible of transformation into fibrous or other tissues, and is lined with an epithelium which secretes a purely serous fluid that contains no fibrin. This description applies to most cases of large encysted dropsy of the ovary.

The second group of encysted tumours comprises all in which the contents of the cyst are not serous, but consist of substances resembling honey, gruel, jelly, or in part of still more solid ingredients. They have received various names, depending upon their accidental composition, such as hygroma, meliceris, atheroma, gummy tumour, &c. The walls of these cysts are much like those last described, but their internal membrane has a closer analogy with mucous than with serous tissue, sometimes presenting vegetations, secernent follicles, and an epithelium, resembling perfectly that of the skin and mucous membranes. The thickness of the contents of the cyst often depends upon the accumulated *débris* of the epithelium, whose superficial scales are constantly thrown off, and cannot, of course, escape from the cyst. In most instances, however, some of the fatty constituents of the body are present, such as olein, margarin, the fat acids, and sometimes cholesterin. Their source is uncertain, but is supposed, in some instances, to be the sebaceous follicles of the lining membrane of the tumour. Frequently, the calcareous salts are deposited in considerable quantity, and the cyst, as well as its contents, becomes entirely, or in part, converted into a concretion. It is then, according to the common phraseology, said to be ossified, although it may contain no true bony substance.

The most extraordinary circumstance connected with the encysted tumours under consideration, is that they occasionally contain highly organized structures, as, for instance, hair, bone, teeth, and horny tissue. Hairs of various lengths and colours have been found in them, perfect in all their parts; some growing from the lining membrane, and others loose within the cavity, which had doubtless been thrown off like the epithelial scales before mentioned. In a case recorded by Dr. J. B. S. Jackson, the lining membrane, from which the hairs grew, consisted apparently of well-formed cutis and cuticle.* The bone met with in these tumours generally lies between the layers of the walls, or in subordinate fibrous cells. They have the organization of normal bone, and are usually invested with periosteum. In form, size, and number, they present the utmost diversity. Perfectly formed teeth, resembling those either of the first or of the second dentition, are also met with; like these, they possess a crown and root, and consist of osseous substance, dentine, and enamel. They may have the form of either of the normal varieties of the teeth, and are developed with precisely the same succession of stages. They are sometimes few in number, (as from one to six,) sometimes more numerous, (as forty-four,) and in one case of ovarian tumour, recorded by Ploucquet and Autenrieth, there were no less than three hundred teeth, besides numerous misshapen bones. Whenever teeth and bones have been met with in tumours, hairs also have been found. The origin of these productions is wholly unknown. The opinion of Cruveilhier and others, that they pertain to an undeveloped fœtus, is no longer entertained; and it can only be said that, as the cyst contains mucous, dermoid, and fibrous tissues, an apparatus exists capable of generating teeth, hair, and bone. But the cause of its peculiar action cannot even be conjectured. Horny substance,

* "A Descriptive Catalogue of the Anatomical Museum of the Boston Society for Medical Improvement, by J. B. S. Jackson, M. D., Curator of the Museum, Professor of Pathological Anatomy in Harvard University. Boston, 1847." This is by far the most important and original illustration of morbid anatomy yet published in America. It bears equally strong testimony to the scientific zeal of the physicians of Boston, and to the earnest industry of the accomplished Curator, by whose exertions, chiefly, the Museum of the Society was formed.

having a spiral and pointed form, has been observed in some rare examples of encysted tumours.

Simple encysted tumours, containing fat and epithelial cells, occur most frequently upon the head, face, and back, and in the ovaries. They are, in general, solitary, and vary from the size of a pea to that of a cocoa-nut; occasionally from four to sixteen have been met with upon the same person. Those containing hairs alone, have been found in various parts of the subcutaneous tissue, and particularly in the neighbourhood of hairy parts; but teeth and bone have been observed in tumours of the ovaries alone. Although encysted tumours, of the kinds thus far described, are not malignant, they are very apt to return after extirpation, unless every particle of the cyst is removed. Whatever portion remains, is incapable of uniting with adjacent parts, but goes on secreting, and thus reproduces the tumour.

Encysted tumours are not always simple, but are often formed of a congeries of separate cysts, some of which may contain different substances; or they may be divided into a number of pouches or imperfect cysts, communicating freely with one another.

CHAPTER IV.

NEW FORMATIONS.

The products to be described in the ensuing pages, differ from all of the normal constituents of the body. They include pus, tubercle, and the several forms of deposit commonly called malignant. One feature is common to them all: a tendency to softening, which induces a greater or less destruction of the tissues in which they are deposited. Another is to dissemination throughout the system, in consequence either of a morbid constitutional condition, or to the development of germs carried from the point originally affected. This is not so apparent in regard to pus as in the case of the other abnormal products, a particular condition of the system being requisite to produce purulent infection.

Pus.—An important fact, which is generally overlooked, has been insisted upon by Vogel, to wit: that numerous distinct fluids are confounded under the general term of pus; such, for instance, as softened tubercle and cancer, and a mixture of epithelial scales with mucus. "Normal pus forms a creamy, thick, opaque, and homogeneous fluid, containing no flocculent matter, depositing on standing a caseous, grumous precipitate, and communicating a soft and fatty feeling when rubbed between the fingers. It has a faint yellow, and sometimes a white and faintly-green tint, and developes, as long as it remains warm, a peculiar mawkish animal odour, which it loses on cooling. It is somewhat sweet and insipid, and has a specific gravity of 1030—1033. It consists essentially of two distinct parts, of very minute organized particles, the pus-corpuscles, and of a colourless aqueous fluid, in which the pus-corpuscles are suspended, as in an emulsion." The form of these corpuscles is in general spherical, but sometimes elongated, oval, or rugged, varying in diameter between the 200th and 300th of a line, and are often studded with minute particles, of about the 1200th of a line in diameter. The corpuscles of genuine pus consist of a nucleus, cell-wall, and contents. They are specifically heavier than the fluid in which they swim, and will sink to the bottom of it when pus is allowed to stand in a tall narrow glass. This fluid is identical with the serum of the blood.

Pus, in common with all new formations as well as all the products of normal nutrition, is formed from exuded fibrin. In this substance, as has been observed in fresh wounds, minute granules first appear, around which, either singly or in groups, a cell-wall is developed. This process may be completed in three or four hours from the first appearance of the granules. Hence it will be perceived that pus is formed externally to the blood-vessels, and in nowise out of the modified corpuscles of the blood, as was once believed.

The only satisfactory manner of determining the purulent character of a fluid is by microscopical examination, which distinguishes the true pus-corpuscles, above described, from the epithelial scales so common in the secretions of inflamed mucous surfaces, as well as from blood-globules, and the elements of softened malignant formations. It is true that in a given fluid there may be a few particles of which it may be difficult to say whether they are purulent or not; but as the qualities of the fluid depend upon its containing a much larger proportion of one ingredient than of any other, there can be no difficulty in deciding upon the nature of any given specimen of fluid.

As a general rule, pus tends to escape from the body. It is insusceptible of any higher organization, and its presence cannot fail to be injurious. In what is called healthy suppuration, this fluid is poured out from a membrane communicating with the exterior, or forms an abscess which by pressure causes the absorption of the tissues lying between it and the surface, and then discharges its contents, after which the parts resume very nearly their original condition. In unhealthy suppuration, on the other hand, this process is attended with a positive loss of substance in the part where it occurs, being sometimes productive of ulceration, and sometimes of gangrene. A discharge of a thin reddish fluid, called ichor, sometimes takes place from gangrenous and ulcerated parts; it has no analogy with pus either in its composition or its origin. It consists of the serum of the blood tinged with dissolved hæmatin. Occasionally collections of pus disappear; their serous portion, and then their corpuscles, after being disintegrated, are absorbed.

The morbid heterologous products which remain to be noticed may be divided into two classes, the former comprising those which are less, and the latter those which are more, completely organized. In the former are included typhous, scrofulous, and tuberculous deposits, and in the latter the several varieties of cancer. Of these a concise description will now be given.

Typhous deposits.—It is well known that in typhoid fever, the glands of Peyer, in the lower part of the ileum, become prominent and then ulcerate, and that, in the same disease, the corresponding mesenteric glands frequently become enlarged, and subsequently soften. These alterations have been traced to the deposit of a peculiar substance in the sub-mucous tissue on which the glands of the intestine rest, and in the parenchyma of those of the mesentery. The same matter has been met with in the spleen and lungs, and under the mucous membrane of the trachea. It consists of a lardaceous substance of a yellowish or whitish colour, which gradually softens, and, involving the normal elements of the part in this process, causes their destruction. The substance in question is partly amorphous, and partly granular or composed of cells and their germinal nuclei, and cannot now be distinguished from the deposits which occur in scrofula and tuberculosis.

Scrofulous deposits.—These, as was just remarked, appear to be physically and chemically identical with the matter of typhoid fever, but while the latter runs through its course in a few days or weeks, the former are developed slowly, and may remain almost stationary for months, before being finally softened and discharged. Scrofulous matter is most commonly deposited in the lymphatic glands. Its general characters vary a good deal: sometimes it is dense and firm, sometimes lardaceous, and sometimes has the appearance and consistence of new cheese. Instead of softening, it is sometimes replaced by a calcareous deposit.

Tubercle.—This is by far the most frequent and interesting of the class of deposits under consideration. Its name, derived from its occurring usually in small rounded masses, was originally applied to all such masses, without reference to their composition. It occurs in two forms, one of which, from the shape and size of the deposit, received from Laennec the name of *miliary* tubercles, (*milium*, millet), and from its colour that of gray granulations from M. Louis. These granulations are small, rounded bodies, quite firm under pressure, and generally varying in size from half a line to a quarter of an inch in diameter. This substance is, however, sometimes infiltrated into a tissue, as the pulmonary, solidifying portions of it completely. The second form consists of rounded, opaque, granular, and cheesy masses. Tubercle may also be formed on serous membranes, appearing as little pearly excrescences, or semi-transparent patches, or may be spread upon mucous surfaces as a homogeneous cheesy layer.

The origin of tubercle is involved in doubt. It is not settled whether the fluid, first secreted, is simply the fibrin of the blood which afterwards undergoes changes resulting in the production of tubercle, or whether there is already formed in the blood a peculiar principle which on being deposited in the tissues, coagulates, and assumes at once the form of tubercle.

Both of the forms of tubercle above described are regarded by some pathologists as original, while by others, and with better reason, it is held that the gray granulations constitute the primary form of the deposit. It would appear to result from the observations which have been made by morbid anatomists, that in many cases, at least, the gray semi-transparent infiltration first takes place, and that in course of time small yellowish points appear disseminated through it, which gradually increase and coalesce so as to substitute the opaque cheesy matter for that which previously existed. However this may be, the tubercular matter is exuded so as to fill up the interstices of the tissues, and these latter are as closely and perfectly invested by it "as the stones of a wall by the mortar which has been applied between them." The effect of this arrangement is evidently to compress the enclosed fibres, and to cut off their supply of blood; for the tubercle itself possesses no trace of vascularity.

Sooner or later, softening of the tubercle usually takes place, and the portions of tissue imbedded in the deposit are at the same time destroyed; the mingled detritus, forming a thick purulent-looking fluid, tends, like the pus of an abscess, towards the exterior of the body, where it is generally discharged, leaving behind a cavity lined with a secreting membrane. This cavity may remain open, or it may gradually contract, its walls becoming semi-cartilaginous, and its opposite sides at last uniting so as to leave only a dense cicatrix in its place. More rarely the contents of the cavity are only in part evacuated, and what remains behind undergoes a transformation into a fatty substance resembling putty. Finally, (and this is most apt to occur when the tubercles are not abundant,) a calcareous deposit takes the place of the tubercular, converting the latter into a chalky mass, or one of stony hardness, which remains encysted in the tissue without further disturbing the health.

The softening now described is a termination common to the least as well as to the most highly organized of heterologous products; but while, as will be shown, the latter implicate in their destruction the tissues which are in contact with them, the influence of the former does not extend beyond its own original limits. Each tuberculous granule is deposited, in consequence of a constitutional vice, and being once formed, it is almost, if not quite, insusceptible of increase; its mischievous influence is thenceforward chiefly dependent upon its softening. Hence the malignity of tubercle depends in a very large degree upon the extent to which it is deposited in the organs.

Persons of all ages are subject to tubercular disease; but young children and old persons less than others. There is no organ or tissue in which tubercle has not been found, but its most ordinary seats are the lungs and glandular structures, especially the mucous follicles of the small intestines and of the larynx. Subsequently to the age of puberty, tubercles are rarely found in other organs without also being met with in the lungs.

Cancer or Carcinoma.—The history of this, the most malignant of the heterologous deposits, is still involved in great obscurity. Morbid anatomists are by no means agreed what characters distinguish cancerous tumours from those which we have included in the class of homologous morbid growths, but the most recent investigations seem to demonstrate that the true distinction can be settled by microscopical examination alone.

Cancerous tumours are not wholly composed of new elements. The greater part of their bulk is, in many instances, identical with that of non-malignant tumours, and even more, a particular tumour may, during a considerable period, be in all respects non-malignant, and yet eventually become truly cancerous. Cancerous tumours, then, may contain fibres, blood-vessels, &c.; but these constituents are not characteristic or essential; they serve only as a matrix, or bed, in which is deposited and developed a new substance which has no analogue amongst the healthy tissues. This substance is composed of cells of various forms and degrees of development. The primary cells are described by Vogel as "nucleated and round, or oval; they vary from the 300th to the 100th of a line in diameter, entirely dissolve on the addition of the caustic alkalies, and disappear, with the exception of their nuclei, on the addition of acetic acid." Others, which are still more characteristic, are caudate, or ramifying; or contain a large number of nuclei, or perfect young cells; or have a very thick wall, exhibiting a double contour; or have granules scattered over their surface, &c. The occurrence of any one of these forms is not conclusive of cancer, but only the presence of several varieties of them in the same specimen.

These cells are believed to have the power of generating new cells, and by this process a cancerous tumour grows. Besides the proof of their possessing this power, which is derived from their formation, that of direct experiment may be invoked. "Langenbeck succeeded in inducing secondary cancerous tumours in the lungs of a dog, by injecting into its blood-vessels fresh cancer-cells from a tumour while still warm, which had been removed two hours and a half previously from the humerus of a man."

Cancer, like other heterologous products, tends to softening; and until this process is set up, the injury occasioned by the disease is purely local, and consists in atrophy of the tissues, and other effects of pressure. On the occurrence of softening, however, not only do the adjacent parts become inflamed, ulcerated, and corroded by the ichorous discharge from the cancer, but this fluid may cause inflammation of the adjacent veins and lymphatics, or, being conveyed into the blood, give rise to that peculiar earthy colour of the skin, and to disturbances in the nutritive and nervous functions, which, taken together, constitute what is called the *cancerous cachexia*. Moreover, partly by the absorption of cancer cells, and partly through the influence of the constitutional diathesis, new tumours may arise in parts of the body more immediately connected by venous and lymphatic trunks with the original seat of the disease, or in organs more remotely situated. According to the former mode of propagation, a single cell may, as Dr. Walshe remarks, be regarded as the possible embryo of an entire tumour.

The *diagnosis* of cancer, founded on its anatomical characters, must, it is evident, be very difficult whenever the homologous constituents of the tumour compose almost its entire bulk. Under these circumstances, our only means of removing doubt is to ascertain whether or not cancer cells are present. After softening has taken place, these cells are numerous, and perfect enough to render their detection easy. But this is precisely the stage when the rougher physical characters of the tumour, its effects upon the health, &c., are usually sufficient, of themselves, to decide the question. It is, for the most part, during the intermediate period between its first formation and its maturity, that the microscopical examination of a tumour leads to really satisfactory results. At that time the assisted eye may detect the characteristic elements in a growth presenting all the general features of a simple fibrous, or other non-malignant tumour.

Three species of cancer are admitted by Vogel, Dr. Walshe, and other late morbid anatomists of competent authority, to wit: encephaloid, scirrhus, and colloid. These terms have now taken the place of the nearly endless catalogue of names applied by different writers to merely accidental varieties of the forms enumerated. In the ensuing description we shall follow, in all essential points, and in regard to the first two species, the authors who have been mentioned.

Encephaloid.—This name (from ἐγκέφαλος, the brain; and εἶδος, resemblance) was applied to the fully developed examples of this species of cancer, from their close resemblance to the substance of the brain. It, however, possesses no characters in common with the cerebral tissue, except that of being a pulpy matter lodged in a reticulated membrane, the matter in question consisting merely in cancer-cells. In some cancerous tumours these cells predominate; in others, the areolar or fibrous tissue which encloses them. The former constitute encephaloid; the latter scirrhous tumours.

In consequence of the extreme softness of encephaloid, it compresses the tissues, amongst which it is deposited, less than hard cancer, even when, as sometimes happens, it is infiltrated amongst their elementary fibres. For a like reason, it is more readily organized, and, indeed, may become so highly vascular as to seem composed of vessels with an interstitial deposit of cancerous matter. To this form, which is one of the most speedily fatal, the name of *fungus hæmatodes* is applied.

Encephaloid is of very rapid growth, and sometimes attains an enormous size. Tumours as large as the head of an adult, are by no means uncommon. "Bérard observed an encephaloid tumour, in the thigh of a female, as large as the body of a full-grown man." This form of cancer may be met with in almost every organ or tissue of the body, and attacks, with equal frequency, both sexes and all ages.

The colour of encephaloid tumours varies considerably; their most ordinary hues being the white and ashen colours of the brain. In other cases, an abundant supply of vessels gives the tumour a pinkish hue, and when hemorrhage from them takes place, the blood effused into the substance of the tumour renders it red or brownish. The consistence of these tumours is equally various. Some of them, even before softening, are not firmer than an infant's brain, in which case slight pressure will force the cancerous matter out of the areolar tissue containing it; others are as firm as, or somewhat firmer than, the healthy adult brain; so that the cancerous matter, when pressed out partially, retains the form of the little compartments in which it was lodged.

Encephaloid is most commonly deposited in the form of rounded masses, enclosed in an imperfect cyst, and these by their arrangement in groups, often give to a tumour a botryoidal aspect. This arrangement is most frequently met with in the lungs, liver, and ovary. In other cases, the individual portions of the tumour are of a less regular shape, but being enclosed in fibrous partitions, cause it to resemble the pancreas. The infiltrated form of deposition is of less common occurrence than the tuberiform, at least originally; the extension of encephaloid from its primary seat, on the other hand, nearly always takes place by infiltration, and in its progress destroys even the hardest tissues.

When encephaloid attacks the subcutaneous cellular tissue, or in the progress of its development from more deeply seated parts, reaches the surface of the body, the skin becomes involved; it grows swollen, and of a dusky red colour, and its veins stand out like blue cords. By degrees the skin ulcerates, fungous and extremely vascular vegetations sprout from the surface of the sore, bleeding upon the least irritation; the morbid deposit softens and is discharged, carrying with it the normal tissues which surround it; wasting and hectic fever are established, and rapidly bring on a fatal termination.

Scirrhus.—In this variety of cancer, which obtains its name from its hardness, (σκιῤῥός, hard,) the fibrous tissue predominates, or that firm amorphous substance which is, in reality, imperfectly developed fibrous tissue. So far as this predominating element is concerned, scirrhous are identical with simple fibrous tumours; but combined with it are cancer-cells, to which alone the malignancy of the compound tumour is due. The mode of formation here pointed out explains the difficulty, so frequently presented, of determining whether a particular tumour is encephaloid or scirrhus; for in some portions of the same mass the fibrous structure may prevail, and in others the brain-like deposit. It equally explains the value of a diagnostic mark between fibrous and scirrhous tumours, proposed by Cruveilhier before the microscope had been successfuly applied to this subject. This anatomist found that, in true scirrhous tumours, a milky fluid exuded from a cut surface when squeezed, while in simple fibrous growths no such result ensued. This cancerous juice, as it has been called, was nothing more than the cancer-cells, or the softer constituent of scirrhus.

The nutritive process is far less active in scirrhus than in encephaloid. The former contains very few vessels; indeed, some observers have denied that it is vascular at all. Owing, no doubt, to its scanty supply of blood, its increase is slow, and it never reaches a considerable size. The largest tumours of this sort rarely exceed three or four inches in diameter. The same imperfect nutrition retards the process of softening in scirrhus. It does not affect so large an extent, nor spread so rapidly to the adjacent tissues as encephaloid, and consequently does not so immediately endanger life. From the description given above, of the mode in which the constituents of scirrhous tumours are combined, it will be readily understood that when softening takes place in them, the breaking up and discharge of the cancer-cells leaves hollows of various sizes. From some of these a thin, turbid, brownish, and watery fluid escapes, or can be expressed; from others, a thick, whitish, opaque, and creamy fluid; and from others, again, a pultaceous or cheesy substance, of a pale yellow, or dull white colour, is protruded exactly like the matter of sebaceous follicles, leaving minute cavities in the sites it had filled. In the further progress of softening, the fibrous element of scirrhous tumours becomes involved, the discharge becomes ichorous and corrodes the adjacent normal tissues, and life is finally destroyed, as in encephaloid cancer. Although so much smaller than encephaloid, scirrhous tumours are productive of more mischief before the stage of softening arrives, by compressing the nerves, blood-vessels, and other important constituents of the organs in which they are seated. They may occur primarily in the bones, voluntary muscles, heart, liver, lungs, brain, penis, and indeed in nearly all the organs of the body; but they present themselves with greatest frequency, and the most distinct features, in glandular structures, and especially in the mammary gland. This variety of cancer usually attacks persons beyond the middle period of life.

Scirrhus may be deposited in the form of tumours, or be infiltrated in the normal tissues. The first is their most frequent form. Scirrhous tumours are usually rounded or oval, with a more or less nodulated surface. They are never enveloped with a true cyst. Infiltrated scirrhus is generally met with in the uterus and brain.

The section of a scirrhous tumour is sometimes of a bluish-white or milky colour, with a peculiar semi-transparent glossiness, especially when the structure is most dense; when the cells are more numerous it is of a white or gray colour with a shade of yellow. Other appearances already described are met with during the stage of softening.

Colloid.—Although, as was before stated, colloid is usually reckoned amongst the varieties of cancer, and in accordance with usage is here described, yet there are important differences between it and both scirrhus and encephaloid. In the first place, it does not present, under the microscope, any of those cells which are characteristic of unquestionable cancer; in the next place, it is by no means so general in its diffusion as the forms above described, and rarely, perhaps never, is disseminated from a primary deposit; thirdly, its mode of softening is entirely different from theirs; and, finally, it does not, like them, produce that vitiation of the system known as the cancerous diathesis. With these qualifications we present a summary of its most conspicuous characters.

Colloid consists essentially of an areolar fibrous texture, with cells of irregular shape varying in size from half a line to half an inch in diameter, and containing within them a jelly-like substance of a yellowish or reddish colour, of a consistence between that of apple-juice and semi-concrete albumen. In simple colloid depositions these qualities are uniform throughout the tumour, a point, in addition to those mentioned, in which it differs from scirrhus and encephaloid.

This disease occasionally affects the uterus, mammæ, and bones, and forms an accidental addition to compound cystoid, bony, and other non-malignant tumours; but its seat of predilection is the sub-mucous cellular tissue of the alimentary canal. Next to this, it is most frequently found in the omentum. Dr. Gross, of Louisville, describes a colloid tumour met by him in this situation which, in regard to size, is probably unique. "It extended from the pelvis to the liver and diaphragm, surrounded the colon and a part of the stomach, and concealed from view nearly the whole of the abdominal viscera. Its thickness was from two and a half to three inches; in length it measured nearly one foot, and in breadth more than eight inches. Its weight was estimated at twenty-five pounds."

In the stomach, colloid, like other heterologous deposits, usually affects the pyloric extremity, and is infiltrated in the sub-mucous tissue. Here, as in other parts of the alimentary canal, it forms a mechanical obstacle to the passage of food, and by inducing atrophy of the normal tissues, renders the coats of the organ softer, and liable to rupture. But it manifests no disposition to ulcerate, and neither gives rise to much pain, nor that degree of sallowness and emaciation produced by true carcinoma.

Colloid may occur at any period of life, but is most frequently met with between the ages of thirty and fifty. It is often latent; that is to say, it occasions no symptoms, so long as it does not interfere, by its bulk, with adjacent organs, or mechanically interrupt the function of that in which it is seated.

CHAPTER V.

MORBID PRODUCTS NOT INCLUDED IN THE PRECEDING CLASSIFICATION.

THERE are two classes of products which from their intimate connexion with disease, either as its cause, or its effect, require a brief consideration in this place. A detailed description of them would be appropriate only in a treatise on special morbid anatomy, and the reader is referred to books on that subject for obtaining a more particular account of the manner in which they severally arise, and the specific derangements produced by them in the organs which they respectively affect. These products are concretions and parasites.

Concretions.—Concretions are inorganic bodies of various forms, sizes, and composition, which may be met with in numerous situations, but are especially frequent in hollow, and in glandular organs. They are sometimes described as foreign bodies, and in one sense correctly, for when formed, they act upon the tissues that surround them precisely as similar substances would do, if introduced from without; in another sense they cannot be so considered, for they are remotely the results of vital processes. The blood and every other fluid of the economy contains certain inorganic elements; these are very abundant in some of the secretions and excretions, particularly in bile and urine, and, under the influence of disease, their aggregate quantity as well as relative proportions, are greatly modified. At this point, however, vitality ceases to control them; once they have escaped from the vessels, they are subjected to exclusively chemical laws, and their reaction upon one another differs in no respect from what would take place among the same elements, in a similarly constituted fluid, at the same temperature, &c., and external to the body.

In health, every fluid containing inorganic elements is perfectly competent to their solution; but in disease this faculty may be impaired, and that in either one of several ways. The fluid, for instance, may be deprived of so large a portion of its water, as to be unable any longer to dissolve the chemical compounds contained in it, these latter are consequently precipitated, and form the basis of concretions. Or the soluble combinations in the fluid may, by the accidental presence of a new agent, or an excess of one which before existed in an inconsiderable quantity, be decomposed, and new compounds formed which are insoluble, and therefore assume the form of concretions. Thus it is that soluble urate of ammonia may be decomposed by the presence of an acid in the urine, and uric acid thrown down, forming a variety of gravel; or when oxalic acid is mixed with the urine, or any other fluid containing lime, it seizes upon this base, and forms with it an insoluble deposit. The formation of concretions by chemical decomposition prevails in the urinary apparatus; that by an excessive secretion of inorganic elements, or by a deficiency of water in the secreted fluid, owing either to evaporation or endosmosis, appears to be more active in glandular structures.

Inorganic concretions are generally crystalline, but occasionally amorphous, and, indeed, often pass through the latter before acquiring the former condition. The particles remaining in the separate state are termed *sand* or *gravel*, and when they occur in larger and fewer masses, *calculi*. Such masses, however, may be composed in either one of two modes: either by the mere aggregation of particles of sand or gravel through the medium of tenacious mucus, or by the regular deposit of crystals around one of these particles or some other body, often one introduced from without, acting as a nucleus. The successive deposit of new matter upon the calculus, usually gives to it a laminated form. In certain cases, the laminæ are not all of the same composition, but formed of several substances; there may be two, for example, regularly alternating with one another from the centre to the surface of the stone. This is most distinctly seen in vesical calculi; one of which, for instance, may be composed of alternating layers of uric acid and the phosphates, in a case where, in order to correct the acid state of the urine, alkalies have been administered at intervals, but with the effect of inducing a phosphatic deposit, instead of merely neutralizing the urine.

Concretions vary extremely in their appearance; sometimes they are smooth, and sometimes, from the deposit of large crystals, have a rough and angular surface. When single, and lying freely in a cavity, they are generally round; but when numerous, and especially if soft, they may assume very irregular figures. The gall-bladder is sometimes distended, and entirely filled with concretions, which have as infinite a variety of shapes as figs packed in a drum. In the bladder they are generally round; in narrow canals, cylindrical and solid, if produced from the contained fluid, and they form fragmentary or perfect sections of hollow cylinders when deposited in their walls, as in "ossification" of the arteries. In the kidney they are sometimes branched, displaying a perfect mould of the pelvis and cones of this organ. In other situations they form shapeless masses of extremely various size.

The principal seats and components of concretions are the following:—The urinary apparatus, in which they are composed chiefly of uric acid, the urate of ammonia, the urates and phosphates of ammonia, lime, and magnesia, and the oxalate of lime. The salivary glands, ducts, and mouth, in the two former of which they occur as roundish or oblong masses of a whitish colour, and in the last, as a deposit upon the teeth, called tartar: their principal constituent is carbonate of lime. In the lachrymal glands, the nostrils, the throat, the tonsils, and the bronchia, they are composed of calcareous salts. In the liver, cholesterin, bile-pigment, and carbonate of lime, are their chief constituents. Concretions found in the intestines are sometimes derived from the liver, pancreas, or fauces, but are more commonly formed in the digestive tube. The composition of true intestinal concretions varies considerably. In some cases they consist merely of an aggregation of indigestible substances which had been swallowed, such as magnesia, the husks of oat-meal, wheaten bran, the stones and seeds of fruits, and the woody fibres of many vegetable substances. These are bound together into an impacted mass by mucus, or coagulated fibrin, and perhaps some calcareous salts. Others are composed almost entirely of the last-named materials, which are derived either from the food or from the secretions of the bowel. In the parenchyma of the organs, concretions present a great many varieties of composition. The most frequent are gouty concretions, and those which succeed tuberculous deposits. The former consist of urate of soda or urate of lime, and occur in the cellular tissue around the joints; the latter are not original, but arise from the transformation of tubercle into cretaceous salts, especially the phosphate and carbonate of lime.

Parasites.—Certain independent organisms, both vegetable and animal, are found in the human body. The vegetable growths are all microscopic, and belong to the lowest orders of plants, the *algæ* and *fungi.* They are never met with except upon cutaneous or mucous surfaces, nor while these surfaces remain healthy. Usually, a secretion of fibrin or mucus, undergoing decomposition, forms the soil in which they grow. In some cases, they are believed to be the media of contagion, as in that form of impetigo which affects the hair-bulbs of the scalp, and is called *favus.* This is the most important example of their connexion with disease.

Animal parasites are very numerous. Many of them are infusorial; many belong to the class of insects and mites, as fleas, lice, bugs, and the acari, of which the most important one is the *itch-mite.* A class of higher consequence comprises several sorts of worms. Those which infest the intestinal canal are extremely common, and are the *oxyuris vermicularis*, or *thread-worm*, which inhabits the rectum; the *trichocephalus dispar*, or *long thread-worm*, which is found in the large intestine, and especially in the cœcum; the *ascaris lumbricoides*, or *round-worm*, whose ordinary residence is the small intestine; and the *tape-worm*, or *tænia*, which also affects the same part. The kidney is occasionally the seat of a round-worm, called the *strongylus gigas*, measuring from five inches to three feet in length, and from two to six lines in thickness. For a detailed account of these animals, of the *trichina*, the *echinococcus*, of *acephalocysts*, and numerous other parasites of still inferior interest, pathologically, the reader must consult special treatises.

The diseases with which even large intestinal worms are connected, appear to be sometimes the cause and sometimes the effect of the presence of these parasites. Very often they exist in considerable numbers without producing the least disturbance of the economy, but in other cases they are unquestionably the cause of much suffering and ill health. How far they are themselves the result of a morbid state of the organs in which they appear, is still an undecided question.

The origin of parasites is extremely obscure, and has long been a mooted point among naturalists. It may not be inappropriate to present a summary of the opinions which are entertained respecting a subject of so much interest, but in doing so, we shall confine our remarks to the parasitic animals which inhabit the interior of the body, or *entozoa*.

It is evident that these animals must originate in one of two ways; that they must be derived directly or indirectly from without, or be created out of materials existing within, and furnished by, the body. No other supposition is possible. If an entozoon is in any manner derived from without, it must be admitted that this takes place either through the reception of the animal itself, or of its ova. If either opinion be assumed, it follows that the parent animal must exist somewhere external to the body. But the parasites in question have never, in any case whatever, been detected except within the organism. If it is objected that many of these animals are so minute that they might easily elude discovery in the elements around us, the argument fails when applied to the giant strongylus, the stout lumbricoid worm, and the tænia measuring many yards in length. Besides, even admitting for a moment the possibility of the parasites which inhabit the intestine, and other mucous cavities, having once existed externally, the insuperable difficulty still remains of explaining the entrance of entozoa into shut cavities and parenchymatous structures, into the eye, or the muscles, for example, and their presence in the unborn child, and even in the bodies of larger entozoa of a different species. On the other hand, if it is maintained that the ova are alone received, it must still be shown that the ova exist external to the body, which has never been done. Nor would the admission of this explanation be sufficient; for many of the entozoa are not propagated by eggs, but belong to the viviparous class, so that in regard to them the difficulty remains undiminished. But granting the existence of ova without, and their reception into the body, it is still impossible to explain the development from them of the animals found in the parenchyma, in the embryo, &c., without at the same time admitting that the ova are not only carried to these localities through the blood-vessels, but actually pass through the walls of the capillaries. Such an admission would be a physiological absurdity; for the extreme vessels will allow of the passage of a single blood-globule, at a time, and no more, and will not permit any denser fluid than the plasma of the blood to permeate their walls, how then could they afford a passage in any manner to ova, the least of which is ten times as large as a blood-globule?

If the hypothesis now presented is untenable, it only remains to adopt the alternative one, to wit, that entozoa are generated or created anew out of the materials or the products of the living organism. It may be urged affirmatively, in support of this doctrine, that each organ possesses its own entozoa; the kidney, a species different from those of the intestine, which are, again, unlike the parasites of the liver. Even more, the several parts of the same organ generate dissimilar animals. The small intestine produces the round and the tape worms, the large intestine the two species of thread worms. These facts seem to show that some extremely local concurrence of circumstances is essential to the production of the several entozoa. It may also be argued, and we think the argument unanswerable, that if spermatic animalcules, which exist in the testicle, are there spontaneously generated, no violence is done to probability in supposing parasitic animals to be produced in the same manner. It will hardly be denied that spermatozoa are literally evolved from the constituents of the semen. But it is objected to the doctrine of spontaneous generation that it is against analogy, which everywhere supports the famous dogma, *omne vivum ex ovo.* This objection is a mere begging of the question. The decision of the case in hand involves the truth of the theory just quoted, and as we believe, must be allowed to show that this theory is not absolutely universal in its application. Other facts, also, amongst which are the following, tend to invalidate it. Nothing can be more certain than that all organized beings were, at some time or another, created; geology proves that successive genera and species have been thus created, at long intervals apart; and the history of disease renders it probable that one affection at least, syphilis, which is now propagated only by direct descent, *ex ovo*, as it were, is really of comparatively recent origin.

In conclusion, after a review of the preceding outline of an argument upon the generation of parasitic entozoa, we feel obliged to admit that the weight of facts and probabilities is wholly on the side of the doctrine of spontaneous generation; at the same time, we cannot but look with interest to the results of future observation in this field, nor altogether suppress the hope that the simple law of nature, *omne vivum ex ovo*, may even yet be found to embrace the classes which now appear to form so striking an exception to its provisions.

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